

Iowa State FFA Agricultural Mechanics Career Development Event 2015

State of Iowa
Department of Education
Iowa State University
Department of Agricultural
Education and Studies

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Electrical Systems Electrical Problem Solving



1. What tool is pictured in the above image?
 - a. Linesman Pliers
 - b. Wire Strippers
 - c. Cable Cutting Pliers
 - d. Conduit Bender



2. What tool is pictured in the above image?
 - a. Circuit Tester
 - b. Wire Strippers
 - c. Cable Cutting Pliers
 - d. Conduit Bender



3. What tool is pictured in the above image?
 - a. Fish tape
 - b. Wire wheel
 - c. Measuring tape
 - d. Toilet auger

4. What is the purpose of the tool in question 3?
 - a. Measure the distance in between two points
 - b. Clean a clog out of a toilet and/or drain
 - c. Store Mig welding wire to protect from the environment
 - d. To pull electrical lines through conduit

5. Using the wiring schematic, troubleshoot the circuit and determine why the breaker is tripping. What is the problem?
 - a. Using the wrong switch
 - b. Hot and neutral wires are reversed on the lamp
 - c. The switch is wired incorrectly
 - d. There is a short in the wire

6. The outlet has power to the top terminal but no power to the bottom terminal, what could explain this issue?
 - a. The tab has been removed connecting the top and bottom terminals
 - b. The outlet has been incorrectly wired
 - c. The outlet is broken
 - d. All of the above

7. What type of wire is on display?
 - a. 14-2
 - b. 14-2 with ground
 - c. 14-3
 - d. 14-3 with ground

8. What does the 2 on a 14-2 wire inform you of?
- The length of the wire
 - The wire gauge
 - The number of wires
 - Type of metal used to make the wire
9. If you were going to connect two three way switches, which of the following wires would you use?
- 12-2 without ground
 - 12-2 with ground
 - 14-2 with ground
 - 14-3 with ground

Electrical Calculation Formulas

$$I=E/R$$

$$R=E.I$$

$$E = IR$$

$$P=IV$$

$$I = P/V$$

$$V= P/I$$

10. The electromotive force that causes electrons to flow in a circuit is measured in:
- Amps
 - Ohms
 - Volts
 - Watts
11. The quantity of electrons flowing in a circuit is measured in:
- Amps
 - Ohms
 - Volts
 - Watts
12. Which of the following formulas describes ohm's law?
- Volts= Amps x Ohms
 - Amps= Volts x Ohms
 - Ohms= Volts x Amps
 - Volts= Amps – Ohms
13. Find the current through a 5-ohm resistive circuit when 10 volts is applied.
- 2 Amps
 - 2 Volts
 - 288 Amps
 - 288 Ohms

14. Find the resistance of a circuit that draws 0.08 amperes with 24 volts applied.
- a. 3 Amps
 - b. 3 Volts
 - c. 300 Amps
 - d. 300 Ohms
15. A DC electric motor transforms 2.50 kW of electrical power into mechanical form. If the motor's operating voltage is 500 volts, how much current does it "draw" when operating at full load (full power output)?
- a. 5 Amps
 - b. 5 Ohms
 - c. 450 Amps
 - d. 450 Ohms

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Environmental/Natural Resource Systems Surveying Problem Solving

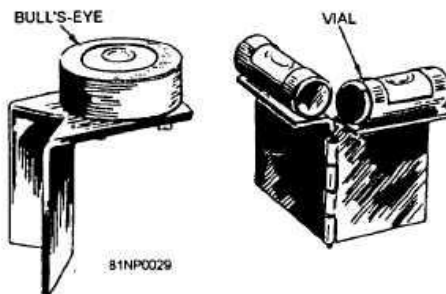


1. What is the item in the picture above?
 - a. Hand level
 - b. Auto level
 - c. Laser level
 - d. Self-leveling

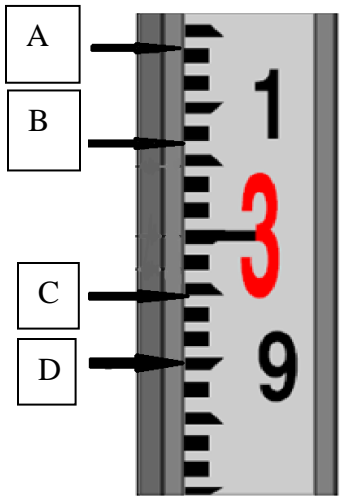


2. What is the item in the picture above?
 - a. Laser detector
 - b. Laser receiver
 - c. Stud finder
 - d. Auto leveler

3. Elevation is the distance _____ or _____ a reference level surface.
- Left, right
 - To, from
 - Above, below
 - Around, across
4. What is the 3-4-5 method used to determine?
- A perfect circle
 - A right angle
 - A 45 degree angle
 - All of the above
5. Angles can be accurately measured with a survey instrument using what unit?
- Degrees-minutes-seconds
 - Decimal degrees
 - DMS
 - All of the above



