Module 1: Numbers

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Numbers (Lineworker)
Scenario

Luis and the line crew are preparing to install underground cables and are evaluating the trench they will need to dig for the cable.

“So, why you are so concerned with how easily the soil can be compacted?” Luis asks his chief.

“It is an OSHA requirement that we evaluate the soil before we dig any trenches. We don’t want things falling in on us. Once we know the soil type, we can calculate the slope we need for our trench.”

“Okay, so what is the slope we need?”

“We have Type C soil, so a slope of 1.5 feet for every foot of trench depth is needed. The trench is 7.3 feet deep, which calculates a slope of 10.95 feet. I think we can round that slope calculation to the nearest foot and begin digging.”

How far back do the sides of the trench need to be sloped if we round the calculated slope to the nearest tenth?

A. 10.8 ft  
B. 11.0 ft  
C. 10.7 ft  
D. 11.01 ft
Problems
Categorizing Real Numbers

Jerry, a lineworker helper, needs to determine the proper depth a 40-foot pole needs to be buried in typical soil. He determines from the construction standards that the pole base must be buried 5 feet deep, or 1/8 of the pole height. Is 1/8 a rational number or an irrational number?

A. irrational
B. rational
C. neither
D. both

Karen is required to calculate the impedance “Z” of an AC circuit. The impedance is equal to the square root of the sum of the squares of the ohms of resistance “R_r” and the inductive resistance “R_i”. If R_r = 1 and R_i = 2, then the impedance is equal to the square root of 1^2 + 2^2 = √5. Is √5 a rational or irrational number?

A. irrational
B. rational
C. neither
D. both

Bob is required to calculate the impedance “Z” of an AC circuit. The impedance is equal to the square root of the sum of the squares of the ohms resistance “R_r” and the inductive resistance “R_i”. If R_r = 4 and R_i = 6, then the impedance is equal to the square root of 4^2 + 6^2 = √52. Is √52 a rational or irrational number?

A. irrational
B. rational
C. neither
D. both

Kari, a lineworker helper, has received 12 spare fuses from the warehouse. She was asked by the chief to divide all of them evenly in the line truck tool cribs. Which number of cribs will not permit an even distribution?

A. 2 cribs
B. 3 cribs
C. 4 cribs
D. 5 cribs
Jeff is replacing all the cable grippers on the line truck. He has 30 grips to put into the line truck tool cribs. The chief asked that all the grips be distributed evenly between the truck crib boxes. Which number of crib boxes will permit an even distribution?

A. 4 boxes  
B. 10 boxes  
C. 8 boxes  
D. 9 boxes

Alice has a box of lag bolts to restock the line truck tool cribs. The chief asked that the lag bolts be distributed evenly in the truck tool cribs. The box contains 100 lag bolts. Which number of crib boxes will not permit an even distribution?

A. 10 boxes  
B. 5 boxes  
C. 2 boxes  
D. 3 boxes
Identifying Place Value

Jerry is measuring the amount of amperage in a circuit. He has to report the amperage to the tenth place. Which of the numbers below should Jerry report?

A. 50 amps  
B. 5 amps  
C. 0.5 amps  
D. 0.050 amps

Alex is required to measure a current transformer (CT) value on an industrial meter. Alex has checked the CT several times and has received slightly different readings each time. The readings were 1.03, 1.0, 1.032, and 1.0323 percent of full load. Alex has to report the numbers to the tenth place. Which number should Alex report?

A. 1.03% of full load  
B. 1.0% of full load  
C. 1.032% of full load  
D. 1.0323% of full load

Val is using a handheld temperature sensing tool to detect abnormal temperature conditions in overhead equipment. After taking four different readings, the temperature indicated 90.15°F, 90.1°F, 90.15°F, and 90.09°F. Val has to report the numbers to the tenth place. Which number should Val report?

A. 90.15°F  
B. 90.1°F  
C. 90.151°F  
D. 90.00°F

Current transformer (CT) reduces the magnitude of the primary current in the circuit to a more manageable level so it can be read by an electrical meter. Lauri is reading a CT so she can determine if the meter is reading correctly. She has to read the CT output to one thousandths of a volt. Which of the following CT conversion factors is reading out to the thousandths place?

A. 1.15 amps  
B. 1.2 amps  
C. 1.03 amp  
D. 1.035 amps
Kari is asked to record the reading on a protective relay to the milliamp (1/1000 of an amp). Which of the numbers below should Kari report?

A. 6.0 amps  
B. 6.00 amps  
C. 6.000 amps  
D. 6.0000 amps

Pete has measured a resistance reading of wire running to a house. The chief asked that Pete report the resistance down to a thousandth. Which reading should Pete report to the chief?

A. 5.2 ohms of resistance  
B. 5.25 ohms of resistance  
C. 5.255 ohms of resistance  
D. 5.255 ohms of resistance
Solving Exponents

Harry is installing a multiple meter panel on an apartment building. In order to install a panel, the crew needs 6 feet on the vertical edge and 6 feet across the horizontal edge. How many square feet does the crew need to install the panel? (Round to the nearest whole number.)

A. 12 ft^2  
B. 36 ft^2  
C. 64 ft^2  
D. 112 ft^2

Lynne is setting out a lay-down area so equipment can be set up for a storm response. The size of the laydown area is 15 feet by 15 feet. How big an area has Lynne created?

A. 30 ft^2  
B. 60 ft^2  
C. 225 ft^2  
D. 120 ft^2
Simplifying Square Roots

Karen is required to calculate the impedance of an AC circuit. Impedance is calculated by taking the square root of the squared sums of the ohms of resistance and the ohms of inductive resistance. If the squared sums of the ohms of resistance and the ohms of inductive resistance is 64, what is the impedance?

A. 124 ohms
B. 32 ohms
C. 16 ohms
D. 8 ohms

Bob is required to calculate the impedance “Z” of an AC circuit. The impedance is equal to the square root of the sum of the squares of the ohms of resistance “Rr” and the ohms of inductive resistance “Rl”. If Rr = 4 and Rl = 6, then the impedance is equal to the square root of \((4^2 + 6^2)\), which equals the square root of 52. The square root of 52 equals which number? (Round to the nearest tenth.)

A. 7.2 ohms
B. 7.0 ohms
C. 7.21 ohms
D. 7.3 ohms
Finding Multiples

The power line is undergoing an upgrade with new poles and transformers scheduled for installation. Transformer installation brackets come 5 to a box and the maximum number of boxes that a line truck can carry is 4 boxes. What are all the possible number of transformer brackets that a line truck can carry in one trip to the job site?

A. 4, 8, 16, 20 brackets  
B. 10, 20, 30, 40 brackets  
C. 5, 10, 15, 20 brackets  
D. 1, 2, 3, 4 brackets

The line crew is responsible for replacing street lights and darkness sensors in street lights. The street light bulbs are shipped 8 to a box, and the sensors are shipped 12 to a box. What is the minimum number of bulb boxes that must be ordered in order to have one bulb for every sensor and no extra sensors?

A. 6 boxes of bulbs  
B. 3 boxes of bulbs  
C. 8 boxes of bulbs  
D. 2 boxes of bulbs

The power line is undergoing an upgrade with new poles and transformers scheduled for installation. There are 18 transformers scheduled for installation for the system. Each transformer requires a separate bracket, which come 3 in a box. What is the minimum number of bracket boxes that Kari must order so that she has one bracket for every transformer being installed on the 6 poles and there are no extra brackets?

A. 4 bracket boxes  
B. 6 bracket boxes  
C. 18 bracket boxes  
D. 9 bracket boxes
Finding Factors

Jerry is asked to organize the tool cribs on the line truck containing various flammable materials. After checking the material safety data sheets (MSDS), he notes that he has 1 container each of 8 different flammable materials that can be safely stored together. What are all the possible numbers of tool cribs that Jerry could use if he wished to distribute the chemicals evenly among 8 tool cribs?

A. 1, 4, or 6 crib(s)
B. 2 or 6 cribs
C. 4, 6, or 8 cribs
D. 2 or 4 cribs

Jerry is organizing the tool cribs on the line truck, and he has 8 containers of flammable material and 12 containers of mark-out paint. These two chemicals cannot be stored together, but Jerry wishes to put the same number of chemicals in each cabinet. What is the greatest number of any chemical that we might find in one cabinet?

A. 12 chemicals
B. 8 chemicals
C. 4 chemicals
D. 2 chemicals
Identifying Number Sequences (Numerical Reasoning)

Jane is numbering new poles in a subdivision. The pole numbering sequence matches a location to identify where the pole is installed. The numbering sequence for the first 4 poles is 2025125, 2025200, 2025275, and 2025350. What would the next number in the sequence be?

A. 2025400  
B. 2025425  
C. 2025450  
D. 2025375

Lynne is installing an overhead wire to a house service. If the poles are placed 125 feet, 250 feet, 375 feet, and 500 feet from the house, how many feet from the house would the fifth pole need to be installed?

A. 600 ft  
B. 750 ft  
C. 625 ft  
D. No need for another pole

Jill is assisting with lifting a transformer to the top of a pole. The polyethylene rope Jill selected has a breaking strength of 270 lbs. Jill has the choice to use three other ropes: polyester (breaking strength of 180 lbs), polypropylene (breaking strength of 120 lbs), and nylon. Assuming that the breaking strength of nylon is based on common ratio basis from the other three ropes, what would be the nylon breaking strength?

A. 60 lbs  
B. 100 lbs  
C. 90 lbs  
D. 53 lbs

Pete is installing aluminum wire into a home service. The breaking strength of the wire is based on the wire size. Wire size 1/0 has an approximate breaking strength of 4,500 lbs; wire size 2/0 has a breaking strength of approximately 5,625 lbs; and wire size 3/0 has an approximate breaking strength of 7,031 lbs. Based on this sequence, what would be the approximate breaking strength of wire size 4/0?

A. 8,789 lbs  
B. 8,437 lbs  
C. 10,986 lbs  
D. 10,125 lbs
Rounding Numbers

Alice is determining the ohms of resistance or impedance in a circuit. Resistance/impedance is equal to the voltage of direct current divided by the amps in the circuit. Alice measures 120 volts in the circuit with 7 amps, which equals 17.143 ohms of resistance/impedance. What is the ohm reading rounded to the nearest tenth?

A. 17.2 ohms  
B. 17 ohms  
C. 17.1 ohms  
D. 17.14 ohms

Bill is determining the ohms of impedance in a circuit. Impedance is equal to the voltage of direct current divided by the amps in the circuit. Bill measures 240 volts in the circuit with 7 amps, which equals 34.285 ohms of impedance. What is the ohm reading rounded to the nearest tenth?

A. 34.2 ohms  
B. 34.3 ohms  
C. 34.285 ohms  
D. 34.29 ohms

Omar is determining the ohms of resistance in a circuit. Resistance is the voltage of direct current divided by the amps in the circuit. Omar measures 120 volts in the circuit with 9 amps, which equals 13.33333 ohms of resistance. What is the ohm reading rounded to the nearest tenth?

A. 13.3 ohms  
B. 13 ohms  
C. 13.33 ohms  
D. 13.4 ohms

Jill is installing copper wire as part of an upgrade project. The upgrade requires using American Wire Gauge (AWG) size 3,000 copper wire. The wire can carry 610 amps of load. What would be the amps of load if rounded to the nearest thousand?

A. 610 amps  
B. 600 amps  
C. 1,000 amps  
D. 500 amps
Pete is working on a transmission upgrade project. Transmission upgrades use aluminum wire based on the high voltage of transmission systems. American Wire Gauge size 1,590,000 can carry 1,380 amps. What would be the number of amps if rounded to the nearest thousand?

A. 1,300 amps  
B. 1,400 amps  
C. 1,350 amps  
D. 1,000 amps

Kim is working on an upgrade project in a subdivision. The crew is using American Wire Gauge size 2/0 for the upgrade. The breaking strength for 2/0 copper wire is 4,765 lbs. What would be the breaking strength rounded to the nearest thousand?

A. 4,700 lbs  
B. 4,000 lbs  
C. 5,000 lbs  
D. 4,800 lbs

Gail is working on a transmission upgrade project. Aluminum wire is being used on the project based on the amp load of 2,150 amps. The American Wire Gauge size of the required aluminum is 3,364,000 AWG. What would be the AWG size rounded to the nearest hundred-thousand?

A. 3,300,000 AWG  
B. 4,000,000 AWG  
C. 3,400,000 AWG  
D. 3,000,000 AWG

Tom is working on a transmission line project. The line voltage of 345,000 volts requires a minimum approach distance of 8 feet, 6 inches. What would be the voltage of this system rounded to the nearest hundred-thousand?

A. 350,000 volts  
B. 400,000 volts  
C. 300,000 volts  
D. 340,000 volts
Larry is working on the transmission system upgrade. The transmission poles have to be rigged and lifted into place by the crane. The size of the cable on the crane is a 3-inch rope diameter being used in a 90° loop. The weight chart for this rope in a 90° loop is 73,200 lbs. What is 73,200 rounded to the nearest hundred-thousand?

A. 100,000 lbs  
B. 73,000 lbs  
C. 80,000 lbs  
D. 75,000 lbs

Tom is an operator in the system operations center. There has been a significant ice storm that has caused over 50% of the company’s 1.2 million customers to be without power. The actual number of customers without power is 655,410 customers. If Tom rounded the number to the nearest hundred-thousand, what number of customer outages would Tom report?

A. 650,000 customers  
B. 700,000 customers  
C. 600,000 customers  
D. 656,000 customers

Alice is determining the alternating current in a circuit. Alternating current is the voltage divided by the resistance. Alice measures 120 volts of alternating current in the circuit with 7 amps of resistance, which equals 17.142857 ohms of resistance. What is the ohm reading rounded to the nearest hundred-thousandth?

A. 17.1439 ohms  
B. 17.144 ohms  
C. 17.143 ohms  
D. 17.14286 ohms

Bill is determining the alternating current impedance in a circuit. Alternating current impedance is the voltage divided by the amps. Bill measures 240 volts in the circuit with 9 amps, which equals 26.66666 ohms of impedance. What is the ohm reading rounded to the nearest hundred-thousandth?

A. 26.667 ohms  
B. 26.666 ohms  
C. 26.666 ohms  
D. 26.66667 ohms
Omar is determining the ohms of resistance in a circuit. Resistance is the voltage of direct current divided by the amps in the circuit. Omar measures 120 volts in the circuit with 9 amps, which equals 13.3333 ohms of resistance. What is the ohm reading rounded to the nearest hundred-thousandth?

A. 13.33333 ohms
B. 13.334 ohms
C. 13.333 ohms
D. 13.3334 ohms

Alice is determining the ohms of resistance in a circuit. Resistance is equal to the voltage of direct current divided by the amps in the circuit. Alice measures 120 volts in the circuit with 7 amps, which equals 17.14285 ohms of resistance. What is the ohm reading rounded to the nearest thousandth?

A. 17.2 ohms
B. 17.14 ohms
C. 17.143 ohms
D. 17.1428 ohms

Bill is determining the ohms of impedance in a circuit. Impedance is equal to the voltage of direct current divided by the amps in the circuit. Bill measures 240 volts in the circuit with 9 amps, which equals 26.66666 ohms of impedance. What is the ohm reading rounded to the nearest thousandth?

A. 26.67 ohms
B. 26.665 ohms
C. 26.667 ohms
D. 26.6667 ohms

Omar is determining the ohms of resistance in a circuit. Resistance is the voltage of direct current divided by the amps in the circuit. Omar measures 120 volts in the circuit with 9 amps, which equals 13.3333 ohms of resistance. What is the ohm reading rounded to the nearest thousandth?

A. 13.333 ohms
B. 13.3 ohms
C. 13.33 ohms
D. 13.334 ohms
**Identifying Significant Digits**

Gus is reviewing pole numbers for work that is scheduled to be completed in the upcoming week. The pole Gus is working on is numbered 13 59 113. How many significant digits are there in the pole number?

A. 3  
B. 4  
C. 6  
D. 7  

Alex is required to measure a current transformer (CT) value on an industrial meter. Alex has checked the CT several times and has received slightly different readings each time. The final reading was 1.0320. How many significant digits are there in the final reading?

A. 1  
B. 3  
C. 4  
D. 5  

Val is using a handheld temperature sensing tool to detect abnormal temperature conditions in overhead equipment. After taking four different readings, the temperature indicated 90.15°F, 90.1°F, 90.151°F, and 90.0°F. Which is the most precise measurement?

A. 90.15°F  
B. 90.1°F  
C. 90.151°F  
D. 90.0°F  

Alex is required to measure a current transformer (CT) value on an industrial meter. Alex has checked the CT several times and has received slightly different readings each time. The readings in percent of full load were 1.03, 1.0, 1.032, and 1.0323. Which is the most precise measurement?

A. 1.03% of full load  
B. 1.0% of full load  
C. 1.032% of full load  
D. 1.0323% of full load
Bob is required to calculate the impedance “Z” of an AC circuit. Impedance is calculated by taking the square root of the squared sums of the ohms of resistance “a” and the ohms of inductive resistance “b”. If the value of a = 4 and the value of b = 6, then the formula is $Z = \sqrt{52}$. Which one of the following results for $\sqrt{52}$ is the most precise?

A. 7.2 ohms  
B. 7.2110 ohms  
C. 7.20 ohms  
D. 7.211 ohms

Bill is asked to measure the voltage of a 120-volt circuit with a multi-meter. Bill takes four different measurements. Which of the measures below is the most accurate reading to report based on the number of significant digits?

A. 119.7 volts  
B. 120.0 volts  
C. 119.78 volts  
D. 120.1 volts

Jim is measuring ohms of resistance in a circuit. He takes four measurements, which read 3.4 ohms, 3.410 ohms, 3.41 ohms, and 3.4131 ohms. Which of the measurements is the most accurate based on the number of significant digits?

A. 3.410 ohms  
B. 3.41 ohms  
C. 3.4 ohms  
D. 3.4131 ohms

Sue is given four numbers indicating the power factor of a circuit, which is the ratio of real power loading to the load of the circuit. The perfect power factor is equal to 1. The numbers Sue is given equal 0.90, 0.91, 0.913 and 0.9133. Which of the measurements is the most accurate based on the number of significant digits?

A. 0.9133 ratio of the real power flowing to the load of the circuit  
B. 0.913 ratio of the real power flowing to the load of the circuit  
C. 0.90 ratio of the real power flowing to the load of the circuit  
D. 0.91 ratio of the real power flowing to the load of the circuit
Converting to Scientific Notation

Val has to add oil to a gallon of gasoline so the fuel can be added to a chainsaw. The mixture is 2 ounces of oil to every 128 ounces of fuel, which results in a dilution ratio of 0.0156. Which of the following represents the dilution in scientific notation?

A. 0.0156 x 10^-2 dilution ratio
B. 1.56 x 10^-2 dilution ratio
C. 156 x 10^-5 dilution ratio
D. 1.56 x 10^-2 dilution ratio

Pete needs to add fuel stabilizer to the fuel tank of a temporary generator. The mixture requires 1/2 of a gallon of fuel stabilizer (64 ounces) to the 75 gallon tank (9,600 ounces), which results in a dilution ratio of 0.00667. Which of the following represents the dilution in scientific notation?

A. 0.00667 x 10^-3 dilution ratio
B. 6.67 x 10^-3 dilution ratio
C. 6.67 x 10^-2 dilution ratio
D. 0.00667 x 10^-2 dilution ratio

Kathy is calculating the energy use of a customer over a 5.5-hour period. The customer uses 1,000 kW/hour, so the customer used 5,500 kW in a 5.5-hour period. How would Kathy report that number in scientific notation?

A. 5,500 kW
B. 55 x 10^2 kW
C. 5.500 x 10^-3 kW
D. 5.500 x 10^3 kW
Val, a plant operator, is checking the monthly energy reading from one of the plant’s turbo-generator sets. The reading is in Megawatt-hours and reads 2,345.9235 MW-h. Val has been asked to report the reading in kW-h, so she records 2,345,923.5 kW-h. For her final report, the recording can be rounded to the nearest hundred kW-h. Which of the following should Val include in her final report?