6. Why would the items in the picture above be included with your Philadelphia rod?
- To increase the accuracy of the reading
 - To make sure the rod is truly vertical
 - To reduce inaccuracy due to holding the rod at an angle.
 - All of the above



Use the arrows pointing to the Philadelphia rod to answer questions 7-11.

7. What is the measurement scale on the rod shown?
 - a. Metric
 - b. Standard
 - c. Engineers
 - d. None of the above

8. What is the measurement for the arrow "A"?
 - a. 3 m 14 cm
 - b. 3 feet 1.4 inches
 - c. 3.14 meters
 - d. 3.14 feet

9. What is the measurement for the arrow "B"?
 - a. 3 feet 7 inches
 - b. 3.07 feet
 - c. 3 meters 7 cm
 - d. 3.07 meters

10. What is the measurement for arrow "C"?
 - a. 2 ft 9.5 inches
 - b. 2.95 feet
 - c. 2 meters 9.5 cm
 - d. 2.95 meters

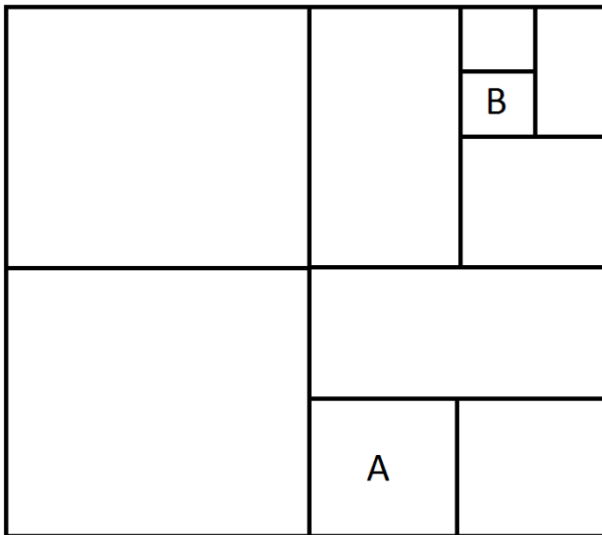
11. What is the measurement for arrow "D"?
 - a. 9 feet
 - b. 2.90 meters
 - c. 2.90 feet
 - d. 2 feet 9 inches

12. One section contains how many acres?

- a. 500
- b. 540
- c. 600
- d. 640

13. A parcel of land within a section with the description of $W \frac{1}{2}, S \frac{1}{4}, NW \frac{1}{4}$ would have an area of how many acres?

- a. 15
- b. 20
- c. 30
- d. 45



Use the diagram of a section to answer questions 14 and 15.

14. How would you describe the parcel of land designated with an “A”?

- a. $SE \frac{1}{4}, SW \frac{1}{4}$
- b. $SE \frac{1}{2}, SW \frac{1}{2}$
- c. $SW \frac{1}{2}, SE \frac{1}{2}$
- d. $SW \frac{1}{4}, SE \frac{1}{4}$

15. How would you describe the parcel of land designated with a “B”?

- a. $SW \frac{1}{4}, NE \frac{1}{4}, NE \frac{1}{4}$
- b. $NE \frac{1}{4}, SW \frac{1}{4}, NE \frac{1}{4}$
- c. $NE \frac{1}{4}, NE \frac{1}{4}, SW \frac{1}{4}$
- d. $SW \frac{1}{4}, NE \frac{1}{4}, NW \frac{1}{4}$

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**Machinery & Equipment Systems
Sprayer Problem Solving**

For this problem solving activity, use the Self-Propelled Sprayers brochure to look up the needed information for an R4045 Sprayer.