A. 2,345,923.50 kW-h  
B. 2,346,000 kW-h  
C. 2,345,900 kW-h  
D. 2,345,923.500 kW-h
Problems
Categorizing Real Numbers

Bob, a plant operator, needs to dilute a concentrated water treatment additive using 1 part of the concentrate to 4 parts of untreated water to obtain a final treated water dilution of 1/5. Is 1/5 rational or irrational?

A. irrational
B. rational
C. neither
D. both

Bob needs to determine the diameter of a pressure tank. He has measured the circumference around the cylindrical central portion of the tank. He plans to compute the diameter by dividing the circumference by $\pi$. Is $\pi$ rational or irrational?

A. irrational
B. rational
C. neither
D. both

Bob needs to divide a dozen spare fuses evenly among the plant part cribs. Which number of cribs will not permit an even distribution?

A. 2 cribs
B. 3 cribs
C. 4 cribs
D. 5 cribs
Identifying Place Value

Val, a plant operator, needs to log the number of cubic feet of natural gas consumed during her shift to the nearest tenth. Which of the numbers below should Val report?

A. 12,350 ft$^3$
B. 12,346 ft$^3$
C. 12,345.6 ft$^3$
D. 12,345.62 ft$^3$

Bob is asked to record the trip setting on a protective relay to the milliamp (1/1000 of an amp). Which of the numbers below should Bob report?

A. 6.1 amps
B. 6.14 amps
C. 6.142 amps
D. 6.1423 amps
Solving Exponents

As part of the preventive maintenance schedule, Bob is preparing the job order to replace the heat tiles in the number-three furnace. The furnace is 16 feet by 16 feet. How many total square feet of tiles will Bob need?

A. 64 ft\(^2\)  
B. 100 ft\(^2\)  
C. 32 ft\(^2\)  
D. 256 ft\(^2\)
Simplifying Square Roots

A bio fuel lot (pile of wood chips) sitting in the fuel yard takes up a space of 576 square feet. If the lot is laid out in a square, what are the dimensions of the sides?

A. 36 ft  
B. 24 ft  
C. 28 ft  
D. 32 ft
Finding Multiples

The power plant is undergoing an expansion and Val is asked to order some convenience outlets for the new addition. An OSHA-approved outlet has been selected and it is shipped in cartons of 6. Val can order no more than 5 cartons at a time. What are all the possible number of outlets that Val can have in one order?

A. 3, 6, 9, 12, 15 outlets  
B. 3, 9, 27, 81, 243 outlets  
C. 6, 12, 18, 24, 30 outlets  
D. 6, 12, 24, 48, 96 outlets

The power plant is undergoing an expansion and Val is asked to order some lighting for the new addition. A high-intensity lamp has been selected that is to be used with a universal base. The lamps are shipped 8 to a pallet, and the bases are shipped 12 to a pallet. What is the minimum number of lamp pallets that Val must order so that she has one base for every lamp and there are no extra bases?

A. 2 lamp pallets  
B. 3 lamp pallets  
C. 12 lamp pallets  
D. 24 lamp pallets
**Finding Factors**

Bob has 8 bottles of water treatment reagent that he needs to store. What are the possible numbers of cabinets that Bob could use if he wants to evenly distribute the bottles in different storage locations?

A. 32, 16, 8, 4, or 1 cabinet(s)  
B. 2 or 1 cabinet(s)  
C. 16 or 8 cabinets  
D. 8, 4, 2, or 1 cabinet(s)

Bob is organizing the chemical storage cabinets. He has a total of 24 oxidizers and 16 aqueous solutions. If Bob wants to store the same ratio of chemicals in each storage locker, what is the greatest number of cabinets that he can use?

A. 12 cabinets  
B. 8 cabinets  
C. 4 cabinets  
D. 2 cabinets
Val saw that her stock of boiler-insulating tiles has dropped to 5 and is ordering more. The tiles are shipped in cases where she could have a final stock of 11, 17, 23, 29, etc. If Val determines that 29 tiles is too low of a number to have in stock, what would her next smallest stock level option be?

A. 32 tiles  
B. 35 tiles  
C. 39 tiles  
D. 41 tiles  

Bob is evaluating the gain on one of the boiler control circuits and records the following sequence of values at regular intervals: 2, 8, 32, 128. What would be the next reading that Bob is likely to record?

A. 150  
B. 196  
C. 256  
D. 512
Rounding Numbers

Val’s monthly energy reading from one of the plant turbo-generator sets is in Megawatt-hours and reads 1,234.567 MW-h. If Val is asked to record it to the nearest tenth Megawatt-hour, how should she record it?

A. 1,234.57 MW-h  
B. 1,234 MW-h  
C. 1,234.5 MW-h  
D. 1,234.6 MW-h

Val’s monthly energy reading from one of the plant’s turbo-generator sets is in Megawatt-hours and reads 1,234.367 MW-h, or 1,234,367 kW-h. If Val is asked to record the reading to the nearest thousand kW-h, which of the following would satisfy the reporting requirement?

A. 1,230,000 kW-h  
B. 1,234,000 kW-h  
C. 1,234,300 kW-h  
D. 1,234,400 kW-h

Val is recording the monthly power outputs of a plant’s turbo generator sets. If the cumulative lifetime sum of the plant’s turbo generators is 1,544,598.247 Megawatt-hours and she is asked to record the total in Gigawatt-hours to the nearest hundred-thousandth, which of the following is how she should record the cumulative lifetime sum?

A. 1,544.60 GW-h  
B. 1,544.598 GW-h  
C. 1,544.5982 GW-h  
D. 1,544.59825 GW-h
Identifying Significant Digits

Bob is asked to log the energy on one of the combustion gas turbine generators in the plant, which is instrumented with a kilowatt-hour (kW-h) meter that reads 3,141.4 kW-h. If Bob was asked to report the reading to 4 significant figures in kW-h, which of the following should Bob report?

A. 3,141.40 kW-h
B. 3,140 kW-h
C. 3,140.4 kW-h
D. 3,141 kW-h

Val is preparing instructions for mounting a piece of switch gear between two terminals with about 3 1/2 inches on either side of the equipment. Which of the following measurements would communicate the greatest precision in centering the unit in the instructions?

A. 3.5 in
B. 3.52 in
C. 3.520 in
D. 3.56 in

Val is asked to log the total energy produced by the plant in one month from an instrument that reports in Megawatt-hours. Can you tell Val which of the following is the most accurate reading to report?

A. 12.3 GW-h
B. 12,310 MW-h
C. 12,310.2 MW-h
D. 12,310 MW-h
Converting to Scientific Notation

Val is asked to express the total energy in kilowatt-hours (kW-h) produced by the plant in one month in scientific notation. She has previously determined the energy is 12,310 Megawatt-hours (MW-h) and knows that this is 12,310,000 kW-h. Which of the following represents the monthly energy to the same accuracy in scientific notation?

A. 0.12300 x 10^5 kW-h
B. 1.231 x 10^7 kW-h
C. 12.310 x 10^6 kW-h
D. 123.10000 x10^5 kW-h
Numbers
(Pipefitter/Pipelayer/Welder)

Scenario

“Hey, Joella, what can I do for you?” Tyrence, a welding supervisor, asks Joella, a welder.

“I’ve been looking at this weld, and it definitely has excessive convexity. So, it needs repair. The problem is, I’ve gotten two different measurements. Can you take a couple measurements?”

“Okay, looks like I got 1.61 millimeters and 1.666 millimeters,” Tyrence says after taking his measurements.

“Okay, I got 1.6 millimeters the first time and 1.0 millimeters the second time. Any suggestions on which measurement to go with?”

“Typically in these types of situations, I suggest that the most precise measurement be used.”

Which of the four measurements is the most precise?

A. 1.6 mm
B. 1 mm
C. 1.61 mm
D. 1.666 mm
Problems
Categorizing Real Numbers

Jerry, a gas distribution helper, needs to determine the corrosion rate of steel pipe. The corrosion rate equals the measurement of the flowing current between the anode and the cathode (I), the voltage difference between the anode and the cathode (E) divided by the resistance (R) \( I = \frac{E}{R} \). He determines from the calculation that the corrosion rate potential is \(-0.70\). Is \(-0.70\) rational or irrational?

A. irrational
B. rational
C. neither
D. both

Karen is required to measure the maximum convexity of a fillet weld. Karen determines the width of the weld face is \( \leq \frac{5}{16} \) of an inch, or \(8\) mm. Based on that measurement, the max convexity is \(1.6\) mm. Is \(1.6\) mm a rational or irrational number?

A. irrational
B. rational
C. neither
D. both

Alesandro is required to calculate the circumference of a pipe. The calculation requires multiplying the diameter of the pipe by \(\pi\), or \(3.14159265\). Is \(\pi\) a rational or irrational number?

A. irrational
B. rational
C. neither
D. both

Kari, a welder helper, has removed 90 welding rods from the oven, which have to be delivered to the welders working on a gas pipe installation job. She was asked by the chief to divide all of them evenly among the welders. Which number of welders will not permit an even distribution?

A. 10 welders
B. 9 welders
C. 8 welders
D. 6 welders
Identifying Place Value

Alex is determining the outside diameter of a 3/4-inch nominal pipe. He needs to report this number to the nearest tenth. Which number would Alex report?

A. 1.057 in
B. 1.0578 in
C. 1.1 in
D. 1.06 in

Pete is calibrating the gas measurement instrument. He puts in a calibration gas containing a 50% mixture of methane and gets a reading. He needs to record the value to a tenth on the calibration sheet. What value would Pete be recording?

A. 48.1%
B. 48.08%
C. 49%
D. 48.087%

Kathy is measuring the voltage between an anode and a cathode to determine the corrosion rate of a steel pipe. The measurement has to be reported in a tenth of a volt. Which measurement would Kathy report?

A. -0.55 volts
B. -0.6 volts
C. -0.557 volts
D. -0.56 volts

Alesandro is determining the nominal wall thickness of a 1/8-inch nominal pipe size schedule 40 pipe. He is required to report the pipe size to the nearest thousandth. Which value would Alesandro report?

A. 0.068 in
B. 0.07 in
C. 0.0699 in
D. 0.1 in

Kathy is measuring the voltage between an anode and a cathode to determine the corrosion rate of steel pipe. The measurement has to be reported in a thousandth of a volt. Which measurement would Kathy report?

A. -0.555 volts
B. -0.6 volts
C. -0.5552 volts
D. -0.56 volts
Solving Exponents

Latoya has to use a crane to move a pipe into a trench. In order to determine if the 1-inch rope can handle the weight of the pipe, Latoya has to square the rope size factor, which for a 1-inch rope is the number 8, and multiply it by the rope safety factor. What number will Latoya use for the rope size factor squared?

A. 64
B. 16
C. 48
D. 60

Pete has to calculate the volume of a pipe that has been installed in a gas system. The pipe is 10 feet long with a 6-inch radius. The volume of the pipe is calculated by multiplying the radius squared \((r^2)\) times \(\pi\) times the length of the pipe. What number would Pete use for the squared radius \((r^2)\) in the calculation?

A. 12 in\(^2\)
B. 24 in\(^2\)
C. 36 in\(^2\)
D. 64 in\(^2\)

Mike has to use a crane to move a pipe into a trench. In order to determine if the rope can handle the weight of the pipe, Mike has to square the rope size and multiply it by the rope safety factor. The rope size is 7. What number will Mike use for the rope size squared?

A. 14
B. 49
C. 21
D. 42
Simplifying Square Roots

Pete has completed calculating the volume of a pipe that has been installed in a gas system. The volume of the pipe in inches cubed is equal to the radius squared \((r^2)\) times pi \(\pi\) times the length of the pipe. In this case, the radius squared equaled 441 square inches. What is the radius of the pipe?

A. 20 in  
B. 44 in  
C. 21 in  
D. 22 in

Jake has to calculate the area of a piece of circular plate steel. The calculation equals \(\pi\) times the radius squared. In this case, the radius squared equaled 280 square inches. What is the radius of the circular piece of plate steel?

A. 16 in  
B. 17 in  
C. 16.73 in  
D. 140 in
Finding Multiples

The gas distribution crew is installing several new connections to run gas to new homes. Each connection requires a tapping fixture into the main pipe. Christine works in the warehouse and is providing the equipment for the installations. The tapping connections come 10 to a box and Christine can only load 5 boxes on a truck at a time. What are the possible numbers of tapping connections that Christine can have on one truck?

A. 10, 20, 30, 40, 50 tapping connections  
B. 5, 15, 25, 35, 45 tapping connections  
C. 10, 20, 30, 50, 60 tapping connections  
D. 5, 10, 15, 20, 25 tapping connections

The gas crew is responsible for replacing anodes and cathodes in the corrosion measure system. The anodes are shipped 8 to a box, and the cathodes are shipped 12 to a box. What is the minimum number of anode boxes that must be ordered in order to have one anode for every cathode and no extra cathodes?

A. 6 boxes of anodes  
B. 8 boxes of anodes  
C. 3 boxes of anodes  
D. 4 boxes of anodes

The gas line is undergoing an upgrade with new gas meters and taps scheduled for installation. There are 6 homes on every block scheduled for installation on the system. Each house requires a meter, which come 3 in a box. What is the minimum number of boxes that Kari must order so that she has one meter for every house on two blocks and no extra meters?

A. 6 boxes  
B. 3 boxes  
C. 4 boxes  
D. 8 boxes
Finding Factors

Alesandro is asked to organize the chemical storage cabinets containing various chemical reagents and water treatment chemicals. After checking the chemicals’ material safety data sheets (MSDS), he notes that he has 1 container each of 8 different chemicals that can be safely stored together. What are all the possible numbers of cabinets that Alesandro could use if he wished to distribute the chemicals evenly among cabinets?

A. 32, 16, 8, 4, or 1 cabinet(s)
B. 2 or 1 cabinet(s)
C. 16 or 8 cabinets
D. 8, 4, 2, or 1 cabinet(s)

Alesandro is organizing the chemical storage cabinet, and he has 12 oxidizers and 8 aqueous solutions. These two chemicals cannot be stored together, but Alesandro wishes to put the same number of oxidizers and aqueous solutions in any one cabinet. What is the greatest number of any one chemical that we might find in one cabinet?

A. 12 chemicals
B. 8 chemicals
C. 4 chemicals
D. 2 chemicals

Larry has boxes of gas fittings that need to be distributed into the gas trucks. The boxes contain either 48, 60, or 96 fittings. What is the greatest common factor for this number of fittings?

A. 4 fittings
B. 6 fittings
C. 12 fittings
D. 16 fittings

Laura has boxes of welding rods that need to be distributed to each of the welders. The boxes contain 35, 40, or 45 rods. What is the greatest common factor for this number of welding rods?

A. 5 rods
B. 10 rods
C. 7 rods
D. 1 rod
Tom has to load valve bolts onto the gas trucks. The bolts come in boxes of 20, 36, or 48. What is the greatest common factor of bolts?

A. 10 bolts
B. 8 bolts
C. 4 bolts
D. 5 bolts
Identifying Number Sequences (Numerical Reasoning)

Pete is working a gas valve. He has to torque the valve bolts in sequence, working from left to right around the top of the valve body to ensure the gaskets get compressed evenly. The final torque value needs to be 90 foot-lbs. The first four torque values are 60 foot-lbs, 65 foot-lbs, and 70 foot-lbs. What would be the next torqueing sequence number?

A. 80 ft-lbs  
B. 75 ft-lbs  
C. 90 ft-lbs  
D. 85 ft-lbs

Alex has several boxes of threaded fittings that he is using to restock the gas trucks. The nominal size of the fittings are 1/4-inch, 1/2-inch, and 3/4-inch. What would be the next nominal fitting size?

A. 1 1/4 in  
B. 8/16 in  
C. 1 in  
D. 1 1/2 in

Kim and the gas crew are working with a cast iron pipe installation. They have pipes at working pressures of 50 psi, 80 psi, and 110 psi, but they think they might need a pipe with the next step up in working pressure. What would likely be the next highest operating pressure?

A. 150 psi  
B. 125 psi  
C. 140 psi  
D. 20 psi

Gail is loading bolts into the gas trucks. She has bolt lengths of 2 millimeters, 6 millimeters, and 18 millimeters. What would be the next bolt length in this sequence?

A. 26 mm  
B. 24 mm  
C. 20 mm  
D. 48 mm
Matt and the gas crew are trying to remove bolts from the top of a valve body. The bolts are stuck and the gas crew decides to slowly heat up the bolts until they come loose. This has to be done in a slow sequence to not damage the valve body or the gasket. The crew begins the warm-up at 125°F, then 250°F, and 500°F. What would be the next temperature in this sequence?

A. 750°F  
B. 876°F  
C. 1,000°F  
D. 1,500°F
Rounding Numbers

Mark is taking readings of gas related to a potential gas leak. His gas meter is reading 40.55% of the lower explosive limit (LEL). Mark needs to round the reading to the nearest tenth. What would be the gas meter reading that Mark would report?

A. 40% LEL  
B. 41% LEL  
C. 40.6% LEL  
D. 40.55% LEL

Paul is getting ready to weld two pieces of steel plate together. The steel plate is 1 1/4 inches thick, which translates into 31.750 millimeters thick. Paul needs to round the number to the nearest tenth. What would be the thickness of the steel plate rounded to the nearest tenth?

A. 31 mm  
B. 32 mm  
C. 31.7 mm  
D. 31.8 mm

George is using a fillet weld measurement gage to determine if a weld is correct. He finds that the weld is incorrect by 3/16 of an inch, or 0.1875 inches. George needs to round the number to the nearest tenth. What number would George report?

A. 0.2 in  
B. 0.19 in  
C. 0.188 in  
D. 0.1875 in

Larry is working on the gas transmission system upgrade. The steel pipes have to be rigged and lifted into place by the crane. The weight of the pipe being lifted off the truck is 15,485 lbs. What is the pipe weight rounded to the nearest thousand?

A. 15,000 lbs  
B. 16,000 lbs  
C. 15,400 lbs  
D. 15,500 lbs
Tom is an operator in the gas system operations center. There has been a significant gas system outage that has caused over 50% of a city’s customers to be without power. The actual number of customers without gas is 2,585. If Tom rounded the number to the nearest thousand, what number of customer outages would Tom report?

A. 2,500 outages  
B. 3,000 outages  
C. 2,600 outages  
D. 2,000 outages

Pete is a gas system control operator. Pete is responsible for taking daily meter readings of the flow through the transmission gas pipeline in thousand cubic feet/day. The average reading over a seven-day period was 2,358 cubic feet/day. Pete needs to round the number to the nearest thousand. What number would Pete report?

A. 2,400 ft³/day  
B. 3,000 ft³/day  
C. 2,000 ft³/day  
D. 2,300 ft³/day

Harry is using the Gas Tungsten Arc Welding (TIG) process for a welding job. The TIG process produces temperatures up to 19,426° C. If Harry rounded the number to the nearest thousand, what temperature would Harry expect to have during the TIG welding process?

A. 19,000° C  
B. 19,400° C  
C. 19,500° C  
D. 20,000° C

Tom is calculating the current between an anode and a cathode to determine the amount of corrosion for a buried mild steel pipe. The calculation resulted in a flowing current of 0.70710678 amps. Tom has to round the number to the nearest hundred-thousandth. What number would Tom report?

A. 0.71 amps  
B. 0.7071 amps  
C. 0.70711 amps  
D. 0.7 amps
Matt and the gas crew are reviewing the thread stress tables for the bolts they are using to torque a valve body. The table indicates that the thread stress for a 5-44 fine thread bolt is 0.00716 thread root/square inch. Matt needs to round the number to the nearest hundred-thousandth. What number would Matt report?

A. 0.008 thread root/sq. in  
B. 0.0072 thread root/sq. in  
C. 0.00716 thread root/sq. in  
D. 0.01 thread root/sq. in

Tom is calculating the current between an anode and a cathode to determine the amount of corrosion for a buried mild steel pipe. The calculation resulted in a flowing current of 0.5527707 amps. Tom has to round the number to the nearest hundred-thousandth. What number would Tom report?

A. 0.553 amps  
B. 0.5538 amps  
C. 0.55277 amps  
D. 0.55278 amps
Identifying Significant Digits

Matt and the gas crew are reviewing the thread stress tables for the bolts they are using to torque a valve body. The table indicates that the thread stress for a 5-44 fine thread bolt is 0.00716 thread root/square inch. How many significant digits are there in the 0.00716 thread root/square inch?

A. 6 digits  
B. 5 digits  
C. 3 digits  
D. 4 digits

Tom is calculating the flowing current between an anode and a cathode to determine the amount of corrosion for a buried mild steel pipe. The calculation resulted in a flowing current of 0.70710 amps. Tom has to determine the number of significant digits. What number would Tom report?

A. 5 digits  
B. 4 digits  
C. 3 digits  
D. 6 digits

Latoya has to use a crane to move a pipe into a trench. In order to determine if the rope can handle the weight of the pipe, Latoya has to perform the following calculation. Size of the rope changed into 1/8 of an inch. Square the numerator and multiply that number by the rope safety factor (60). Latoya has one-inch nylon rope, which converts to 8/8 eight-halves of an inch. The calculation = 8² x 60 results in a safe load number of 3,840 lbs. How many significant digits are there in the number 3.84 x 10³ lbs?

A. 3 digits  
B. 4 digits  
C. 2 digits  
D. 5 digits

Pete is using a welder gage to determine if a fillet weld has been done correctly. The gage indicates a 1/16-inch gap in the weld. Which of the following numbers is the most precise conversion of this gap to inches?

A. 0.06 in  
B. 0.1 in  
C. 0.063 in  
D. 0.0625 in
Latoya has to use $\pi$ in calculating the circumference of a pipe. Which value of $\pi$ would result in the most precise calculation?

A. 3.14  
B. 3.14159  
C. 3.142  
D. 3.1416

Tom is calculating the current between an anode and a cathode to determine the amount of corrosion for a buried mild steel pipe. Tom has to report the most accurate number based on the number of significant digits. Which number would Tom report?

A. 0.55278 amps  
B. 0.55277 amps  
C. 0.5527707 amps  
D. 0.552771 amps
Converting to Scientific Notation

Matt and the gas crew are reviewing the thread stress tables for the bolts they are using to torque a valve body. The table indicates that the thread stress for a 5-44 fine thread bolt is 0.00716 thread root/square inch. Matt needs to convert the number to scientific notation. Which number would Matt report?

A. 0.00716 thread root/sq. in
B. 0.0072 x 10^{-2} thread root/sq. in
C. 7.16 x 10^{-3} thread root/sq. in
D. 7.16 x 10^{3} thread root/sq. in

Tom is calculating the flowing current between an anode and a cathode to determine the amount of corrosion for a buried mild steel pipe. The calculation resulted in a flowing current of 0.5527707 amps. Tom has to report the most accurate number in scientific notation. Which number would Tom report?

A. 0.55278 amps
B. 5.5277 x 10^{-1} amps
C. 55.27707 x 10^{-1} amps
D. 5.52771 x 10^{-2} amps
Numbers (Technician)

Scenario

“So, this is the carton of 20-amp breakers, right?” Sally, a power plant technician, asks her supervisor, Genelle.

“Correct. There are 30 20-amp breakers in the carton. Please distribute them evenly among the spare parts cribs when you get a chance,” Genelle responds.

“Okay, I will do my best to get the same number in each crib.”

Which number of cribs would not permit Sally to evenly distribute the amp breakers?

A. 3 cribs
B. 4 cribs
C. 5 cribs
D. 6 cribs
Problems
Categorizing Real Numbers

Enrique, a power plant water treatment technician, needs to dilute a concentrated water treatment additive using 1 part of the concentrate to 4 parts of untreated water to obtain a final treated water dilution of 1/5. Is 1/5 rational or irrational?

A. irrational
B. rational
C. neither
D. both

Tavon, a power plant boiler technician, needs to compute the area of a circular access port into a boiler. He measures the port’s diameter, D, and computes the area, A, as $\pi/4 D^2$. Is $\pi/4$ rational or irrational?

A. irrational
B. rational
C. neither
D. both

Janelle needs to divide a dozen spare fuses evenly among the plant part cribs. Which number of cribs will not permit an even distribution?

A. 2 cribs
B. 3 cribs
C. 4 cribs
D. 5 cribs
Identifying Place Value

Val, a power plant gas technician, needs to log the number of cubic feet of natural gas consumed during her shift to the nearest tenth. Which of the numbers below should Val report?

A. 12,340 ft³
B. 12,345 ft³
C. 12,345.0 ft³
D. 12,345.60 ft³

Blake, an electrician, is asked to log the running time on one of the plant back-up generators to the nearest tenth of an hour. Which of the numbers below should Blake report?

A. 1,230
B. 1,234
C. 1,234.50
D. 1,234.0

Gary, a relay technician, is asked to record the trip setting on a protective relay to the milliamp (1/1000 of an amp). Which of the numbers below should Gary report?

A. 6.0 amps
B. 6.00 amps
C. 6.000 amps
D. 6.0000 amps

Val, a power plant gas technician, is checking the output of a thermocouple that is part of the boiler gas pilot interlock system. She wants to record the thermocouple output to the nearest millivolt (1/1000 of a volt). Which number below should Val report?

A. 0.01 volts
B. 0.020 volts
C. 0.30 volts
D. 0.0405 volts
Solving Exponents

As part of the preventive maintenance schedule, Tavon, a power plant boiler technician, is preparing the job order to replace the heat tiles in the number-three furnace. The furnace is 16 feet by 16 feet. How many total square feet of tiles will Tavon need?

A. 64 ft$^2$
B. 100 ft$^2$
C. 32 ft$^2$
D. 256 ft$^2$

Tavon needs to compute the area of a circular access port into a boiler. He measures the port’s diameter (D) as 14 inches and computes the area (A) as $\pi/4 \cdot D^2$. Which of the following should Tavon use?

A. $\pi/4 \cdot 28 = A$ in$^2$
B. $\pi/4 \cdot 98 = A$ in$^2$
C. $\pi/4 \cdot 196 = A$ in$^2$
D. $\pi/4 \cdot 256 = A$ in$^2$
Simplifying Square Roots

Sam, a renewable fuel specialist, examines the bio fuel lot (pile of wood chips) sitting in the fuel yard. The lot takes up an area of 576 square feet. If the lot is laid out in a square, what is the length of each side?

A. 36 ft  
B. 24 ft  
C. 28 ft  
D. 32 ft

Deandra, a distribution system electrician, has been asked to order fencing for a square transformer storage yard of 1,444 square feet. What is the length of the square storage yard's sides?

A. 38 ft  
B. 40 ft  
C. 42 ft  
D. 32 ft
Finding Multiples

The power plant is undergoing an expansion and Blake, an electrician, is asked to order some convenience outlets for the new addition. An OSHA-approved outlet has been selected and it is shipped in cartons of 6. Blake can order no more than 5 cartons at a time. What are all the possible number of outlets that Blake can have in one order?

A. 3, 6, 9, 12, 15 outlets
B. 3, 9, 27, 81, 243 outlets
C. 6, 12, 18, 24, 30 outlets
D. 6, 12, 24, 48, 96 outlets

The power plant is undergoing an expansion and Blake is asked to order some lamp fixtures for the new addition. An OSHA-approved fixture has been selected and it is shipped in cartons of 8. Blake can order no more than 6 cartons at a time. What are all the possible number of fixtures that Blake can have in one order?

A. 4, 8, 12, 16, 20, 24 fixtures
B. 8, 16, 32, 40, 48, 60 fixtures
C. 16, 24, 32, 40, 48, 60 fixtures
D. 8, 16, 24, 32, 40, 48 fixtures

The power plant is undergoing an expansion and Blake, a plant electrician, is asked to order some lighting for the new addition. A high-intensity lamp has been selected that is to be used with a universal base. The lamps are shipped 8 to a pallet, and the bases are shipped 12 to a pallet. What is the minimum number of lamp pallets that Blake must order so that he has one base for every lamp and there are no extra bases?

A. 2 lamp pallets
B. 3 lamp pallets
C. 12 lamp pallets
D. 24 lamp pallets

Sally, a distribution technician, is to order materials for a new subdivision to be served by underground primary feeders. For reliability, the subdivision is served by several reconfigurable loops each with an open switch, and the switches are located in underground vaults accessible through service holes. The vaults are shipped 3 to a shipping container while the switches are shipped 4 to a pallet. What is the minimum number of shipping containers that Sally must order so that she has a vault to house each switch?

A. 2 vault containers
B. 3 vault containers
C. 4 vault containers
D. 5 vault containers
Finding Factors

Enrique, a water treatment technician, is asked to organize the chemical storage cabinets containing various chemical reagents and water treatment chemicals. After checking the chemicals’ material safety data sheets (MSDS), he notes that 8 different chemicals can be safely stored together and the chemicals are sold in cartons of 8 canisters each. If he buys 8 cartons, one carton of each of the 8 different chemicals, what are all the possible numbers of cabinets that Enrique could use so that each cabinet contains the same amount of each chemical?

A. 32, 16, 8, 4, or 1 cabinet(s)
B. 2 or 1 cabinet(s)
C. 16 or 8 cabinets
D. 8, 4, 2, or 1 cabinet(s)

Blake, an electrician, has been asked to identify a set of low-voltage, molded case circuit breakers at commonly used amperages to be available as spares in the plant cribs. He identifies 12 different breaker styles for his set of spares. The breakers are sold in cartons of 12. If he buys 1 carton of each of the 12 different types, what are all the possible numbers of cribs that Blake could use if he wished to distribute the breaker sets evenly among cribs?

A. 12, 6, 3, 4, 2 or 1 crib(s)
B. 12, 10, 6, 4, 2 or 1 crib(s)
C. 12, 6, 5, 4, 3, 2, or 1 crib(s)
D. 8, 4, 2, or 1 crib(s)

Enrique is organizing the chemical storage cabinets and he has 12 bottles of oxidizer and 8 bottles of aqueous solutions. Enrique wishes to put the same number of oxidizer bottles and aqueous solution bottles in each cabinet. What is the greatest number of oxidizer bottles that can be put in a single cabinet?

A. 8 bottles
B. 4 bottles
C. 3 bottles
D. 2 bottles
Identifying Number Sequences

Val, a boiler technician, saw that her stock of boiler-insulating tiles has dropped to 5 and is ordering more. The tiles are shipped in cases where she could have a final stock of 11, 17, 23, 29, etc. If Val determines that 29 tiles is too low of a number to have in stock, what would her next smallest stock level option be?

A. 32 tiles
B. 35 tiles
C. 39 tiles
D. 41 tiles

Blake is evaluating the gain on one of the boiler control circuits and records the following sequence of values at regular intervals: 2, 8, 32, 128. What would be the next reading that Blake is likely to record?

A. 150
B. 196
C. 256
D. 512
Rounding Numbers

Gary, a relay technician, has been asked to measure and record the pickup current on a trip unit to the nearest tenth of an ampere. If Gary reads 321.00, what should he record?

A. 320 amps  
B. 321 amps  
C. 321.0 amps  
D. 321.00 amps

Ben, an instrument technician, is calibrating the energy monitor on one of the plant’s turbo-generator sets. He applies a power standard to the instrument for the specified period and reads 1,234.367 MW-h or 1,234,367 kW-h. If Ben is asked to round the reading to the nearest thousand kW-h, which of the following would satisfy the calibration reporting requirement?

A. 1,230,000 kW-h  
B. 1,234,000 kW-h  
C. 1,234,300 kW-h  
D. 1,234,400 kW-h

Gary, a relay technician, has been asked to measure and record the pickup current on a trip unit. He measures the AC current as 0.008766 amperes. He is asked to round the measurement to the nearest hundred-thousandth. Which of the following is how Gary should round the pickup current?

A. 0.0087 amps  
B. 0.0088 amps  
C. 0.00876 amps  
D. 0.00877 amps
Identifying Significant Digits

Ben, an instrument technician, is asked to assess the kilowatt-hour meter that monitors the energy produced by one of the combustion gas turbine generators in the plant. He is asked to record the meter’s reading before and after his inspection. Before the inspection, he reads 3,141.4 kW-h. If Ben was asked to report the readings to 4 significant figures in kW-h, which of the following should Ben report?

A. 3,141.40 kW-h
B. 3,140 kW-h
C. 3,140.4 kW-h
D. 3,141 kW-h

Ben is asked to assess the four-digit digital kilowatt (kW) meter that displays the current power supplied by one of the combustion gas turbine generators in the plant. With his test meter connected to the equipment, Ben records the displays of both meters. The generator meter reads 31.02 kW. If Ben were asked to report the reading to 3 significant figures in kilowatts, which of the following would Ben report?

A. 31.02 kW
B. 31.0 kW
C. 31 kW
D. 31.00 kW

Blake, an electrician, is preparing instructions for mounting a piece of switch gear between two terminals with about 3 1/2 inches on either side of the equipment. Which of the following measurements would communicate the greatest precision in centering the unit in the instructions?

A. 3.5 in
B. 3.52 in
C. 3.520 in
D. 3.56 in

Gary, a relay technician, has been asked to measure and record the AC pickup current on a trip unit. Can you tell Gary which of the following is the most precise reading to report?

A. 12,300 milliamps
B. 12,310 milliamps
C. 12.310 amps
D. 12,310,000 microamps
Converting to Scientific Notation

Gail, a water quality technician, has to dilute a water treatment concentrate to a dilution of 138 parts per million \((138 \times 10^6)\). Which of the following represents the dilution in scientific notation in standard form?

A. \(1.38 \times 10^{-3}\)
B. \(1.38 \times 10^{-4}\)
C. \(13.8 \times 10^{-5}\)
D. \(1.36 \times 10^{-8}\)
Math Review

Scenarios and Problems

Student Guide

Module 2: Basic Operations

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Multiplying and Dividing by Powers of 10

Basic Operations with Whole Numbers and Decimals (Technician)

Scenario

Problems

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Multiplying and Dividing by Powers of 10
Basic Operations with Whole Numbers and Decimals (Lineworker)

Scenario

Jerry, a lineman apprentice, is working on the installation of an underground service with his crew leader, Jim.

“All right, Jerry. Do you have all your measurements before you cut the wire for your run?” Jim asks.

“I think so,” Jerry replies.

“Let’s double-check just to be sure.”

“Okay, I have 4 feet from the pad mount transformer to the underground service, 30 feet to the home, 6 feet from the service to the meter, and an extra foot on either side for the connections.”

“That is what I have, too. Go ahead and cut your wire for the service run.”

How many feet of wire should Jerry cut for this underground service installation?

A. 38 ft  
B. 40 ft  
C. 42 ft  
D. 44 ft
Problems
Adding and Subtracting

Jim needs 300 yards of wire for today’s job, but only has 125 yards left on the truck. How many additional yards of wire does Jim need for today’s work?

A. 200 yd
B. 300 yd
C. 175 yd
D. 125 yd

Kari, a line helper, is helping with the installation of a new pole that is 35 feet from the ground to the top. She will install a neutral wire 5 feet below the base of the transformer, and the transformer base is 5 feet below the top of the pole. How far up from the base of the pole must the neutral wire be installed?

A. 20 ft
B. 25 ft
C. 30 ft
D. 35 ft

As part of his duties, Jerry has to measure a new length of wire for an underground service. The new underground service requires 4 feet of wire from the pad mount transformer to reach the underground service, 50 feet of wire to reach the customer’s home, 5 feet of wire from the underground service to the customer’s meter, and an extra foot of wire on both ends so the connections can be completed. How many feet of wire must Jerry measure to complete the underground service?

A. 54 ft
B. 59 ft
C. 60 ft
D. 61 ft

Ernesto is installing a temporary electrical service for a house under construction. The temporary pole is 20 feet long and it must be buried 4 feet in the ground. A meter panel that needs to be installed has to be 5 feet off the ground. How far up the pole does Ernesto mark for the meter installation before the pole is placed in the ground?

A. 10 ft up the pole
B. 5 ft up the pole
C. 7 ft up the pole
D. 9 ft up the pole
As part of her duties, Kari is asked to check the oxygen content of a confined space the line crew has to enter. Kari checks the air content and the meter alarms for low oxygen content at 18.7%. The normal content of oxygen in air is 21%. How many percent must the oxygen content change so the percentage comes up to 21% and the crew can enter the confined space?

A. 4.4%
B. 2.3%
C. 3%
D. 2.4%

Tom is asked to check the operating pressure of the hydraulic system. The pressure indicates that it is reading approximately 18.8 psi. The normal pressure of the system should be at least 50.5 psi. How many psi must Tom adjust the hydraulic pump output pressure so the system is operating at 50.5 psi?

A. 32.7 psi
B. 50.5 psi
C. 31.7 psi
D. 41.7 psi

Bill is taking a measurement of a meter constant transformer. The measurement indicates the constant transformer is reading at 0.977% of full load. The constant transformer should be reading at 1.10% of full load. How much of an increase does Bill need to adjust the constant transformer in order to make it read correctly?

A. 0.123% of full load
B. 0.0123% of full load
C. 1.23% of full load
D. 0.015% of full load
Multiplying and Dividing

Alice is working with a crew pulling an underground cable. The cable must be lubricated during the pull. Alice is expected to use 8 pounds of lubricant for every 100 feet of cable. The cable pull is 400 feet long. How many pounds of lubricant does Alice need to load into the truck?

A. 32 lbs  
B. 38 lbs  
C. 12.5 lbs  
D. 24 lbs

Tom has to determine the correct amount of amps for the electrical system he is installing to a house. The house needs 1,400 watts of power and the system is a 240-volt system feeding the house. The amps are determined by dividing the watts needed for the house by the system voltage. How many amps of power will this house use? (Round up to the nearest whole number.)

A. 5.8 amps  
B. 5.0 amps  
C. 6.0 amps  
D. 0.58 amps

Mary is working in a residential subdivision. The voltage in the subdivision is 13,600 volts. This voltage must be equally divided among the 5 subdivision branches. What would be the voltage for each branch?

A. 3,000 volts  
B. 2,720 volts  
C. 2,700 volts  
D. 1,360 volts

Ernesto is pulling a new overhead cable. The cable truck has 1,000 feet of cable on the cable spool. The distance between each of the poles is 120 feet. How many complete poles can Ernesto pull the cable across before he has to get another spool of wire? (Round to the nearest whole number.)

A. 8.5 poles  
B. 8.0 poles  
C. 7.0 poles  
D. 8.3 poles
The line crew is laying plastic pipe to pull a service into a house. The driveway to the house is 220 feet long and each piece of plastic pipe is 15 feet long. How many pieces of pipe does the crew need to complete the cable pull to the house? (Round up to the nearest whole number.)

A. 15.0 pieces  
B. 23.0 pieces  
C. 16.0 pieces  
D. 15.3 pieces

Camila has to calculate how many amps of current is required for a 10,000 kW load from a 220-volt ac system with a power factor of 0.8. To begin, Camila must multiply 220 volts by the power factor of 0.8. What would this number be?

A. 17.6  
B. 176  
C. 1760  
D. 17,600

Pete has to rig a 1,300-pound transformer up to the top of a pole. If he uses a 3/8-inch polypropylene rope, he can pick up 1.4 times more weight than the 3/8-inch nylon rope he had planned on using. If the 3/8-inch nylon rope can pick up 1,300 pounds, how many additional pounds can Pete pick up using the 3/8-inch polypropylene rope?

A. 1,820 lbs  
B. 2,598 lbs  
C. 520 lbs  
D. 1,300 lbs

Ernesto and the line crew are troubleshooting a loss of power at a customer’s pizza business. The crew identified that the 25-amp fuse has failed. The crew needs to determine if the 25-amp fuse is the correct size by calculating the current needed to run the pizza ovens at the business. To begin, they must multiply the supply voltage of 110 volts by a power factor of 0.8. What would this result be?

A. 0.88  
B. 8.8  
C. 88  
D. 880
Tom has to calculate the number of transformers for a residential neighborhood. The average demand for the 12 houses in the neighborhood is 3,500 watts each. The calculation requires multiplying the number of houses by the average demand divided by 1,000, which equals 42. Tom must now multiply by a factor of 0.067 to determine the need. How many transformers are required for this neighborhood? (Round up to the nearest whole number.)

A. 2 transformers
B. 12 transformers
C. 3 transformers
D. 4 transformers

Jack was asked to calculate the amount of current (amps) needed to light 10, 60-watt bulbs. These bulbs use a 120-volt system with a power factor of 0.93. To get the current, he has to divide the total watts (600) by the product of the voltage times the power factor, or 600 divided by (120 * 0.93). Thus, the current is calculated by dividing 600 watts by 111.6 volts. How much current did Jack determine was needed to light the 10 bulbs?