1. What is the boom width on your R4045 sprayer?
 - a. 80 feet
 - b. 100 feet
 - c. 120 feet
 - d. 140 feet

2. What is the solution capacity for the R4045 sprayer?
 - a. 600 gallons
 - b. 800 gallons
 - c. 1,000 gallons
 - d. 1,200 gallons

3. What is the field speed for an R4045 sprayer?
 - a. 20 mph
 - b. 25 mph
 - c. 30 mph
 - d. 35 mph

4. What is the application rate for an R4045 sprayer?
 - a. 230 gallons per minute
 - b. 225 gallons per minute
 - c. 170 gallons per minute
 - d. 640 liters per minute

5. If you are spraying in straight lines, how far will you need to travel to cover one acre with the R4045 boom? (one acre = 43,560 ft²)
 - a. 407 feet
 - b. 363 feet
 - c. 352 feet
 - d. 297 feet

6. For good herbicide coverage, it is recommended to use 2 quarts of glyphosate per acre. How many gallons of glyphosate would it take to cover a 320 acre field?
(1 gallon = 4 quarts)
 - a. 100 gallons
 - b. 120 gallons
 - c. 140 gallons
 - d. 160 gallons

7. It is recommended to spray 20 gallons of water per acre with the glyphosate to allow for optimum coverage. What will the total amount of liquid applied be per acre?
(Water + glyphosate)
 - a. 20 gallons per acre
 - b. 20.5 gallons per acre
 - c. 21 gallons per acre
 - d. 21.5 gallons per acre

8. Using the solution capacity for the R4045 sprayer, how many acres are you able to cover with one tank? Round to the nearest ten acres.
 - a. 60 acres
 - b. 50 acres
 - c. 40 acres
 - d. 70 acres

9. Assume you can cover 60 acres per hour. How many acres can you cover if you spray for 12 hours in a day but have to take 10 minutes to refill every time the sprayer is empty?
 - a. 720 acres
 - b. 647 acres
 - c. 617 acres
 - d. 700 acres

10. How many times will you need to refill your sprayer to cover the 320 acre field? Round up to the nearest whole number.
 - a. 3 times
 - b. 4 times
 - c. 5 times
 - d. 6 times

11. The local co-op charges \$7.00 per acre to spray your field, not including chemical cost. How much would it cost to have the Co-op spray your 320 acre field, not including chemical costs?
- \$2,400
 - \$2,420
 - \$2,040
 - \$2,240
12. Your sprayer costs \$400,000 dollars. How many times would you or the co-op have to spray your 320 acre field to pay for the sprayer? Round up to the nearest whole number.
- 179
 - 154
 - 163
 - 187
13. If you owned a total of 1,500 acres, how many times would you have to spray everything to cover the cost of the sprayer? Round up to the nearest whole number.
- 267
 - 39
 - 136
 - 84
14. If you spray your 1,500 acres twice per year, about how many years will it take to cover the cost of the sprayer?
- 15 years
 - 20 years
 - 25 years
 - 30 years
15. What situation described below could allow the producer to recover their cost sooner?
- Farming more land to be sprayed
 - Needing to spray more times per year
 - Needing to spray fewer times per year
 - Both a & b
 - Both a & c

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**Metals & Welding Systems
Gas Metal Arc Welding Problem Solving**

1. What is a **not** a result of welding with the current set too low?
 - A. Slag inclusion
 - B. Poor fusion
 - C. Poor arc stability
 - D. Increased arc length.

2. A weld made at a high temperature will have all of the following qualities **EXCEPT...**
 - A. Narrow bead
 - B. Wide bead
 - C. Flat bead
 - D. Deep penetration

Troubleshoot the welds in front of you.

3. The problem with weld #1 is...
 - A. Normal
 - B. The speed is too fast
 - C. The current is too low
 - D. The speed is too slow
 - E. The current is too high

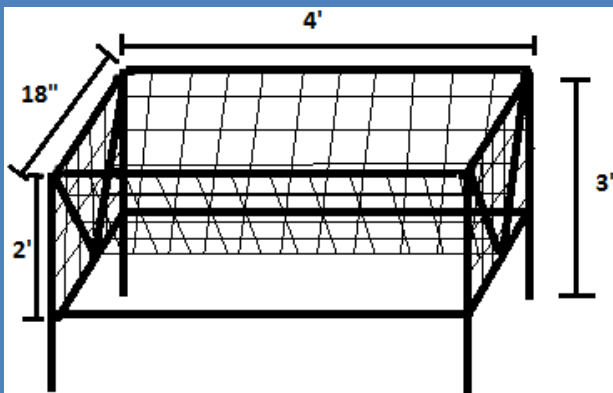
4. The problem with weld #2 is ...
 - A. Normal
 - B. The speed is too fast
 - C. The current is too low
 - D. The speed is too slow
 - E. The current is too high

5. You are using a welding rod with the numbers 7018. How many **pounds per square inch** of tensile strength would it take to pull it apart?