A. 4.65 amps
B. 5.38 amps
C. 0.54 amps
D. 0.47 amps
Multiplying and Dividing by Powers of 10

Pete is ordering new materials for the warehouse. He has identified that the warehouse is very short on bolts used to attach equipment to utility poles. Each box of bolts contains 12 bolts. Pete has determined he needs 100 bolts for the warehouse. How many bolts is Pete ordering?

A. 120 bolts  
B. 100 bolts  
C. 1,200 bolts  
D. 1,000 bolts

Camila is working on a power upgrade project for a downtown area of the city. The energy use of all the customers on the circuit is 1,000 watts/hour. Camila has to calculate the energy use of all the customers over a 5.5-hour period. How much power did the downtown area use over the 5.5-hour period?

A. 5,500 watts  
B. 550.0 watts  
C. 55.0 watts  
D. 5,5000 watts

Val is using a handheld temperature sensing tool to detect abnormal temperature conditions in a boiler. After taking the reading, the temperature indicated 90.15°F when the boiler was shut down. If the temperature increases by a factor of 10 when it is operating, what would be the new reading?

A. 0.9015°F  
B. 9.015°F  
C. 901.5°F  
D. 900.0°F

Camila is calculating the energy use of a large industrial customer over a 5.5-hour period. The customer uses 10,000 kW/hour, so how many kW of energy did the customer use in a 5.5-hour time period?

A. 55,000,000 kW  
B. 55,000 kW  
C. 550.0 kW  
D. 55.0 kW
Tim, a power system control technician, received an alarm of an under-voltage condition on the electrical system. The normal voltage on the system is 13.6 kV. Tim’s reading indicates voltage dropped by 1/1000. What would be the system voltage?

A. 0.0136 kV  
B. 0.136 kV  
C. 0.00136 kV  
D. 1.36 kV

Alex is monitoring the transmission system during a winter storm. The system voltage is normally 345,000 V. During the storm, the system voltage shows a momentary drop by 1/1000 times smaller and immediately returns to normal system voltage. What were Alex’s instruments indicating the system voltage was during the momentary drop in power?

A. 345 volts  
B. 345,000 volts  
C. 34.5 volts  
D. 3.45 volts

Camila is working on determining the size of a transmission line to provide the energy needs of a town with 10,000 households. If each household uses 1,000 watts on average, what must the transmission line provide on average?

A. 100,000 watts  
B. 10,000 watts  
C. 1,000,000 watts  
D. 10,000,000 watts

Bill is determining the impedance in an a.c. circuit. The impedance is the voltage divided by the current. Bill measures 240 volts in the circuit with 0.009 amps, which equals 26,667 ohms of impedance. What would be the ohm of impedance reading if the amps were increased 10,000 times larger?

A. 26,667 ohms  
B. 266.67 ohms  
C. 2,666.7 ohms  
D. 2.6667 ohms
Craig is a system operator. A storm has hit the utility company service territory, causing major customer outages. On a normal day, there are about 32 customer outages at any one time. During this storm, the outages are 10,000 times greater. How many customers are without power during the storm?

A. 3,200 customers  
B. 3,200,000 customers  
C. 32,000 customers  
D. 320,000 customers
Basic Operations with Whole Numbers and Decimals (Plant Operator)

Scenario

A new diesel fuel storage tank is being considered for the plant backup/peaking generators. Jeanne, a plant operator, will be involved in checking and maintaining this fuel storage, as well as the fuel contained therein. The old tank held 157 cubic feet of fuel and the new tank holds 314 cubic feet of fuel.

Jeanne has participated in a discussion of adding the new tank as well as keeping the old tank. What would be their combined capacity in cubic feet?

A. 451 ft$^3$
B. 461 ft$^3$
C. 481 ft$^3$
D. 471 ft$^3$
Problems
Adding and Subtracting

Jeanne is overseeing the installation of a new diesel fuel storage tank. The old tank held 157 cubic feet of fuel and the new tank holds 314 cubic feet of fuel. How much additional volume in cubic feet of fuel does the new storage tank hold when compared to the old storage tank?

A. 147 ft$^3$
B. 157 ft$^3$
C. 167 ft$^3$
D. 177 ft$^3$

As part of her duties, Jeanne records the reading on the cumulative engine hours indicator on each of the diesels monthly. She notes that the diesels ran 249.7 hours in March and 367.2 hours in April. How many additional hours did it run in April when compared to March?

A. 107.5 hours
B. 127.5 hours
C. 117.5 hours
D. 118.5 hours

As part of her duties, Jeanne records, computes, and logs the engine hours on each of the diesels monthly. If one engine logged 125.7 hours and the other engine logged 124.9 hours, what was the total running time for both engines for the month?

A. 249.5 hours
B. 248.6 hours
C. 249.6 hours
D. 250.6 hours

The engine running time indicator resembles an automotive odometer that records total vehicle miles. The running time indicator rolls over every 1,000 hours from 999.9 to 000.0. If Jeanne records a reading of 897.6 in April and 132.4 in May, what was the total running time between the two readings?

A. 234.8 hours
B. 248.6 hours
C. 765.2 hours
D. 1,030 hours
**Multiplying and Dividing**

Jeanne knows the new diesel fuel tank is holding 342 cubic feet of fuel and, at the current temperature, the fuel weighs 60 pounds per cubic foot. How many pounds of fuel are in the tank?

A. 20,420 lbs  
B. 20,520 lbs  
C. 19,520 lbs  
D. 19,420 lbs

Jack, a plant operator, has been asked to estimate the amount of lubricant remaining in a 40-gallon drum. He weighed the drum and subtracted the weight of an identical empty drum to determine that the remaining lubricant weighed 176 pounds. He also found that a 1-gallon sample weighed 8 pounds. How many gallons of lubricant remain in the drum?

A. 24 gallons  
B. 23 gallons  
C. 22 gallons  
D. 21 gallons

Because diesel fuel is delivered to the plant in gallons, Jeanne needs to calculate the number of gallons the new 342 cubic foot tank holds. If one cubic foot has a volume of 7.48 gallons, how many gallons, to the nearest gallon, can the new tank hold?

A. 2,558 gallons  
B. 2,568 gallons  
C. 2,158 gallons  
D. 3,268 gallons
Multiplying and Dividing by Powers of 10

Jeanne needs 2,850 feet of #10 AWG wire for a plant upgrade. She locates a pallet containing 10 reels of #10 AWG wire and each reel contains 250 feet. How many feet of #10 AWG wire has she found?

A. 200 ft  
B. 2,250 ft  
C. 2,500 ft  
D. 2,8500 ft

Jack is asked to log the energy in Megawatt-hours (MW-h) on one of the larger generators in the plant. Its energy instrument currently reads 3,141,592.2 kilowatt-hours (kW-h). Since 1 MW-h is equivalent to 1,000 kW-h, how many MW-h should he report?

A. 3,141.4 MW-h  
B. 3,141 MW-h  
C. 3,141.5 MW-h  
D. 3,141.6 MW-h

To prevent the formation of boiler scale, an additive is added to the water at a rate of 100 parts per million (ppm) by weight. How many pounds of water should Jessica, a plant operator, use to dilute 1 pound of additive to the correct concentration?

A. 100 lbs  
B. 1,000 lbs  
C. 10,000 lbs  
D. 100,000 lbs
Basic Operations with Whole Numbers and Decimals (Pipefitter/Pipelayer/Welder)

Scenario

“Hey, Harvey,” Jeff, a gas distribution mechanic, says as he gets ready to start his day. “Are we getting a shipment in today?”

“Yes, looks like we are getting a valve, some bolts and flanges, and about 134 pounds of other supplies.”

“I think the forklift could handle lifting all of those off the truck at the same time, right?”

“The valve is large and weighs 1,573 pounds, and the box of bolts and flanges is 210 pounds. Add those to the 134 pounds of other supplies, and you have your answer.”

How many pounds of material will Jeff unload with the forklift if he unloads all the items at once?

A. 1,603 lbs
B. 1,707 lbs
C. 1,783 lbs
D. 1,917 lbs

Jeff and Harvey will be unloading gas equipment. Courtesy the EPA, image is in the public domain.
Problems
Adding and Subtracting

Mariana is going out on a gas installation job on a busy highway. She has to make sure the crew has sufficient cones to put the entire traffic pattern in place to protect the crew. Mariana needs 20 cones leading up to the trucks, 15 cones alongside the trucks and 22 cones after the trucks. How many cones should Mariana load on to the truck to cover the entire traffic pattern?

A. 42 cones
B. 37 cones
C. 35 cones
D. 57 cones

Harry is resupplying a gas truck with bolts. He has several different sizes to put in the truck bins. Harry has 20 3/8x5-inch bolts, 32 1x5-inch bolts, 18 3/4x5-in bolts, and 24 3/8x6-inch bolts. How many bolts is Harry loading into the truck bins?

A. 94 bolts
B. 70 bolts
C. 76 bolts
D. 74 bolts

Jill is doing a pipe fusion on plastic pipe being installed in a new gas system. The pipe specifications require that before the pipe is fused, the fusion machine must be heated to 480° F. The machine is currently reading 233° F. How many more degrees does the machine have to heat up to get to the required temperature of 480° F?

A. 250° F
B. 257° F
C. 247° F
D. 253° F
Mary and the gas crew are performing valve maintenance at a gate station. The valve body bolts are 1-inch bolts that need to be torqued to 1,392 foot-pounds. The crew has torqued the bolts to 1,199 foot-pounds. How many more foot-pounds does the crew have to torque the bolts to reach the torquing requirements?

A. 193 ft-lbs  
B. 93 ft-lbs  
C. 190 ft-lbs  
D. 1,392 ft-lbs

Jim is preparing to complete a welding job using an E-80 welding rod. The rod is always kept in a warming oven set at 200 to 250°F. Unfortunately the welding rod was damp and needed to be reconditioned in an oven set at 600 to 750°F. What is the heat range that Jim needs to increase the oven temperature in order to recondition the welding rod?

A. 200 to 250°F  
B. 300 to 400°F  
C. 400 to 500°F  
D. 500°F

Tyrone has to weld 2 pieces of plate together to cover a gas trench in the main road. He has one piece of plate that is 0.969 inches thick and a second plate that is 0.156 inches thick. When Tyrone is finished welding the plates together, what will be the total thickness of the plate?

A. 1.125 in  
B. 1.11 in  
C. 0.1125 in  
D. 1.119 in

Gail is doing a butt joint weld between two plates of steel. Her supervisor reviewed the weld, and he determined that the weld had an insufficient amount of weld bead. The weld bead should have been 5/16 of an inch, or 0.3125 inches, but was only 3/16 of an inch, or 0.1875 inches. How big a weld bead does Gail have to add to get the butt joint to the correct size?

A. 0.13-in bead  
B. 0.125-in bead  
C. 0.1350-in bead  
D. 0.15-in bead
Multiplying and Dividing

Joe and the gas crew are replacing old cast iron piping with plastic piping. They must replace 7 lengths of 16 feet cast iron pipe. How many feet of plastic pipe does the crew need to complete the job?

A. 112 ft  
B. 56 ft  
C. 72 ft  
D. 23 ft

Tom has to rig some pipe on a truck. He only has a sling made of 5/8-inch nylon rope. Tom calculates the rope’s safety limit in the following way: 25 x 60 = safe weight of lift. Based on Tom’s calculation, what is the safety limit of the nylon rope?

A. 300 lbs  
B. 600 lbs  
C. 1,500 lbs  
D. 750 lbs

Craig is working with the gas crew installing a new plastic piping system in a residential neighborhood. The system is 1,800 feet long and there is a tap for the houses every 75 feet. How many taps does Craig have to install to complete a connection for every house?

A. 20 taps  
B. 25 taps  
C. 24 taps  
D. 22 taps

Ken is installing a new piping system, which requires a valve for every 300 feet of pipe. If there are 15,000 feet of pipe in the system, how many valves does Ken need to be install?

A. 50 valves  
B. 5 valves  
C. 500 valves  
D. 60 valves
Alex is doing a welding job on a 1/2-inch piece of plate steel. In order to determine how many pounds of welding rod he will need, Alex will need to multiply the thickness of the plate by the weld angle by how many feet of weld bead is required. In this case, Alex is welding a 1/2-inch plate with a 0.45 weld angle and needs 10 feet of weld bead. How many pounds of welding rod will Alex use to complete the job?

A. 2.0 lbs  
B. 2.25 lbs  
C. 22.5 lbs  
D. 0.225 lbs

Ned’s crew is calculating the design pressure of a 12-inch steel pipe. The calculation for the design pressure = (2 * Operating Pressure * Wall Thickness) / Outside Pipe Diameter. Ned’s crew has the following numbers: 35,000 psi operating pressure, 0.281-inch wall thickness, and 12.75-inch outside diameter. After multiplying the first three numbers together, this calculation reduces to: 19,670 / 12.75 = design pressure. What number would Ned’s crew report as the design pressure?

A. 1543 psig  
B. 15,427 psig  
C. 154.3 psig  
D. 15.427 psig

Regina is fitting a new high-pressure gas distribution piping system today, which is 80 times as much pressure as the 0.4 psi-rated residential pipes she usually works with. What is the new piping’s psi rating?

A. 30 psi  
B. 32 psi  
C. 3.2 psi  
D. 300 psi
Kelly is a gas system operator responsible for monitoring the flow rate of natural gas through the transmission system pipeline. The normal flow into the region is 4,300,000 cubic feet/day. Kelly knows that during the summer time, the rate decreases by 1/100 based on warmer temperatures. What flow rate would Kelly expect to report during the summer months?

A. 4,300 ft\(^3\)/day  
B. 43,000 ft\(^3\)/day  
C. 430,000 ft\(^3\)/day  
D. 430,000,000 ft\(^3\)/day

Pete is monitoring gas customers who don’t have gas, called an outage, related to a valve failure in the system. The current number of outages is 428 customers. In order for the valve to be repaired, the gas system has to be shut down for a couple of hours. The resulting shut down is going to increase the number of outages to 100 times more customers. How many customer outages is Pete expected to report?

A. 42 outages  
B. 428 outages  
C. 4280 outages  
D. 42,800 outages

Kathy is making a bulk order to restock the warehouse with plastic pipe fittings. Each box of fittings has 18 taps. She needs 10,000 boxes. How many taps is Kathy ordering?

A. 18,000 taps  
B. 1800 taps  
C. 180 taps  
D. 180,000 taps

A gas transmission line transports 53,000,000 cubic feet/year of natural gas. The gas is evenly distributed to 100 major customers. How many cubic feet/year does each customer use on average?

A. 53,000 ft\(^3\)/year  
B. 50,000 ft\(^3\)/year  
C. 530,000 ft\(^3\)/year  
D. 5,300 ft\(^3\)/year
Harry and the gas crew are doing a system upgrade to replace old class 150 carbon steel pipe with new class 900 carbon steel pipe. The working pressure of the class 150 carbon steel pipe was 150 psig. The new pipe increases the psig by 10 times. What would be the new operating pressure of the system based on this piping upgrade?

A. 9,000 psig  
B. 3,000 psig  
C. 1,500 psig  
D. 15,000 psig

Tom and the gas crew are monitoring corrosion on steel gas pipelines. A month ago the metal loss calculated for the pipe was 0.043 pounds. The crew has noticed an increase in the corrosion rate based on an increase in stray voltage on the system. The new rate is 10 times faster than measured a month ago. What new metal loss would the crew report?

A. 0.0430 lbs  
B. 0.0043 lbs  
C. 43 lbs  
D. 0.43 lbs

Kathy is calculating the gas use of a large industrial customer. The customer used 55,000 cubic feet in a 5.5-hour period. If the customer shuts down all of their large furnaces, the consumption is reduced by 1/1000. What would be the amount of consumption reduction?

A. 5,500 ft³  
B. 55,000 ft³  
C. 550.0 ft³  
D. 55.0 ft³

Alex is monitoring the volume in the liquefied natural gas tank. The normal volume of the tank is 190,000 gallons. Alex received an alarm that indicates the volume decreased by 1/1000. How many gallons did the volume decrease?

A. 190 gallons  
B. 1,900 gallons  
C. 19,000 gallons  
D. 19 gallons
Kathy is working on a gas system upgrade to support the installation of a new transmission line in her area. The flow of natural gas in the current piping system is 5,300 cubic feet/year of natural gas. The transmission pipe is expected to increase to 10,000 times more flow of natural gas. What would be the new gas flow rate through the system?

A. 53,000,000 ft³/year  
B. 5,300,000 ft³/year  
C. 530,000 ft³/year  
D. 53,000 ft³/year

Craig is a gas system operator. A leak in the system has forced the operators to shut off the gas to a city in the company's territory. On a normal day there are about 3 customer outages at any one time. During this system shutdown, the gas outages have increased to 10,000 times more customers. How many customers are without gas during this system shutdown?

A. 3,000 customers  
B. 3,000,000 customers  
C. 30,000 customers  
D. 300,000 customers
Basic Operations with Whole Numbers and Decimals (Technician)

Scenario

“Hey Melissa, ready to finish up the Motor Control Unit checks?” Gabriel, an electrician, asks Melissa, another electrician, after coming back from lunch.

“Yep, I am ready to go,” responds Melissa. “How many MCUs did we check this morning?”

“Let’s see, I show we inspected 39 units.”

“Okay, we had to check a total of 63 MCUs, so we should be able to finish up this afternoon.”

How many MCUs do Gabriel and Melissa have left to check?

A. 14 MCUs
B. 24 MCUs
C. 34 MCUs
D. 44 MCUs
Problems
Adding and Subtracting

Melissa and Gabriel are electricians in a power plant. They have been given the task of checking the Motor Control Units (MCUs) in three motor control centers (MCCs). The first MCC has 24 MCUs, the second MCC has 18 MCUs, and the third MCC has 12 MCUs. How many total MCUs will they need to check?

A. 42 MCUs
B. 36 MCUs
C. 54 MCUs
D. 72 MCUs

Demetra and Henry, two power plant electricians, are inspecting electrolyte fluid levels in battery cells. They noted several low levels in the battery cell banks and are using fluid to refill them. They use 5 pints to fill one bank of cells, 8.5 pints in the next bank of cells, and 4.5 pints in the last bank of cells. If they had 50 pints of electrolyte fluid to start with, how much electrolyte fluid do they have left?

A. 18 pints
B. 21 pints
C. 32 pints
D. 37 pints
Multiplying and Dividing

Brian is an electrician in a power plant. He has been given the task of replacing filters in air handling units for 5 battery rooms. Each air handling unit needs 16 filters to clean the incoming air. How many filters will Brian need?

A. 21 filters  
B. 40 filters  
C. 65 filters  
D. 80 filters

Dominique, an electrician, has been assigned an assistant named Henry. Together they can change 32 filters in an 8-hour period. How many total filters can they change in 1 hour?

A. 24 filters  
B. 16 filters  
C. 4 filters  
D. 2 filters

Mia is planning for an upcoming job and knows that two electricians working together can inspect, clean, and test a Motor Control Unit (MCU) in 2 hours. How many MCUs could the two electricians inspect over the course of a 40-hour workweek?

A. 10 MCUs  
B. 20 MCUs  
C. 40 MCUs  
D. 80 MCUs

Electricians Jimmy and Scott are assigned the task of inspecting all the spare electric motors stored in the warehouse. Together the two electricians can inspect 12 motors per hour. If they have 5.5 hours left in the day to work on the task, how many motors can they complete in the remaining time?

A. 58 motors  
B. 60 motors  
C. 66 motors  
D. 72 motors
Multiplying and Dividing by Powers of 10

Val, a boiler maker, is using a handheld temperature sensing tool to detect abnormal temperature conditions in a boiler. After taking the reading, she noted the temperature was 90.15°F above ambient when the boiler was shut down. If the temperature increases by a factor of 10 above ambient when it is operating, what would the operating temperature be?

A. 1,101.5°F  
B. 100.15°F  
C. 1,001.5°F  
D. 901.5°F

Jack, a technician, is asked to log the energy in megawatt-hours on one of the larger generators in the plant. Its energy instrument currently reads 3,141,000 kW-h. Since 1 Megawatt-hour (MW-h) is equivalent to 1,000 kilowatt hours (kW-h), how many MW-h should he report?

A. 3,141,000 MW-h  
B. 3,141 MW-h  
C. 3.141 MW-h  
D. 31,410 MW-h

Brian, an electronics technician, has been asked to check out a voltage amplifier that is supposed to have a gain of 10,000. He measures the amplifier input and records a reading of 100 microvolts (0.000100 volt). If the amplifier is operating properly, what voltage would Brian expect to find at its output?

A. 1 volt  
B. 10 volts  
C. 0.1 volt  
D. 0.01 volts
Math Review

Scenarios and Problems

Student Guide

Module 3: Forms of Fractions

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Forms of Fractions (Lineworker)

Scenario

“Hi, Leala,” Stan says as he sees Leala, an electrician, returning from the field. “How much oil did you use on those transformers?”

“I only had to add oil to the transformers at the Perry St. substation. Let’s see, looks like one needed a whole gallon, the second only took about 1/3 of a gallon, and the last used about 1/2 of a gallon.”

Leala could report that she used 1 1/6 gallons of oil. Instead of 1 1/6 gallons of oil, which of the following could Leala say?

A. 1 1/3 gallons of oil
B. 1 1/6 gallons of oil
C. 1 5/6 gallons of oil
D. 1 2/3 gallons of oil
Problems
Identifying and Writing Fractions

Tom has 4 pole inspections to do and has completed 3 inspections. What fraction of the pole inspections has Tom completed?

A. 75% of the inspections
B. 3/4 of the inspections
C. 4/3 of the inspections
D. 13% of the inspections

Kemen is pulling wire for an upgrade project. Kemen and the crew have pulled 400 feet of the 500 feet required to complete the job. What fraction of the wire pulling has the crew completed?

A. 75% of the wire
B. 500/400 of the wire
C. 4/5 of the wire
D. 25% of the wire

Laura's crew is settling poles for a power upgrade project. The crew has set 5 of the 8 poles for the project. What fraction of the total project has the crew completed?

A. 63% of the project
B. 5/8 of the project
C. 8/5 of the project
D. 16% of the project
Changing Improper Fractions to Mixed Numbers

Gail is an electrician assigned to monitor oil levels in the network transformers. Gail notes that the transformers had 2/5 of a gallon added last month and she is adding 4/5 of a gallon during her current inspections. Instead of logging 6/5 of a gallon being added over the last 2 months, which of the following could Gail use to accurately report as the amount of oil added in the last 2 months?

A. 1 gallon
B. 1 1/5 gallon
C. 1 2/5 gallon
D. 2/5 of a gallon

Ned is adding SF6 gas to gas-cooled transformers in a transmission substation. Ned notes that the last three additions were 1/3 of a bottle, 4/5 of a bottle, and 4/5 of a bottle. Besides reporting 29/15 of a bottle of SF6 gas was added in the last three months, which of the following could Ned also use to accurately report the amount of SF6 gas used?

A. 2 bottles
B. 1 bottle
C. 1 14/15 bottles
D. 1 1/15 bottles

The line crew is using wedge fittings to tie in transformers for a new overhead line system. The crew has 18 wedge connectors total, nine on each of the two line trucks. One crew has used 4/9 of the wedge connectors and the other crew has used 6/9 of the wedge connectors. Instead of saying 10/9 of the connectors were used, which of the fractions below could be used to report the connectors that were used?

A. 1 1/3 of the connectors used
B. 1 1/9 of the connectors used
C. 33% of the connectors used
D. 8/9 of the connectors used
Changing Mixed Numbers to Improper Fractions

Alex is doing a splice for an underground service. He used a 1 3/4-inch splice on one end and due to cable damage, had to use a 3 2/3-inch splice on the other end. Instead of reporting 5 5/12 inches of splice being used, Alex could use which of the following to report the amount of splice used in inches?

A. 37/12 in of splicing material  
B. 65/12 in of splicing material  
C. 22/12 in of splicing material  
D. 5 5/12 in of splicing material

Leala is an electrician required to add oil to the transformers in a substation. Leala added the following amount of oil to three transformers: one transformer needed 1 gallon of oil, another needed 1/6 of a gallon, and the last transformer needed 2/3 of a gallon. Leala could report that she used 1 5/6 of a gallon. Instead of 1 5/6 of a gallon, which of the following could Leala also say?

A. 35/6 of a gallon  
B. 11/6 of a gallon  
C. 6/11 of a gallon  
D. 1.75 gallons

Ken is required to inspect the hot sticks of three line trucks. On the first truck, Ken finds 3/5 hot sticks pass inspection. On the second line truck, 3/4 of the hot sticks pass inspection. One the third truck, Ken finds 1/2 of the hot sticks pass inspections. Instead of saying that 1 17/20 of the hot sticks passed inspection, which of the following could Ken say?

A. 37/20 of the sticks passed  
B. 7/11 of the sticks passed  
C. 17/20 of the sticks passed  
D. 38/12 of the sticks passed
Renaming Fractions to Lowest Terms

Jim is checking the grounding wire spools in two of the line trucks. Jim notes that in one truck, 2 of the 6 spools have been used. What fraction of the grounding wires spools have to be replaced to restock the truck?

A. 2/3 of the spools
B. 3/3 of the spools
C. 3/4 of the spools
D. 1/3 of the spools

Holly and the line crew are setting poles for a power upgrade. The crew is required to set 30 poles and they have completed 6 of them. What fraction of the poles has been set?

A. 4/5 of the poles
B. 20% of the poles
C. 1/5 of the poles
D. 1/6 of the poles

The line crew is using wedge fittings to tie in transformers for a new overhead line system. The crew has 18 transformers to tie in and each transformer uses 1 wedge connector. The crew has completed 8 of the 18 transformers. What fraction of the 18 wedge connectors has been used?

A. 47% wedge connectors
B. 10/18 wedge connectors
C. 53% of the wedge connectors
D. 4/9 of the wedge connectors
Forms of Fractions (Plant Operator)

Scenario

“Where are we at with the coal usage for the day?” asked Byron, a new plant operator, as he began his shift.

“We have used all of Silo #1, which holds 200,000 cubic feet of coal,” Cassandra, the current plant operator, responds. “And it looks like we have 25,000 cubic feet of coal remaining in Silo #2, which holds 250,000 cubic feet.”

What fraction of Silo #2 is full?

A. 1/8 full
B. 1/10 full
C. 2/5 full
D. 1/4 full
Problems
Identifying and Writing Fractions

Cassandra, a plant operator, has inspected 3 of the total 4 boilers in the plant. What fraction of the boilers has she inspected?

A. 4/3 of the boilers
B. 3/4 of the boilers
C. 75% of the boilers
D. 67% of the boilers

Devon, a plant operator, reduced plant power to 400 MW due to decreased demand. If the maximum rated power for the power plant is 500 MW, at what fraction of maximum power is the plant operating?

A. 4/5 of maximum power
B. 4/9 of maximum power
C. 2/5 of maximum power
D. 100 MW
Changing Improper Fractions to Mixed Numbers

While compiling the weekly usage reports, Devon noted that 2/3 gallons of the chemical water additive had been added twice. Besides saying that 4/3 of a gallon had been used, which of the following could Devon also accurately say had been used?

A. 3/4 gallon
B. 1 1/3 gallons
C. 2 1/3 gallons
D. 4 1/3 gallons

Cassandra, a plant operator, noted that the coal usage for the past 24 hours was 5/8 of Silo #2 and 7/8 of Silo #4. Besides recording that 12/8 of the total silo volume was used, which of the following could she say was used during the 24-hour period?

A. 2/8 of the total silo volume
B. 1 3/8 of the total silo volume
C. 1 1/2 of the total silo volume
D. 1 2/8 of the total silo volume
Changing Mixed Numbers to Improper Fractions

Devon was getting ready to order grease for the equipment maintenance shop. He noted that during the first quarter, \( \frac{1}{2} \) of a barrel of grease was used, and during the second quarter, \( \frac{3}{4} \) of a barrel of grease was used. Instead of saying 1 1/4 barrels of grease was used, which of the following could he also say was used?

A. 1 1/4 barrels
B. 5/4 barrels
C. 5/2 barrels
D. 4/8 barrels

While overhauling the plant’s three boilers, insulation tiles were replaced. Boiler #1 took 3/4 pallet of tiles, Boiler #2 took 5/8 pallet, and Boiler #3 took 1/2 pallet of tiles. If 1 7/8 pallets of tiles were used, how else could the used amount be recorded?

A. 9/14 pallets of tile
B. 17/8 pallets of tile
C. 6/8 pallets of tile
D. 15/8 pallets of tile
Renaming Fractions to Lowest Terms

Devon, a plant operator, is currently using 2 of the plant’s 4 generators for power production. What fraction of the plant’s generators is being used?

A. 3/8 of the plant’s generators
B. 1/3 of the plant’s generators
C. 2/6 of the plant’s generators
D. 1/2 of the plant’s generators

Cassandra, taking logs on the plant’s water purification system, recorded that 24 of the 32 reverse osmosis cylinders were in use and 8 were undergoing a regeneration soak. What fraction, in lowest terms, of the osmosis cylinders were in use?

A. 8/32 cylinders
B. 3/4 cylinders
C. 24/32 cylinders
D. 1/4 cylinders

The daily coal train delivery consists of 40 coal cars. If 25 coal cars have unloaded so far, what fraction, in lowest terms, of the coal cars remain to be unloaded?

A. 5/8 of the coal cars
B. 40/25 of the coal cars
C. 3/8 of the coal cars
D. 25/40 of the coal cars
Forms of Fractions
(Pipefitter/Pipelayer/Welder)

Scenario

“Hey, Tom, are you getting close to finishing?” Jim, the lead meter mechanic, asks.

Tom is applying leak detection fluid to the fittings on 8 gas meters at an apartment complex.

“Getting there. Each gas meter has 3 connections and I’ve checked 12 of the 24 connections.”

“So how much do you have left then?”

What is the remaining fraction of connections Tom has to check?

A. 11/24 of the connections
B. 1/2 of the connections
C. 24/11 of the connections
D. 13/24 of the connections
Problems
Identifying and Writing Fractions

Julie is performing weld inspections on the newly installed stainless steel gas main. Julie has 4 welds to inspect and she has completed 3 of them. What fraction of the welds has Julie inspected?

A. 75% of the welds
B. 3/4 of the welds
C. 4/3 of the welds
D. 13% of the welds

Larry is calibrating gas meters prior to use in the field. There are 10 meters to calibrate and Larry has completed 7 of them. What fraction of the meters has Larry calibrated?

A. 70% of the meters
B. 1/5 of the meters
C. 7/10 of the meters
D. 14% of the meters
Changing Improper Fractions to Mixed Numbers

Yolanda is a distribution gas mechanic who is removing liquid from traps in the gas line. Yolanda has 3 traps to drain during her shift. Yolanda has removed 3/4 of a gallon from one trap, 1/4 of a gallon from the second trap and 3/4 of a gallon from the third trap. This results in 7/4 total gallons of water removed. What is another way to report this amount?

A. 2 gallons
B. 3/4 of a gallon
C. 1 3/4 gallons
D. 1 1/4 gallons

Sam is welding together pieces of plate steel to cover a trench in a roadway and has 3 boxes of welding rods at the job site. Sam has 2 welding ovens for drying his welding rod. Sam puts 5/12 of one box of the welding rods in one oven and 9/12 of another box of welding rods in the other oven. Besides saying that Sam used 14/12 boxes of welding rods, which of the following could Sam also accurately say for the amount of welding rods he used?

A. 12 boxes of welding rods were used
B. 82% boxes of the welding rods were used
C. 1 2/12 or 1 1/6 boxes of the welding rods were used
D. 1 4/12 or 1 1/3 boxes of the welding rods were used

Chris is operating a backhoe of a gas line installation. Chris is responsible for checking and, if necessary, adding oil to the backhoe on a daily basis. Chris’ review of the recent oil check records indicates that 3/4 of a quart was added yesterday and Chris needs to add an additional 3/4 of a quart today. Besides saying that 6/4 of a quart had been added, which of the following could Chris also accurately say had been added?

A. 2/3 of a quart
B. 6/8 or 3/4 of a quart
C. 1 1/2 quarts
D. 6 1/4 quart
Changing Mixed Numbers to Improper Fractions

Harry is laying gas marking tape for a new gas service line. Harry used $\frac{1}{2}$ of a tape roll on one service and $\frac{4}{5}$ of a tape roll on another service. Instead of saying that Harry used 1 3/10 of the marker tape rolls, which of the following could he also say?

A. 13/10 of the rolls  
B. 7/10 of the rolls  
C. 5/7 of the rolls  
D. 14/12 or 7/6 of the rolls

Yolanda is a distribution gas mechanic who is removing liquid from traps in the gas line. Yolanda has 3 traps to drain during her shift. Yolanda has removed $\frac{3}{4}$ of a gallon from one trap, $\frac{2}{3}$ of a gallon from the second trap, and $\frac{1}{2}$ of a gallon from the third trap. Besides saying that she has removed 1 11/12 of a gallon, which of the following could Yolanda report as an amount of liquid removed from the traps?

A. 24/12 or 2 gallons  
B. 23/36 of a gallon  
C. 1 11/12 gallons  
D. 23/12 of a gallon

Sue is using leak detection fluid on several meter gas fittings at an apartment complex. Sue used $\frac{1}{2}$ of a quart on one set of meters, $\frac{1}{3}$ of a quart on the second meter set, and $\frac{1}{4}$ of a quart on the third meter set. Instead of reporting that Sue used 1 1/12 quarts of leaking detection fluid, which of the following could she also report?

A. 13/36 of a quart  
B. 14/12 or 7/6 of a quart  
C. 9/3 or 3 quarts  
D. 13/12 of a quart
Renaming Fractions to Lowest Terms

Pete is performing pressure checks on the gas distribution system. He has completed 2 of the 12 inspections. What fraction of the inspections has Pete completed?

A. 1/6 of the inspections  
B. 1/3 of the inspections  
C. 17% of the inspections  
D. 2/3 of the inspections

Dawn is responding to the smell of gas in a neighborhood. She has 14 houses to check and she has completed 4. What fraction of all the houses has Dawn checked for gas?

A. 1/3 of the houses  
B. 29% of the houses  
C. 1/7 of the houses  
D. 2/7 of the houses

Gail is drilling holes alongside a foundation of a house to find the source of the natural gas leak, which was reported by the home owner. Gail has to drill 14 holes and she has completed 5 of them. What fraction of the total holes has Gail completed?

A. 36% of the holes  
B. 1/3 of the holes  
C. 5/14 of the holes  
D. 7/14 of the holes
Module 4: Operations with Fractions

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Operations with Fractions (Lineworker)

Scenario

Sam is the head linesman for an overhead line crew that has been restoring power after a significant thunderstorm. His crew is on their way to the next job when he gets a call from Justin, a dispatcher.

“Hi, Sam, this is Justin. We might need some additional help on the east side of town. How much time is the crew going to have left?”

“We are 8 1/2 hours into our 16-hour shift,” Sam says. “We have four neighborhoods left: the Cascades, Whispering Pines, Middlebrook, and Stone Crest. Barring any setbacks and including travel time, we will spend 2 1/2 hours at the Cascades, 2 hours at Whispering Pines, 1 3/4 hours at Middlebrook, and 3/4 of an hour at Stone Crest.”

If Sam’s crew cannot work more than 16 continuous hours, how much time does the crew have left to help with the east side of town?

A. 1 hour  
B. 1/2 hour  
C. 5/12 hour  
D. 3/4 hour
Eve, an engineering tech, is working with an overhead line crew doing thermal inspections of the line taps in an industrial park. The crew did 2/3 of the taps in one section of the park and 1/5 of the taps in a different section. What fraction of the taps has Eve and the crew inspected?

A. 2/15 of the taps  
B. 3/10 of the taps  
C. 13/15 of the taps  
D. 3/4 of the taps

The line crew is running ground wires for overhead sensing insulators. The crew used 1/2 of a spool for one job, 1/4 of a spool for another, and 1/6 of a spool for the final job. What fraction of the ground line spool remains?

A. 11/12 of a spool  
B. 1/3 of a spool  
C. 1 1/3 of a spool  
D. 1/12 of a spool

Bob is a stock handler responsible for restocking the overhead line distribution trucks at the end of the day. Bob finds one truck has 1/4 of a case of wedge connectors remaining. The other truck has 1/3 of a case of wedge connectors remaining. What fraction of a case did Bob find on the 2 trucks?

A. 1/12 of a case  
B. 1/6 of a case  
C. 2/7 of a case  
D. 7/12 of a case
### Adding and Subtracting Mixed Numbers

Zac is an electrician responsible for adding oil to network transformers. Zac has added the following amounts of oil to 5 network transformers: \( \frac{1}{2} \) of a gallon, \( \frac{1}{3} \) of a gallon, \( \frac{1}{4} \) of a gallon, \( \frac{3}{4} \) of a gallon, and \( \frac{2}{3} \) of a gallon. How many gallons of oil did Zac use to fill the 5 transformers?

A. 2 1/2 gallons  
B. 1 1/2 gallons  
C. 2 1/4 gallons  
D. 2 \( \frac{8}{12} \) or 2 2/3 gallons

René is an engineering technician working with the overhead line crew doing thermal inspections of wire taps. The crew had 19 miles of wire to inspect. During their first inspection period, the crew did 3 1/3 miles. In the second inspection period, the crew inspected 5 1/2 miles. After lunch, the crew inspected an additional 6 3/4 miles. How many miles of wire do René and the crew have left to inspect?

A. 15 7/12 miles  
B. 1 7/12 miles  
C. 3 5/12 miles  
D. 1 1/2 miles

Lynne and her line crew were notified that down ground wires are missing from multiple poles in the town. The crews have to do a drive-by inspection, identify how many poles will need new down ground wires, and record their inspections in mileage inspected. The crews completed the following mileage of inspections: 1 3/4 miles, 5 1/2 miles, 3 1/3 miles, and 8 1/6 miles. How many miles did the crews inspect?

A. 17 3/4 miles  
B. 18 miles  
C. 18 2/5 miles  
D. 18 3/4 miles
Multiplying and Dividing Fractions

Transformer visual inspections take 1/3 of an hour to complete. Pete’s line crew has 10 inspections to complete. How many hours of inspections will the crew need for all 10 of the inspections?

A. 3 1/3 hours
B. 3 hours
C. 30 hours
D. 5 hours

Holly is a stock person who is responsible for restocking the overhead trucks at the end of the day. Holly has 1/2 of a case of fuses to divide among 6 overhead line distribution trucks. What fraction of the fuse case will be put on each of the trucks?

A. 1/12 of the case
B. 1/6 of the case
C. 1/3 of the case
D. 1/9 of the case

Tom’s overhead line distribution crew is responding to a power outage impacting 52 residential customers. The crew estimates that each customer’s restoration will take about 1/5 of an hour. How many hours will it take Tom’s crew to restore all the customers?

A. 10 1/5 hours
B. 10 hours
C. 10 2/5 hours
D. 10 3/5 hours
Multiplying and Dividing Mixed Numbers

Sarah and the overhead line crews are performing patroller inspections after a storm passed through a portion of the town. The crew has 5 1/3 miles to patrol. Sarah decided to split the crew into 4 separate teams to speed up the inspections. How many miles does each crew have to inspect?

A. 1 1/3 miles  
B. 1 1/2 miles  
C. 1 2/7 miles  
D. 2 2/3 miles

Gail has 5 1/4 gallons of oil that she will distribute evenly into 6 network transformers. What amount of oil will Gail add to each transformer?

A. 3/4 of a gallon  
B. 7/8 of a gallon  
C. 1/8 of a gallon  
D. 1/6 of a gallon

Darren has 3 2/3 boxes of 100-amp fuses on the line trucks, but the overhead line distribution crew needs 4 times as many boxes to respond to a significant power outage. How many boxes of 100-amp fuses does Darren have to get out of the warehouse to restock the line trucks as the overhead linemen requested?

A. 14 2/3 boxes  
B. 12 2/3 boxes  
C. 14 1/3 boxes  
D. 13 2/3 boxes
Operations with Fractions (Plant Operator)

Scenario

“Hi, Devon. Looks like we have two generators going right now,” Jeannine, a plant operator, says as she comes on for her shift.

“Yes, they are the 10 Megawatt generators,” Devon replies.

“How is our cooling water flow looking for the two?”

“Looks like Generator #1 is receiving about \( \frac{5}{12} \) of the total available cooling water and Generator #2 is receiving about \( \frac{1}{3} \) of the total available cooling water.”

“So, Generator #1 is still requiring a little more water than Generator #2.”

How much more of the total water flow is Generator #1 receiving?

A. \( \frac{2}{12} \) or \( \frac{1}{6} \) of the total water flow
B. \( \frac{3}{12} \) or \( \frac{1}{4} \) of the total water flow
C. \( \frac{1}{12} \) of the total water flow
D. \( \frac{11}{12} \) of the total water flow
Problems
Adding and Subtracting Fractions

Enrique, a plant operator, is reviewing a parts inventory and sees that there are two cases of spare air filters. The first case was 1/2 full and the second was 1/3 full. What is the total number of cases available in inventory?

A. 5/6 cases
B. 2/5 cases
C. 2/3 cases
D. 1/6 cases

The coal train had two cars with only partial loads. One was 2/5 full and the other was 1/5 full. If both loads were placed in one coal car, how full would it be?

A. 3/10 full
B. 3/5 full
C. 2/25 full
D. 1/5 full

Two partial train cars of coal were delivered today. By weight, the first car was 13/32 full and the second was 5/8 full. What is the sum of the two carloads?

A. 5/32 full carload
B. 1 1/32 full carload
C. 20/32 or 5/8 full carload
D. 10/32 or 5/16 full carload

A 200,000-cubic-foot coal silo started the shift at 7/8 full volume. During the shift, half of the total silo volume was used. How much, by fraction of volume, is left in the silo?

A. 1/2 total silo volume
B. 1/8 total silo volume
C. 3/8 total silo volume
D. 5/8 total silo volume
During a recent inspection of the water purification system, 1/8 of the purification columns were undergoing scheduled maintenance, and an additional 1/8 of the columns were offline and needed to be back-flushed due to low flow rates. What fraction of the total purification columns is still available for use?

A. 2/8 or 1/4 of the columns
B. 6/8 or 3/4 of the columns
C. 2/16 or 1/8 of the columns
D. 1/2 of the columns
Adding and Subtracting Mixed Numbers

Kari, a new plant operator, is preparing her work plans for the day. The two jobs she was assigned each came with procedure cards that listed materials needed, estimated time for completion, and the steps of the procedure listed out. If the first job had an estimated time of 2 1/2 hours and the second was estimated to take 1 3/4 hours, how many total estimated hours of maintenance was Kari assigned?

A. 3 2/3 hours  
B. 4 1/4 hours  
C. 4 1/2 hours  
D. 3 1/4 hours

A monthly tally of the bottom ash shipped back to the coal company showed that two shipments were sent. The first shipment sent 10 1/3 rail cars of ash and the second sent 12 5/6 rail cars of ash. How many total rail cars of ash were sent for the month?

A. 22 6/9 or 22 2/3 rail cars  
B. 23 1/3 rail cars  
C. 24 2/6 or 24 1/3 rail cars  
D. 23 1/6 rail cars

While reviewing inventory, Enrique noted there were 16 1/2 gallons of lube oil for the back-up generator. If the generator takes 8 3/4 gallons of oil, how much oil will be left in inventory after the next generator oil change?

A. 8 1/4 gallons  
B. 7 3/4 gallons  
C. 7 1/2 gallons  
D. 8 1/2 gallons

After recording the air compressor’s run time for the week, Kari noted that last week’s total run time was 2,356 7/10 hours and this week’s total run time is 2,395 3/10 hours. How many more hours did the air compressor run this week than last week?

A. 41 4/10 or 41 2/5 hours  
B. 42 1/10 hours  
C. 38 6/10 or 38 3/5 hours  
D. 39 5/10 or 39 1/2 hours
Multiplying and Dividing Fractions

Enrique, preparing for his maintenance day, sees that he has 3 water pumps that each have an estimated 1/4 hour preventive maintenance task scheduled and a tank cleaning task listed at 5 hours. If he chooses to do work on just the pumps before taking a break, how long should it take?

A. 3 hours  
B. 3/4 hour  
C. 1/2 hour  
D. 4/3 or 1 1/3 hours

Kari is performing preventive maintenance on a group of 6 hydraulic valves by changing out the hydraulic fluid. If each valve has a hydraulic fluid capacity of 1/8 gallons, how many gallons of hydraulic fluid will Kari use?

A. 8/6 or 1 1/3 gallons  
B. 1/6 gallons  
C. 6/8 or 3/4 gallons  
D. 2/3 gallons

Enrique is restocking supplies in the 3 water testing stations and wants to distribute the 1/2 case of litmus paper packs he has in stock evenly between the sampling stations. What fraction of the case should he stock each station with?

A. 1/3 of the case  
B. 1/4 of the case  
C. 1/5 of the case  
D. 1/6 of the case

Each quarter, 1/8 of the solar cell array is bench tested for effectiveness. If the electrical shop wants to test an equal amount of the array each month of the 3-month quarter, what fraction of the total array is tested each month?

A. 1/24 of the array  
B. 3/8 of the array  
C. 1/3 of the array  
D. 3/24 or 1/8 of the array
Multiplying and Dividing Mixed Numbers

Enrique, after restocking supplies in the plant’s 4 watch stations, notes that there were 1 1/2 boxes of ear plugs at each station. How many total boxes of ear plugs were in all 4 watch stations?

A. 6 boxes  
B. 4 1/2 boxes  
C. 4/2 or 2 boxes  
D. 5 boxes

Kari is preparing for the plant maintenance shutdown by readying work packages on the generators. If the air filter replacement for each of the 3 generators takes an estimated 2 3/4 hours, how many total hours is needed to replace the air filters in the 3 generators?

A. 8 1/4 hours  
B. 6 9/12 or 6 3/4 hours  
C. 6 1/2 hours  
D. 8 1/2 hours

Enrique received 6 1/2 pallets with buckets of bearing grease. If each pallet holds 8 buckets and Enrique wants to evenly distribute the buckets to 4 plants, how many pallets should he send to each plant?

A. 13 buckets  
B. 1 5/8 pallets  
C. 1 1/2 pallets  
D. 10 buckets

Kari took 4 1/2 hours to complete a preventive maintenance task that tested the motor balance of 6 water pumps. If each pump took the same amount of time to test, how many hours did each pump’s test take?

A. 3/4 hours  
B. 1/2 hours  
C. 1 1/2 hours  
D. 1 1/4 hours
Operations with Fractions (Pipefitter/Pipelayer/Welder)

Scenario

Roberto is welding a stainless steel gas main on a new pipeline project.

“Hi, Roberto. How many welds do you have left?” Jill, Roberto’s supervisor, asks during their lunch break.

“I think I have 3 welds left. We have another 4 hours to get this job done, correct?”

“Right. Are you going to finish on time?”

“It was taking me about 1 1/2 hours to prep and finish 1 weld this morning.”

If Roberto maintains the same 1 1/2 hours per 1 weld rate, will he finish on time?

A. Yes, he’ll need 3 1/2 hours to complete the job
B. No, he’ll need 4 1/2 hours to complete the job
C. Yes, he’ll need 4 hours to complete the job
D. No, he’ll need 6 hours to complete the job
Problems
Adding and Subtracting Fractions

Jim, a welding inspector, is reviewing welds on steel plates being used to cover a trench cut through a town road. Jim found that 1/5 of the welds had undercut, which is a weld root that is left unfilled by weld metal, on one set of plates and 1/7 of the welds had undercut on the other plate. What fraction of the welds had undercut?

A. 12/35 of the welds had undercut
B. 1/6 of the welds had undercut
C. 2/35 of the welds had undercut
D. 2/12 or 1/6 of the welds had undercut

Kath was making multiple passes to complete a weld. On her first pass, Kath filled 1/2 of the gap. On Kath’s second pass, she filled an additional 1/3 of the weld gap. How much of the total weld gap has Kath filled on the 2 passes?

A. 2/5 of the weld gap filled
B. 1/6 of the weld gap filled
C. 5/6 of the weld gap filled
D. 2/6 or 1/3 of the weld gap filled

Enrique is a stock handler responsible for restocking the gas distribution trucks at the end of the day. Enrique finds one truck has 1/4 of a case of plastic gas fittings remaining. The other truck has 1/3 of a case of plastic fittings remaining. What fraction of a case has Enrique found on the 2 trucks?

A. 1/12 of a case
B. 1/6 of a case
C. 2/7 of a case
D. 7/12 of a case
Adding and Subtracting Mixed Numbers

Jill is an apprentice gas distribution mechanic. She is inspecting residential gas meters on homes in a local neighborhood. Jill has 3 1/3 miles to inspect on one street and 2 1/5 miles on another. How many miles does Jill have to inspect?

A. 5 1/8 miles  
B. 5 1/4 miles  
C. 5 8/15 miles  
D. 5 1/15 miles

Gail is completing 2 welds in the remaining 5 hours of her work day. The first weld is going to take 1 1/4 hours to prep and weld. The second weld is going to take 2 1/2 hours to prep and weld. How much time will Gail have left in the remaining 5 hours of her work day?

A. 3 3/4 hours  
B. 3 1/4 hours  
C. 1 1/4 hours  
D. 1 3/4 hours

Frank and his gas crew have responded to a gas system outage of 45 customers in a residential neighborhood. Frank has split his crew into 2 working groups to relight customer pilot lights. One crew had estimated they had relit 1/3 of the customers in the first hour. The second crew estimated they had relit 1/5 of the customers. What fraction of the customers still need to have their pilot lights relit?

A. 7/15 of the customers remain  
B. 1/4 of the customers remain  
C. 1/15 of the customers remain  
D. 8/15 of the customers remain
Multiplying and Dividing Fractions

Tom’s gas distribution crew is responding to a gas outage impacting 20 residential customers. The crew estimates 1/5 of an hour to relight each pilot light. How many hours will it take Tom’s crew to relight all the pilots?

A. 4 hours  
B. 1 3/4 hours  
C. 8 hours  
D. 5 hours

Dan and his gas distribution crew have responded to the report of a gas valve failure. The valve failure resulted in 1/3 of all the customer on the street to be without service. In order to repair the valve, the crew has to shut off the gas to 3 times as many customers on the street. What fraction of customers will be without service during this repair?

A. 2/3 of the street’s customers  
B. 1/9 of the street’s customers  
C. All the street’s customers  
D. 1/6 of the street’s customers

Marla is a stock person who is responsible for restocking the gas trucks at the end of the day. Marla has 1/2 of a case of fittings to evenly divide among 6 gas trucks. What fraction of a case of fittings will be put on each of the trucks?

A. 1/12 of a case of fittings  
B. 1/6 of a case of fittings  
C. 1/3 of a case of fittings  
D. 1/9 of a case of fittings
Multiplying and Dividing Mixed Numbers

Sue has 1 1/5 boxes of welding rods available for each of the 4 welders welding high-pressure steel gas mains. How many total boxes of welding rods does Sue have available?

A. 1 4/5 boxes
B. 4 1/5 boxes
C. 4 4/5 boxes
D. 5 boxes

Vinny and his gas crews are relighting pilot lights in an apartment complex where they repaired a gas leak. Vinny’s crews are responsible for 2 1/3 of the apartment buildings in the complex that need their pilot lights relit. Vinny has divided his crew into 4 working groups to speed up the relight process. If all groups help an equal number of buildings, what fraction of the buildings will each crew handle?

A. 1 5/7 of the buildings
B. 5/7 of the buildings
C. 7/12 of the buildings
D. 3/12 or 1/4 of the buildings

Darren has 3 2/3 boxes of plastic gas fittings. The gas distribution crew has 8 customers requiring the installation of plastic pipe into their homes. What fraction of the plastic gas fittings will be divided among the 8 customers?

A. 11/24 of the fittings
B. 1/2 of the fittings
C. 2/3 of the fittings
D. 3/8 of the fittings
Math Review

Scenarios and Problems

Student Guide

Module 5: Converting Fractions, Decimals, and Percents

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Converting Fractions, Decimals, and Percents (Lineworker)

Scenario

“Well, how far have we gone?” Frank, the head lineworker, asks Debra.

Frank and his crew are conducting thermal inspections on transformer taps in a 1-mile-long section of a residential subdivision.

“According to the GPS, we have traveled .35 miles in the first 2 hours,” Debra replies.

What percentage of the residential subdivision section had the crew inspected in the first 2 hours?

A. 3.5%
B. 7%
C. 65%
D. 35%
Problems
Converting Fractions to Decimals

Gail and the line crew were pulling wire for a new subdivision. The crew had completed 5/6 of a mile of the 1-mile wire pull. How would the crew express how much line they completed in decimal form?

A. 8.33 miles
B. 0.0833 of a mile
C. 0.833 of a mile
D. 0.00833 of a mile

Mateo and his crew were assigned to inspect transformer taps after several failures had been reported in an area rebuilt after a winter storm. Mateo found that 1/5 of all the taps that had inspected were installed incorrectly. How would Mateo express the crew's finding in decimal form?

A. 20% of the taps
B. 2.00 of the taps
C. 0.02 of the taps
D. 0.20 of the taps

Monika was assigned to patrol a 1-mile-long right-of-way to identify any damage to the electrical system after a thunderstorm. Monika had traveled about 1/8 of a mile before she was stopped by a large tree that had fallen across the electrical wires. How would Monika express the distance she had traveled as a decimal?

A. 0.125 of a mile
B. 1.25 miles
C. 12.5 miles
D. 1.25% miles
Converting Decimals to Percents

Bill is checking the current transformers on an industrial meter. The proper reading should be 1 ampere. Bill found that the current transformer was reading 0.972 amperes. How would Bill report his findings as a percentage of the proper reading of 1 ampere?

A. 97.2%
B. 9.72%
C. 0.972%
D. 0.0972%

Jane is performing oil level inspections on oil-fill substation transformers. The reading on the sight glass indicated 0.45 full. How would Jane report her findings as a percentage?

A. 4.5% full
B. 0.045% full
C. 45% full
D. 0.45% full
Converting Percents to Decimals

Karen was assigned to monitor the total amount of cable being removed from a reel during an overhead cable pulling job. Halfway through the job, Karen noted that 42% of the reel had been used. How would Karen report the percent used in decimal form?

A. 4.20 of the reel used  
B. 0.42 of the reel used  
C. 0.50 of the reel used  
D. 0.042 of the reel used

Bob and his crew were assigned to install ground rods at the base of the utility poles in a new subdivision. When the crew stopped for lunch, they had installed 66% of the ground rods and had 34% remaining. How would the crew express the amount of remaining work in a decimal?

A. 0.66 of the rods remaining  
B. 3.40 of the rods remaining  
C. 0.34 of the rods remaining  
D. 0.034 of the rods remaining

Chun works in the store room. On the night shift, her job is to inspect all the fire extinguishers on the line trucks and replace any of them that are getting ready to expire or indicate low pressure. Chun had completed 52% of the inspections during the first night of her shift and had 48% to complete on the next night. How would Chun express what she had completed as a decimal?

A. 0.48 of the inspections complete  
B. 5.20 of the inspections complete  
C. 0.052 of the inspections complete  
D. 0.52 of the inspections complete
Converting Fractions, Decimals, and Percents (Pipefitter/Pipelayer/Welder)

Scenario

“How is that weld coming along, Frank?” Danaria asks.

Frank is welding two 1-inch-thick steel plates to cover an open trench on a new gas system installation.

“Looks like I have 0.281 inches of the 1-inch weld complete,” Frank says after checking the weld depth.

How many inches deep is the weld if Frank reported it as a percentage?

A. 2.81 %
B. 0.0281%
C. 281%
D. 28.1%
Problems
Converting Fractions to Decimals

Ned is using a welding gage to read the depth of a root weld for welding two lengths of pipe together. Ned’s reading indicates 3/16 in of a root weld gap. How would Ned report his reading in a decimal?

A. 1.88 in  
B. 0.188 in  
C. 0.0187 in  
D. 0.0531 in

Martina is assigned to check gas meter calibrations at a housing complex. Martina found that 1/5 of the meters needed calibration. How would Martina report his findings as a decimal number?

A. 0.20 gas meters  
B. 2.00 gas meters  
C. 0.02 gas meters  
D. 20% of the gas meters

Laurie is restocking the gas distribution trucks with pipe fusion fittings. She found that 2/3 of the trucks needed 1 inch butt fusion fittings. How would Laurie report her findings to her supervisor as a decimal number?

A. 667% of the trucks  
B. 6.67 of the trucks  
C. 0.667 of the trucks  
D. 0.0667 of the trucks
Converting Decimals to Percents

Avery and the gas crew are installing 1 mile of new residential gas piping in a subdivision. The crew had completed 0.432 miles on the first day. What percentage of the project would Avery report to the supervisor is completed?

A. 43.2%
B. 4.32%
C. 0.432%
D. 432%

Mateo and the gas distribution crew have reported to a customer’s complaint of the smell of natural gas on a rural road. The crew is using a gas meter and has walked 0.12 miles of the 1-mile road. What percentage of the road has Mateo’s crew inspected?

A. 1.2%
B. 0.12%
C. 12%
D. 120%
Converting Percents to Decimals

Nancy and her gas distribution crew are assigned to complete 24 pipe fusions for a piping system upgrade. When the crew stopped for lunch, they had completed 8 of the fusions, or 33%. How would Nancy report what the crew had completed to her supervisor in decimal form?

A. 3.30 of the fusions completed  
B. 0.33 of the fusions completed  
C. 0.66 of the fusions completed  
D. 0.80 of the fusions completed

Chun works in the store room. During her night shift, her job is to inspect all the fire extinguishers on the gas trucks and replace any of them that are getting ready to expire or indicate low pressure. Chun had completed 65% of the inspections during the first night of her shift and had 35% to complete on the next night. How would Chun express what she had completed in decimal form?

A. 0.35 of the inspections complete  
B. 6.50 of the inspections complete  
C. 0.065 of the inspections complete  
D. 0.65 of the inspections complete

Bret is reviewing piping system drawings prior to starting the piping installation in an industrial park. The crew is in a hurry to get started, but Bret has only reviewed 62% of all the piping diagrams and he still has 38% of the drawings to review. How would Bret report to the crew in decimal form how many more drawings he needs to review prior to starting work?

A. 0.38 of the drawings  
B. 3.80 of the drawings  
C. 38.0 of the drawings  
D. 0.038 of the drawings
Math Review

Scenarios and Problems

Student Guide

Module 6: Operations with Percents

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Operations with Percents (Lineworker)

Scenario

“We are going at a pretty good pace, huh, Matt?” Jill, a lineworker, says to her supervisor as she eats her lunch.

Jill and Matt are part of a line crew pulling wire for an overhead system upgrade.

“Yes, we are. Looks like we pulled 160 feet of wire.”

“How many total feet are we pulling for this job?”

“Total is 350 feet, so we still have a little ways to go.”

What percentage of wire do Matt and his crew still have to pull for the overhead system upgrade?

A. 45.7%
B. 65.6%
C. 54.3%
D. 19%
Problems
Finding the Unknown Percent

Matt and the line crew are pulling wire for an overhead system upgrade. They have 220 feet of wire to pull. After the first two hours, they had pulled 60 feet. Sixty feet is what percentage of the entire job?

A. 45%
B. 27.3%
C. 36.6%
D. 30%

Cathy is restocking the line trucks. She has 150 wedge connectors and she is required to put 30 wedge connectors on each truck. Thirty is what percentage of 150?

A. 20%
B. 6%
C. 5%
D. 15%

Chin and his crew are adding oil to the transformers in a substation. Chin had a 55-gallon drum of oil when he started the job. His crew has added 5 gallons each to 5 transformers for a total of 25 gallons of oil. What percentage is 25 gallons of the 55-gallon barrel?

A. 45.5%
B. 54.5%
C. 22%
D. 50%
**Finding the Unknown Part**

Jack and the crew are doing pole inspections. They have completed 25% of the 60 poles the crew has to inspect. How many poles has the crew inspected?

A. 30 poles  
B. 15 poles  
C. 45 poles  
D. 25 poles

Kerri and her crew are setting a new pole. The angle of the boom on the pole setting truck is at 45°, which limits the ability of the crane to pick up 60% of the entire 4,000-pound pole weight. What is the weight the truck can lift with the boom at a 45° angle?

A. 1,600 lbs  
B. 1,800 lbs  
C. 2,400 lbs  
D. 4,000 lbs

Laura and her line crew are pulling wire for a new subdivision. The spool on the truck has 600 feet of primary copper wire. The crew used 28% of the spool in the morning. How many feet of wire did the crew use?

A. 432 ft  
B. 214 ft  
C. 386 ft  
D. 168 ft
Finding the Unknown Whole

Jack and his crew have to do thermal inspections on the connectors in a business development. The crew has completed 35%, or 63 connectors, as of their lunch break. How many total connectors does the crew have to inspect on this day?

A. 180 connectors  
B. 103 connectors  
C. 117 connectors  
D. 85 connectors

Yolanda is performing hot stick inspections. She found 5%, or 8 sticks, either needed an expired inspection label or had cracks that would impact the safety of the crew. How many total hot sticks has Yolanda inspected?

A. 100 sticks  
B. 160 sticks  
C. 40 sticks  
D. 120 sticks

Tom and his line crew are looking for a fault in a direct buried cable leading to a home. The crew has completed 30%, or 36 feet, using the pin-pointer fault detection equipment. How many feet of the total cable will the crew be inspecting?

A. 61 ft  
B. 108 ft  
C. 51 ft  
D. 120 ft
Operations with Percents (Plant Operator)

Scenario

“What are we raising the flow power to at the Hinkson Creek substation?” Jerry asks Chin, a plant operator.

“Looks like we are bringing it up to 5.4 Megawatts from 2.0 Megawatts this afternoon,” Chin responds.

“Is that a bigger increase than yesterday afternoon?”

“We increased power 150% to Hinkson Creek yesterday.”

What percentage increase in today’s power flow would Chin report to Jerry for the Hinkson Creek substation?

A. 270%
B. 27%
C. 127%
D. 340%
Problems
Finding the Unknown Percent

Chin has been asked to raise the plant spinning reserve to at least 200 MW to meet anticipated demand during the hot afternoon peak. His current spinning reserve is 120 MW. By what minimum percentage must Chin increase spinning reserve?

A. 270%
B. 180%
C. 167%
D. 80%

In order to comply with a request to raise the plant spinning reserve to at least 200 MW, Chin will have to bring a 100 MW steam turbo-generator on line that will raise the plant’s actual spinning reserve from the current 120 MW to 220 MW. By what actual percentage will Chin be increasing the spinning reserve?

A. 270%
B. 183%
C. 83.3%
D. 40%

Howard, a plant operator, has been asked to reduce his plant’s output from 100%, full power at 140 MW, to 120 MW as a large customer goes off-line for the weekend. What is the plant’s new output in percent?

A. 86%
B. 14%
C. 108%
D. 120%

Bart, a plant operator, has been asked to dispatch 150 Megawatt-hours (MW-h) of energy to the transmission inter-tie substation during his current shift. Thus far, he has dispatched 90 MW-h. What percentage of the total energy remains to be dispatched?

A. 25%
B. 60%
C. 167%
D. 40%
Finding the Unknown Part

Bart has been asked to dispatch 200 Megawatt-hours (MW-h) of energy to the transmission inter-tie substation during his current shift. Thus far, he has dispatched 30% of this amount. How much energy in MW-h remains to be dispatched?

A. 30 MW-h
B. 70 MW-h
C. 140 MW-h
D. 170 MW-h

Chin, a plant operator, has been asked to adjust the flow of power from the plant to the Hinkson Creek substation to 4.5 Megawatts (MW). If Hinkson Creek is currently drawing 40% of that amount, how much additional power in MW must Chin feed to Hinkson?

A. 2.7 MW
B. 4.10 MW
C. 1.80 MW
D. 2.75 MW

Chin has been asked to raise the plant spinning reserve to at least 250 MW to meet anticipated demand during the hot afternoon peak. His current spinning reserve is 61% of this minimum amount. What is the current level of the spinning reserve in MW?

A. 189 MW
B. 152.50 MW
C. 97.50 MW
D. 80 MW

As the afternoon temperature and load both continue to rise, Chin realizes that he needs to rapidly increase the plant’s current spinning reserve by bringing the combustion gas turbine peaking unit online. The peaking unit will increase the current 60 MW of spinning reserve by an additional 130%. What additional spinning reserve in MW does the 130% represent?

A. 78 MW
B. 130 MW
C. 138 MW
D. 190 MW
As the afternoon temperature and load both continue to rise, Chin realizes that he needs to rapidly increase the plant’s current spinning reserve from 60 MW by an additional 120% by bringing the combustion gas turbine peaking unit online. What would the total spinning reserve become, if there are no load changes, as the combustion gas turbine is brought online?

A. 72 MW
B. 120 MW
C. 132 MW
D. 180 MW

Ramon notes the addition of 200 gallons of #2 diesel fuel to back-up generator diesel A’s storage tank raises the level indicated in its sight glass by 40%. What should he estimate to be the volume of A’s tank?

A. 300 gallons
B. 400 gallons
C. 500 gallons
D. 600 gallons

Ramon notes the addition of 200 gallons of #2 diesel fuel to the back-up generator B’s diesel storage tank raises the fuel gauge from 25% to 50% full. What should he estimate to be the volume of B’s tank?

A. 250 gallons
B. 400 gallons
C. 550 gallons
D. 800 gallons
“That was a long day, huh, Tammy?” Lowell, a gas distribution mechanic, says to his supervisor Tammy after fusing gas pipes all day.

“Yes it was, and we still have a ways to go,” Tammy says, looking at the work order for the neighborhood.

“How many fusions did we get done?”

“Looks like we finished up 30 today, and we have 200 total fusions to complete.”

What percentage of the fusions does Tammy’s crew still need to complete?

A. 15%
B. 70%
C. 65%
D. 85%
Problems
Finding the Unknown Percent

Frank has to complete 30 feet of welding in order to connect 2 plates of steel together to cover a gas trench in a roadway. By 10 a.m., Frank has completed 8 feet. What percentage of the 30 feet has Frank completed?

A. 26.6%
B. 37.5%
C. 73.4%
D. 15%

Tammy and her gas distribution mechanics are completing fusions for gas pipes in a residential neighborhood. The crew has to complete 130 fusions to complete the entire neighborhood. After the first day, the crew had completed 20 fusions. What percentage of the fusions has the crew completed?

A. 35%
B. 26%
C. 15%
D. 42%

Wen is restocking the gas trucks. She has 150 pipe connectors and she is required to put 30 pipe connectors on each truck. What percentage of the 150 connectors is stocked on each truck?

A. 20%
B. 6%
C. 2%
D. 15%
**Finding the Unknown Part**

Gail and the gas crew have responded to a reported gas leak. In order to find the leak, the crew has to complete 60 bar holes around the house foundation. The crew completed 15% of the holes in the first 10 minutes of their work. How many holes did the crew complete in the first 10 minutes?

A. 3 holes  
B. 9 holes  
C. 5 holes  
D. 33 holes

Mark is heating welding rods for the gas distribution crew laying a 10-inch steel gas main. Mark has 120 rods in the warming oven but he can only use 25% of the rods on this job. How many welding rods will Mark and the crew use?

A. 40 rods  
B. 102 rods  
C. 30 rods  
D. 5 rods

Vinny is a welding inspector. He has inspected 40 welds and found 15% that have to be redone due to multiple welding issues. How many welds have to be redone?

A. 6 welds  
B. 34 welds  
C. 27 welds  
D. 13 welds
Finding the Unknown Whole

Tammy and the gas crew have completed fusing 30 connectors on a residential assignment. If this represents 40% of all the connectors they have to complete, how many total connectors do Tammy and the crew have to complete?

A. 50 connectors  
B. 42 connectors  
C. 75 connectors  
D. 70 connectors

Reggie is welding a steel plate to cover a trench in a roadway. Reggie has completed 15%, or 6 feet, of the total weld. How many total feet of weld does Reggie have to complete?

A. 40 ft  
B. 90 ft  
C. 60 ft  
D. 25 ft

Iris is putting a new gas main down under a town road. The town crew is cutting the asphalt so the gas trench can be dug in the road. The town crew has cut 45 feet of the asphalt, which is only 15% of the entire length of the new gas line. How many total feet of asphalt need to be removed so the gas crew can begin digging the trench?

A. 675 ft  
B. 333 ft  
C. 300 ft  
D. 630 ft
Module 7: Ratios and Proportions
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Ratio and Proportions (Lineworker)
Scenario

“Hey, Gabriel, you want to check my numbers on this system upgrade plan?” René asks her supervisor.

“Sure, no problem,” Gabriel responds.

“Okay, so we have to install 840 feet of wire for the upgrade, and the pole at the substation is already set.”

If they must use 120 feet of wire between each pole, how many poles past the substation should René bring to the job?

A. 7 poles
B. 6 poles
C. 9 poles
D. 10 poles
Problems
Calculating Ratios

Jack is pulling cable for an underground job in a city. The crew is using cable-pulling lubricant to assist in the pull and not damage the cable. Jack has used 5 gallons of lubricant for the first 100 feet of cable pulled. What is the ratio for feet of cable pulled to the gallons of lubricant used expressed in lowest terms?

A. 50 ft of cable to 1 gallon of lubricant
B. 100 ft of cable to 1 gallon of lubricant
C. 20 ft of cable to 1 gallon of lubricant
D. 500 ft of cable to 1 gallon of lubricant

Faith is clearing brush around utility poles and has mixed 640 ounces of gas with 40 ounces of oil in a trimmer’s 2-cycle motor. What is the ratio of gas to oil expressed in lowest terms?

A. 16:1 oz
B. 1:16 oz
C. 1:8 oz
D. 8:1 oz

Ken’s crew has just finished installations for a new subdivision. There were 39 new customers and the crew had to install 13 fuses. What is the ratio of customers to fuses expressed in lowest terms?

A. 39 customers to 13 fuses
B. 26 customers to 1 fuse
C. 5 customers to 1 fuse
D. 3 customers to 1 fuse
**Calculating Direct Proportions**

Kim is determining how many discs an insulator must have for a given voltage. The engineering calculation estimate indicates that for every 10 kV of voltage, the insulator must have 1 insulating disc. If the voltage of the system Kim is working on is 120 kV, how many discs must the insulator have for this voltage?

A. 11 discs  
B. 10 discs  
C. 12 discs  
D. 20 discs

Alex is sloping a trench for a directed buried electrical line installation. For every 1 foot of depth, the slope of the trench side walls must be at least 1 1/2 feet back. If the trench is 10 feet deep, how far back does the crew need to slope the trench so they can work the installation safely?

A. 12 ft of slope  
B. 10 ft of slope  
C. 15 ft of slope  
D. 10 1/2 ft of slope
Calculating Inverse Proportions

Karen is planning an upgrade job to provide a new service to a factory. She knows it will take 10 linemen 7 days to do the job. How many days will it take if Karen assigns 15 linemen to do the same job?

A. 4.7 days  
B. 7.5 days  
C. 10.5 days  
D. 3 days

Joan has received a call from dispatch to respond to an accident involving a car and a utility pole. The dispatcher has asked Joan for an estimate of how long it will take her to get to the car accident. Joan knows that if she can do 45 mph, it will take her 55 minutes to get to the leak. If Joan gets on the highway, she can do 65 mph. How long will it take Joan to respond to the car accident if she uses the highway?

A. 30 minutes  
B. 38 minutes  
C. 53 minutes  
D. 79.4 minutes

Mike is in charge of the warehouse and he has to restock all the electric distribution trucks on Friday afternoon so they are ready to go on Monday morning. Two warehouse workers typically take 6 hours to restock the trucks. Mike has assigned 3 warehouse workers to the restocking effort. How long will it take the 3 warehouse workers to restock all the trucks?

A. 2 hours  
B. 3 hours  
C. 9 hours  
D. 4 hours
Calculating Averages

Len has 5 different meter reading crews. Using the automated meter reading system, the crews are reading meters at the following rates: crew 1 – 60 meters/day; crew 2 – 125 meters/day; crew 3 – 85 meters/day; and crew 4 – 90 meters/day. What is the average number of meters read by the crews in a single day?

A. 90 meters/day  
B. 72 meters/day  
C. 78 meters/day  
D. 80 meters/day

Harris is determining how many poles a line crew can set in a given day. The crews set poles at different rates based on the complexity of the job and soil conditions. The crews set the following number of poles: 5, 6, 3, 2, 6 and 8. What is the average number of poles a crew should be able to set in a day?

A. 6 poles  
B. 5 poles  
C. 4 poles  
D. 7 poles

Kim is reviewing a completed transmission job. Her task is to determine the average amount of wire the crew pulled per day. The crew numbers were: 1,000 feet, 1,500 feet, 850 feet, 1,250 feet, 1,500 feet, and 2,000 feet. What was the average number of wire pulled in one day?

A. 1,350 ft/day  
B. 1,620 ft/day  
C. 1,320 ft/day  
D. 1,100 ft/day
Ratio and Proportions  
(Pipefitter/Pipelayer/Welder)  
Scenario

“Hi, Laura. How are we doing with the outage in the Thornbrook neighborhood?” Denise asks Laura, a gas dispatcher.

“I was just getting ready to call in the gas distribution mechanics,” responds Laura. “We expect the gas system to be repaired within the next 45 minutes.”

“Sounds good. I want all 150 customers relit within an hour of the gas system’s repair.”

Laura knows from experience that 1 mechanic can relight 10 houses in an hour. How many gas mechanics need to come in to restore all the customers within an hour after the system is repaired?

A. 10 mechanics  
B. 15 mechanics  
C. 5 mechanics  
D. 30 mechanics
Problems
Calculating Ratios

Jane is placing cones for a work zone around a new gas pipe installation. The site requires 5 cones for every 75 feet of the work zone. What is the ratio of cones to the length of the work zone expressed in lowest terms?

A. 1 cone to every 15 ft
B. 1 cone for every 10 ft
C. 15 cones for every 75 ft
D. 1 cone for every 7 1/2 ft

Hank needs to pump out a trench that has filled with rain water. The portable gas pump runs for 3 hours and uses 6 gallons of gas. What is the ratio of gas use to hours of pump operation expressed in lowest terms?

A. 1 gallon of gas for 2 hours of pump operation
B. 1 gallon of gas for 1/2 hour of pump operation
C. 1 gallon of gas for 3/4 hour of pump operation
D. 3 gallons of gas for 6 hours of pump operation

Karen is heating up welding rods for a weld job to cover a road trench with a plate of steel. She needs 20 welding rods for every 5 feet of weld on the plate. What is the ratio of welding rod to the length of the weld expressed in lowest terms?

A. 4 welding rods for every 5 ft of weld
B. 5 welding rods every 5 ft of weld
C. 2 welding rods for every 1 ft of weld
D. 4 welding rods for every 1 ft of weld
Calculating Direct Proportions

Darron is sloping a trench for a gas pipeline installation. For every 5 feet deep, the slope of the trench side walls must be at least 3/4 feet back. If the trench is 15 feet deep, how far back does the crew need to slope the trench so they can work the installation safely?

A. 1 1/2 ft of slope  
B. 3 3/4 ft of slope  
C. 2 1/4 ft of slope  
D. 3/4 ft of slope

Jane is calculating the loads of fill she needs to fill a trench where a new pipe was installed. For every 8 feet of trench, Jane needs 6 tons of fill. How many tons of fill does Jane need for a 24-foot trench?

A. 12 tons of fill  
B. 6 tons of fill  
C. 18 tons of fill  
D. 8 tons of fill
Calculating Inverse Proportions

Tom is designing a gas installation job. Tom knows that it will take 12 days to dig the trench with 3 backhoes. If Tom can get 6 backhoes, how many days will it take to dig the trench?

A. 4 days
B. 24 days
C. 3 days
D. 6 days

Ned has received a call from dispatch to respond to a gas leak. The dispatcher has asked Ned for an estimate of how long it will take Ned to get to the gas leak. Ned knows that if he can do 30 mph, it will take him 45 minutes to get to the leak. If Ned can do 45 mph, how long will it take Ned to respond to the gas leak?

A. 60 minutes
B. 30 minutes
C. 45 minutes
D. 15 minutes

Mike is in charge of the warehouse and he has to restock all the gas distribution trucks on Friday afternoon so they are ready to go on Monday morning. Two warehouse workers typically take 6 hours to restock the trucks. Mike has assigned 3 warehouse workers to the restocking effort. How long will it take the 3 warehouse workers to restock all the trucks?

A. 2 hours
B. 3 hours
C. 6 hours
D. 4 hours
Calculating Averages

Wendy is the welder on a pipeline installation. Wendy completed 6 welds the first day, 10 welds the second day, and 8 welds the third day. What is the average number of welds Wendy is completing per day?

A. 8 welds/day  
B. 6 welds/day  
C. 10 welds/day  
D. 12 welds/day

Yolanda is responsible for several crews doing pipe fusions in a new residential subdivision. The 3 crews averaged 30 fusions the first day, 28 the second day, 26 the third day, and 20 the final day. What is the average number of fusions the 3 crews are completing per day?

A. 34 fusions/day  
B. 26 fusions/day  
C. 27 fusions/day  
D. 8 fusions/day

Five welders are working on a new gas pipeline installation. The welders work at different rates depending on the complexity and quality of their welding ability. The welders are welding 30 inches of bead/hour, 21 inches of bead/hour, 15 inches of bead/hour, 25 inches of bead/hour, and 29 inches of bead/hour. What is the average rate of welding for the 5 welders?

A. 20 in of bead/hour  
B. 25 in of bead/hour  
C. 24 in of bead/hour  
D. 26 in of bead/hour
Module 8: Conversions

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Conversions (Lineworker)

Scenario

“Hey, Tom, how much wire are we going to need for the repair?” Abigail asks.

Tom is working with Abigail’s crew from Canada during a major storm.

“We’ll need 151 feet of line to repair the damage to the residential area,” Tom replies.

“You wouldn’t happen to know what that amount is in meters, would you?” Abigail asks.

How many meters of wire would Tom tell Abigail’s crew they need to complete the repair?

A. 50 m  
B. 46 m  
C. 15 m  
D. 450 m
**Problems**

**Converting English Units**

Yolanda is working with a line crew lowering an underground network protector into a vault. The network protector weighs 750 pounds. How would Yolanda report the weight of the network protector in tons?

A. 0.333 tons  
B. 0.375 tons  
C. 0.750 tons  
D. 2.667 tons

Harry’s line crew is measuring the distance for an overhead line job. The line crew determined they need 1/2 a mile of wire for the job. Since the wire spool is measured in feet, how many feet of wire would the crew have to get from the warehouse to complete the wire pulling job?

A. 5,280 ft  
B. 2,500 ft  
C. 2,640 ft  
D. 1,760 ft

Jim’s crew is checking the oil level in several oil breakers in a substation. The crew determined they need 10 pints of oil to top-off all the breakers. How many gallons of oil should the crew get from the warehouse to top-off all the breakers?

A. 2 1/2 gallons  
B. 1 1/3 gallons  
C. 2 gallons  
D. 1 1/4 gallons
Converting Metric Units

Wanda is taking measurements on a circuit. She has a measurement of 250 milliamps. How many amps would Wanda report for her measurement?

A. 0.250 amps
B. 2,500 amps
C. 250,000 amps
D. 2.50 amps

Jack is adding oil to a generator being used for temporary power on a new construction site. Jack added 1.5 liters to the generator. How many milliliters of oil did Jack add?

A. 150 milliliters
B. 1,000 milliliters
C. 1,500 milliliters
D. 1.5 milliliters

Ned is completing a splice on an underground cable. When finished, the splice measures 15 centimeters. How long is the splice in millimeters?

A. 1.5 mm
B. 1,500 mm
C. 0.0015 mm
D. 150 mm
Converting from English to Metric Units

Fran is working on completing a splice. The directions for the splice say she needs to remove 5 inches of the cable jacket prior to starting the splice, but her ruler measures in centimeters. How many centimeters does Fran have to cut the cable jacket prior to starting the splice?

A. 15 cm  
B. 12.5 cm  
C. 12.7 cm  
D. 1.27 cm

Jack is purchasing a new engine for an emergency diesel generator for a small town utility. He needs a 525-horsepower engine. One option is an engine coming from a foreign manufacturer that is rated in kilowatts. If 1 horsepower = 0.735 kilowatts, what kilowatt rating is equivalent to a 525-horsepower engine?

A. 714 kW  
B. 526 kW  
C. 404 kW  
D. 386 kW
Converting from Metric to English Units

Tyler is a line helper checking the engine oil in the district's line trucks. The oil container is marked in liters. Tyler has added 6 liters of oil to the trucks. How many gallons of oil has Tyler added to the line trucks?

A. 1.58 gallons  
B. 1.46 gallons  
C. 1.82 gallons  
D. 2.05 gallons

Enrique is measuring the amount of neutral wire needed for a new construction project. The reels of wire contain 305 meters each. How many feet of neutral wire is on each cable reel?

A. 915 ft  
B. 3,660 ft  
C. 1,000 ft  
D. 366 ft
Conversions
(Pipefitter/Pipelayer/Welder)
Scenario

“Hey, Rhonda, know how much pipe we need for that new residential area?” Rhonda’s supervisor, Anthony, asks.

“Let me check the crew’s notes,” she replies. “Looks like they are anticipating 0.57 miles of pipe needed.”

“Okay, but I am going to need that number in feet.”

How many feet of pipe should Rhonda report? (Round to the nearest whole number.)

A. 570 ft
B. 3,010 ft
C. 5,280 ft
D. 9,263 ft
Problems
Converting English Units

Yolanda is working with a gas crew lowering a steel plate over an open trench in a roadway. The plate weighs 350 pounds. How would Yolanda report the weight of the plate in tons?

A. 0.167 tons  
B. 0.175 tons  
C. 5.71 tons  
D. 0.257 tons

Jim’s crew is removing condensation from drip traps in several gas lines. The crew removed a total of 15 pints from several drip traps. How many gallons of water should the gas crew report was removed from the gas lines?

A. 3.25 gallons  
B. 3 gallons  
C. 2 gallons  
D. 1.88 gallons
Converting Metric Units

Jack is adding oil to a generator being used for temporary power on a new construction site. Jack added 1.5 liters to the generator. How many milliliters of oil did Jack add?

A. 150 milliliters
B. 1,000 milliliters
C. 1,500 milliliters
D. 1.5 milliliters

Ned is completing a weld on a stainless steel 0.5 psi pressure pipe for a gas service in a residential neighborhood. The 1/4-inch pipe wall thickness is 1.65 millimeters. Ned has to convert millimeters to centimeters. How many centimeters is the wall thickness of this 0.5 psi, 1.65 millimeter pipe?

A. 1.65 cm
B. 0.0165 cm
C. 0.00165 cm
D. 0.165 cm

Alice is checking the pressure in a 0.5 psi piping system. A 0.5 psi system is equal to 0.0344 bars of pressure. Alice needs to convert bars to millibars. What pressure would Alice report as the system pressure in millibars?

A. 344 millibars of pressure
B. 3.44 millibars of pressure
C. 34.4 millibars of pressure
D. 0.0344 millibars of pressure
Converting from English to Metric Units

Jim’s crew is removing condensation from drip traps in several gas lines. The crew removed a total of 10 pints from several drip traps. How many liters of water should the gas crew report was removed from the gas lines?

A. 47.3 liters  
B. 5.16 liters  
C. 0.473 liters  
D. 4.73 liters

Fran is working on completing a pipe fusion. The directions for the fusion requires that the pipe be inserted 1.5 inches into the coupling. Her ruler measures in centimeters. How many centimeters does Fran have to insert the plastic pipe into the coupling?

A. 38.1 cm  
B. 3.07 cm  
C. 3.81 cm  
D. 0.38 cm

Dan is measuring the amount of plastic piping needed for 10 homes. The distance from the main line on the street to the homes is 100 feet, so Dan needs 1,000 feet of low-pressure plastic pipe. How many meters of plastic pipe does Dan need to complete the project?

A. 305 m  
B. 333 m  
C. 281 m  
D. 3,048 m
Converting from Metric to English Units

Tyler is a gas distribution mechanic helper checking the engine oil in the district’s gas trucks. The oil container is marked in liters. Tyler has added 10 liters of oil to 6 trucks. How many gallons of oil has Tyler added to the 6 gas trucks?

A. 15.8 gallons
B. 15 gallons
C. 20 gallons
D. 12 gallons

Enrique is measuring the amount of low-pressure pipe needed for a new construction project. The reels of pipe contain 100 meters each. How many feet of low-pressure pipe is on each reel?

A. 300 ft
B. 333 ft
C. 328 ft
D. 330 ft
Module 9: Use of Formulas

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Use of Formulas and Equations (Lineworker)

Scenario

The line crew is using a block and a rope to lift a load up to the top of a pole. The block is rigged to the cross arm on the pole, and the cross arm is held on by bolts.

Samyra, a lineman working on the ground, sees Barry, the head linesman, and asks, “Hey, Barry, we have the block and rope ready to make this lift up the pole, but we are not sure if that bolt in the cross arm is going to shear.”

“Okay, well the shearing stress is equal to the load divided by the cross sectional area of the bolt. That gives us this formula,” Barry says as he writes down the information and shows it to Samyra.

Samyra sees that Barry has written $X$ pounds / 0.2485 square inches = 805 pounds per square inch. If $X$ represents the maximum load, what is the maximum weight of the load the crew can pick up?

A. 400 lbs  
B. 200 lbs  
C. 3,239 lbs  
D. 50 lbs
Problems
Translating practical problems into useful mathematical expressions where X represents the unknown

The line crew is calculating the load resulting from a customer adding an air conditioning unit to their building. The air conditioner uses 1,750 watts of power and over a period of time the crew determines that the air conditioner used 9,625 watt-hrs. Which calculation would provide the number of hours (X) that the air conditioner was used?

A. 1,750 watts / X hrs = 9,625 watt-hrs
B. 1,750 watts * X hrs = 9,625 watt-hrs
C. 1,750 watts / 9,625 watt-hrs = X hrs
D. 1,750 watts * 9,625 watt-hrs = X hrs

The crew is verifying the power factors for a customer with a maximum load of 4,000 W true power. The crew determines that the kVA apparent power (kilo volt-amp actual) is 4,600 kVA. The power factor equation is the true power divided by the apparent power. Which calculation provides the power factor (PF) of the transformer?

A. 4,600 kVA * 4,000 W = PF
B. 4,600 kVA / 4,000 W = PF
C. 4,000 W / 4,600 kVA = PF
D. 4,000 kW * PF = 4,600 kVA

The line crew has reported to a manufacturing location to investigate a customer’s complaint about dimming lights. The crew determined that the apparent power (volt-amperes) being used by the customer is 22,000 volt-amperes. The crew must calculate the amps load by dividing 22,000 volt-amperes by the system voltage, which is 220 volts. Which calculation would the crew use?

A. 22,000 volt-amperes / 220 volts = X
B. 22,000 volt-amperes * 220 volts = X
C. 220 volts / 22,000 volt-amperes = X
D. 22,000 volt-amperes = 0.220 volts * X
Solving Simple Algebraic Equations

The line crew just received an emergency call that a car has hit a pole and people are trapped in the car. The crew is 20.85 miles from the event and they have 30 minutes to get to it. To determine the speed the crew has to drive the formula is: \(0.5 \text{ hours} \times X = 20.85 \text{ miles}\), where \(X\) is the speed. What is the minimum speed that the crew could travel and still reach the accident site within 30 minutes? (Round to the nearest whole number.)

A. 45 mph  
B. 42 mph  
C. 60 mph  
D. 21 mph

The line crew has determined that the watts loss due to resistance in the line going to a business is 950 watts. The amps in the line equal 12 amps. What is the ohms of resistance in the line using the following calculation: 950 watts = \(12^2\) amps \(\times\) \(X\), where \("X"\) is the ohms of resistance?

A. 6.6 ohms  
B. 66 ohms  
C. 39.6 ohms  
D. 0.66 ohms
Determining Slope, Midpoint, and Distance

The line crew is working in a trench installing an underground system. The trench is 6 feet deep. The Occupational Safety and Health Administration (OSHA) requires that for the type of soil the crew is working in, the slope of the trench side walls must be at least 1.5 feet back for every 1 foot of depth. How far back does the crew need to slope the trench so they can work the installation safely?

A. 6 ft  
B. 12 ft  
C. 9 ft  
D. 18 ft

The line crew is setting poles and pulling wire from a substation for a new subdivision. Twelve poles are used. The first pole is set 150 feet from the substation and the rest of the poles are 150 feet apart. How many feet of wire does the crew have to pull to get to the mid-span of the 12 poles?

A. 900 ft  
B. 825 ft  
C. 300 ft  
D. 1,200 ft
Use of Formulas and Equations (Plant Operator)

Scenario

“How much coal did we receive today?” Carlos asks Sara, a plant operator.

“Looks like we are right at 9,400 tons for the day from the 75 cars that were offloaded,” Sara responds.

“That seems high. We usually average about 116 tons per train car, right?”

“Correct. They used the newer train cars today, so I think they were able to get more in than usual, but I am not sure.”

What was the average amount of coal in tons per train car for the most recent shipment?

A. 154.67 tons
B. 125.33 tons
C. 81.03 tons
D. 78.57 tons
Problems
Translating practical problems into useful mathematical expressions where X represents the unknown

Used resin from a water purification system is collected and stored in small metal drums. If a total of 56 drums are ready for shipment and 8 drums can be stacked on each pallet, which calculation below would determine how many pallets are needed if X represents the number of pallets?

A. 8 drums per pallet * X pallets = 56 drums
B. 8 drums per pallet + X pallets = 56 drums
C. 56 drums * X pallets = 8 drums per pallet
D. 56 drums * 8 drums per pallet = X pallets

If make-up water is produced at a rate of 50 gallons/minute and a 2,000-gallon tank needs to be filled, which calculation below would determine how many minutes will it take if X represents minutes?

A. 50 gallons/minute * 2,000 gallons = X minutes
B. 50 gallons/minute * X minutes = 2,000 gallons
C. 2,000 gallons – 50 gallons/minute = X minutes
D. 2,000 gallons * X minutes = 50 gallons/minute

In each coal delivery, a train with 80 cars averaging 30 tons of coal per car arrives every day at 4 AM. Which calculation below would determine how much coal is delivered every day if X represents the tons of coal?

A. 4 tons per car * 80 cars = X tons
B. 80 cars + 30 tons per car = X tons
C. 80 cars * 30 tons per car = X tons
D. 30 tons per car * X tons = 80 cars
Solving Simple Algebraic Equations

A train with 50 cars delivers 1,650 tons of coal to a coal power plant. If Sara is trying to determine the average amount of coal delivered per train car, she can use the following formula: $50 \times X = 1,650$. What is the average amount of coal in tons per train car?

A. 30 tons  
B. 33 tons  
C. 35 tons  
D. 32 tons

Sara, who works at a nuclear plant which operates at a constant output, is trying to determine the power level, in Megawatts (MW), that the plant produces each hour. The total plant output for the day is 12,000 MW-h. She uses the following formula to calculate the power level of the plant: $24 \text{ hrs} \times X = 12,000 \text{ MW-h}$. What is the power level?

A. 50 MW  
B. 500 MW  
C. 1,500 MW  
D. 120 MW

A coal plant uses 15 tons of coal per hour to fuel the furnaces. If a coal silo contained 500 tons of coal, how much coal is left after 15 hours of operation? Mark used the following equation to determine the remaining coal: $15 \text{ tons/hour} \times 15 \text{ hour} + X = 500 \text{ tons}$. 

A. 530 tons  
B. 470 tons  
C. 225 tons  
D. 275 tons
Determining Slope, Midpoint, and Distance

After a maintenance period, large plants are heated to operating temperature in stages. These stages can include a waiting period called a soak, and the soak allows piping and equipment time to heat and expand evenly. If a plant can be linearly heated from 50°F to 1,500°F in the span of eight hours, at what temperature should the soak occur if the procedure calls for the soak at the heating span’s midpoint?

A. 750°F  
B. 4 hrs  
C. 775°F  
D. 1,550°F

The auger for the coal deliveries takes coal from the delivery bin 150 feet away to a silo and dumps the coal into the silo from the top at 75 feet elevation. What is the slope of the auger?

A. 2 ft  
B. 168 ft  
C. 1/2 ft  
D. 225 ft

A conveyer that leads to the furnace hopper runs from the feed point 40 feet horizontally and up 30 feet vertically. If a conveyor ran directly from the feed point to the top of the hopper, what would be its length?

A. 70 ft  
B. 10 ft  
C. 50 ft  
D. 35 ft
Use of Formulas and Equations (Pipefitter/Pipelayer/ Welder)

Scenario

“The last of the pipe will be installed today, correct?” Leona, the head of the gas crew, asks her crew.

“Looks that way,” Jarred, a crewmember, responds.

“Excellent. Have you figured out how much back fill we are going to need in this trench?”

“Yeah, looks like we’ll need 1,920 cubic feet.”

“Okay, but I’ll need that number in yards instead of feet since our trucks haul fill material by the cubic yard.”

Using a conversion factor of 1 cubic yard to 27 cubic feet, which calculation below would give Leona the correct amount of fill material in cubic yards, where X is cubic yards?

A. $X \text{ yds}^3 = \frac{1,920 \text{ ft}^3}{27}$
B. $X \text{ yds}^3 = 1,920 \text{ ft}^3 \times 27$
C. $X \text{ yds}^3 = \frac{27}{1,920 \text{ ft}^3}$
D. $X \text{ yds}^3 / 1,920 \text{ ft}^3 = 27$
Problems
Translating practical problems into useful mathematical expressions where X represents the unknown

The gas crew is taking materials out of the warehouse for a major pipe replacement job planned for the upcoming week. The crew has 36 meters ready for replacement with 4 meters on each pallet. Which equation determines the number of pallets, where the number of pallets is X?

A. 4 meters per pallet * X pallets = 36 meters
B. 4 meters per pallet / X pallets = 36 meters
C. 36 meters * 4 meters per pallet = X pallets
D. X pallets / 4 meters per pallet = 36 meters

The gas crew is working on a major highway. The job requires that the crew place traffic cones out to warn motorist of the construction activity. The length of the work zone is 50 feet leading up to the trucks, 100 feet around the construction zone, and 20 feet to allow the cars to get back in their lane. The total work zone is 170 feet. The crew has 10 cones. Which calculation would be used to calculate the distance between the cones?

A. 170 ft * X ft between = 10 cones
B. X ft between = 170 ft / 10 cones
C. 10 cones = X ft between / 170 ft
D. 170 ft * 10 cones = X ft between
Solving Simple Algebraic Equations

The gas crew just received an emergency call that a car has hit the side of a house, snapping off a gas meter and causing a gas leak. The crew is 11.5 miles from the event and they have 15 minutes, or 0.25 hours, to get to it. To determine the speed the crew has to drive, the formula is: 0.25 hours * X = 11.5 miles, where X is the speed. What is the minimum speed the crew could travel and still reach the accident site within 15 minutes?

A. 33 mph  
B. 46 mph  
C. 37 mph  
D. 66 mph

The gas crew is using a small crane and a rope sling to lift a 1,500-pound load of pipes off a flatbed truck. The two rope slings are at a 45° angle coming off the single crane hook. The crew needs to know the total pounds of lift the two slings must provide. The calculation is 1,500 pounds = X / 1.414, where X is the weight to be lifted. How many pounds of lift must the two ropes provide?

A. 3,000 lbs  
B. 2,121 lbs  
C. 1,500 lbs  
D. 1,750 lbs

The gas crew is doing a liquid pressure test on a new piping system. The crew has to calculate the amount of water necessary to fill the pipe. The calculation is length of the pipe multiplied by the radius of the pipe squared times π (3.14), which equals the volume of the pipe in cubic feet. This amount is then multiplied by 7.4 gallons of water in a cubic foot. Their pipe is 8 feet long pipe with a 0.25-foot radius, so the formula is 8 feet * (0.25 feet)² * 3.14 * 7.4 gallons/cubic feet = X, where X is the amount of water needed to fill the pipe. What is X?

A. 47.7 gallons  
B. 1.57 gallons  
C. 32.5 gallons  
D. 11.6 gallons
Determining Slope, Midpoint, and Distance

The gas crew is working in a trench installing an underground piping system. The trench is 6 feet deep. The Occupational Safety and Health Administration (OSHA) requires that for the type of soil the crew is working in, the sides of the trench must have a slope of 1.5 feet of slope for every 1 foot of trench depth. How far back does the crew need to slope the trench so they can work the installation safely?

A. 6 ft  
B. 12 ft  
C. 9 ft  
D. 18 ft

Darryl, a welder, is reconditioning some weld rod that had gotten damp. The rod has to be heated in an oven until it is completely dried and ready for reuse. The E-60 rod has to be heated at 700°F for 1 hour. The current oven temperature is 250°F. The welder has turned the oven temperature to 700°F. What would be the mid-point in the heating process?

A. 500°F  
B. 700°F  
C. 350°F  
D. 475°F

The gas crew is laying out a new residential piping system. The Class 4 piping system has to be at least 220 feet from the nearest building with four or more stories. There are four-story buildings on both sides of the pipe installation project that are 605 feet apart. What is the distance to the piping system if it is installed at the midpoint between the buildings?

A. 300 ft  
B. 220 ft  
C. 385 ft  
D. 302.5 ft
Use of Formulas and Equations (Technician)

Scenario

“What did the crew determine on the load for that new air conditioner unit, Randall?” George, a journeyman electrician, asks.

“Looks like the energy usage was 9,625 watt-hours,” Randall responds.

“Okay, looks like the unit’s power is 1,750 watts. How many hours was the air conditioner used?”

Which calculation would provide the number of hours (X) that the air conditioner was used?

A. 1,750 watts / X hrs = 9,625 watt-hrs
B. 1,750 watts * X hrs = 9,625 watt-hrs
C. 1,750 watts / 9,625 watt-hrs = X hrs
D. 1,750 watts * 9,625 watt-hrs = X hrs

George’s crew has calculated the load for a new building AC unit

Courtesy Achim Hering via Wikimedia commons, image licensed under Creative Commons
Problems
Translating practical problems into useful mathematical expressions where X represents the unknown

Nicolette, an instrument and control technician, is checking a solenoid controlled valve. The valve is energized from 24 volts DC and the solenoid draws a current of 4 amps. Nicolette must calculate the solenoid resistance in ohms by dividing the system voltage by the system amperage. Which calculation would provide the solenoid resistance (X) in ohms?

A. 24 volts * X ohms = 4 amps
B. 24 volts * 4 amps = X ohms
C. X ohms = 24 volts / 4 amps
D. X ohms = 4 amps / 24 volts

Lionel, an instrument and control technician, needs to add a relay to control a remote load. The relay has a coil resistance of 100 ohms. Lionel measures the DC voltage across the energized relay coil and finds it measures 22 volts. Lionel needs to calculate the solenoid power dissipation in watts by dividing the voltage squared (22 x 22 = 484) by the resistance. Which calculation would provide the solenoid coil power dissipation (X) in watts?

A. 484 volts / 100 ohms = X watts
B. X watts = 100 ohms / 484 volts
C. 484 volts * 100 ohms = X watts
D. 44 volts / 100 ohms = X watts
**Solving Simple Algebraic Equations**

George, a journeyman electrician, has determined that the power (wattage) loss due to resistance in the line going to a business is 950 watts. The current (amps) in the line equals 12 amps. What is the resistance (ohms) in the line using the following calculation: $950 \text{ watts} = 12^2 \text{ amps} \times X$, where $X$ is the resistance in ohms?

A. 6.6 ohms  
B. 66 ohms  
C. 39.6 ohms  
D. 0.66 ohms  

Charlotte, an electrician, has determined the power loss in an energized solenoid controlled valve is 40 watts at a DC voltage across the solenoid of 22 volts. What is the resistance of the solenoid using the following calculation: $40 \text{ watts} = \frac{22^2}{X}$, where $X$ is the resistance in ohms?

A. 121 ohms  
B. 12.1 ohms  
C. 1.21 ohms  
D. 1.82 ohms
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