- A. 70
- B. 70,000
- C. 18
- D. 18,000

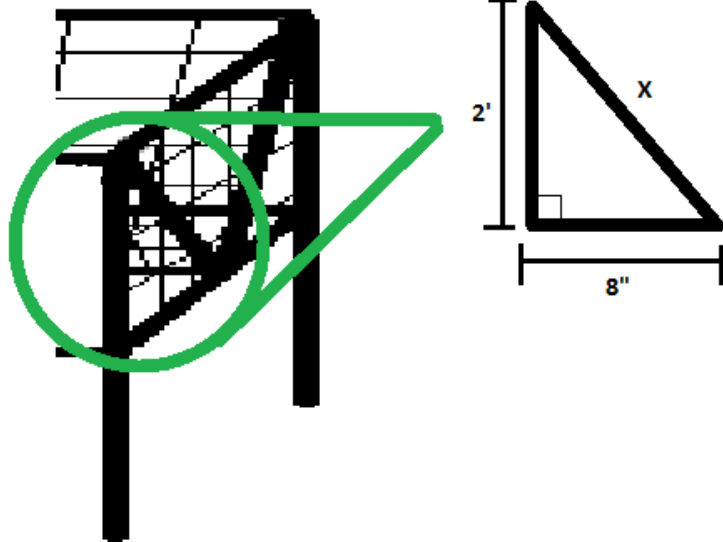
6. You are welding an overhead joint. Which rod would you definitely **not** want to use?

- A. 6010
- B. 6013
- C. 7018
- D. 7024



The hay feeder pictured is made using 1" square tubing for the legs, frames, and "V" supports. Steel fencing is used to cover the ends and is placed in a "V" towards the middle to hold the hay.

Use the diagrams provided to answer questions 7-15.



7. Using Pythagorean's theorem ($A^2 + B^2 = C^2$), determine the length of one of the "V" support pieces. Round up to the nearest full inch.

- A. 20"
- B. 26"
- C. 30"
- D. 32"

8. Determine the total length of 1" square tubing you will need for this project. Round up to the nearest foot.

- A. 42'
- B. 47'
- C. 36'
- D. 51'

9. 1" steel tubing costs \$1.19 per foot. How much will it cost to purchase enough steel tubing for this project?

- A. \$40.17
- B. \$42.85
- C. \$46.23
- D. \$49.98

10. Determine the total amount of steel fencing you will need in square footage. Round to the nearest square foot.

- A. 9 ft²
- B. 12 ft²
- C. 15 ft²
- D. 18 ft²

11. The fencing can be purchased for \$0.45 per square foot. How much will it cost to purchase enough fencing to complete your project?

- A. \$5.40
- B. \$6.95
- C. \$4.99
- D. \$5.12

12. Each place a piece of tubing is joined it will be welded on all four sides of the joint. Assuming you can get 8" of welding out of one welding rod, how many welding rods will it take to weld the project? Add 6 additional welding rods to your answer to account for attaching the fencing.

- A. 9
- B. 12
- C. 15
- D. 18

13. Welding rods are sold by the pound. Assuming an average of 16 welding rods per pound, how many pounds of welding rod will you have to purchase?

- A. 1 pound
- B. 2 pounds
- C. 3 pounds
- D. 4 pounds

14. The welding rods cost \$1.49 per pound. How much will it cost to purchase the necessary amount of welding rods?

- A. \$1.49
- B. \$2.98
- C. \$4.47
- D. \$5.96

15. What is the total cost for your project including the steel tubing, fencing and welding rods?

- A. \$58.36
- B. \$54.64
- C. \$49.78
- D. \$67.82

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Structure Systems
Plumbing Problem Solving



1. What is the fitting located in the picture above?
 - a. Tee
 - b. Elbow
 - c. Stopper
 - d. Cap



2. What is the fitting located in the picture above?
- a. Tee
 - b. Elbow
 - c. Three-way bend
 - d. Cap



3. What is the fitting located in the picture above?
- a. Tee
 - b. Elbow
 - c. Coupling
 - d. Cap



4. What is the name of the fitting in the image above?
 - a. Tee
 - b. Elbow
 - c. Two-way bend
 - d. Cap

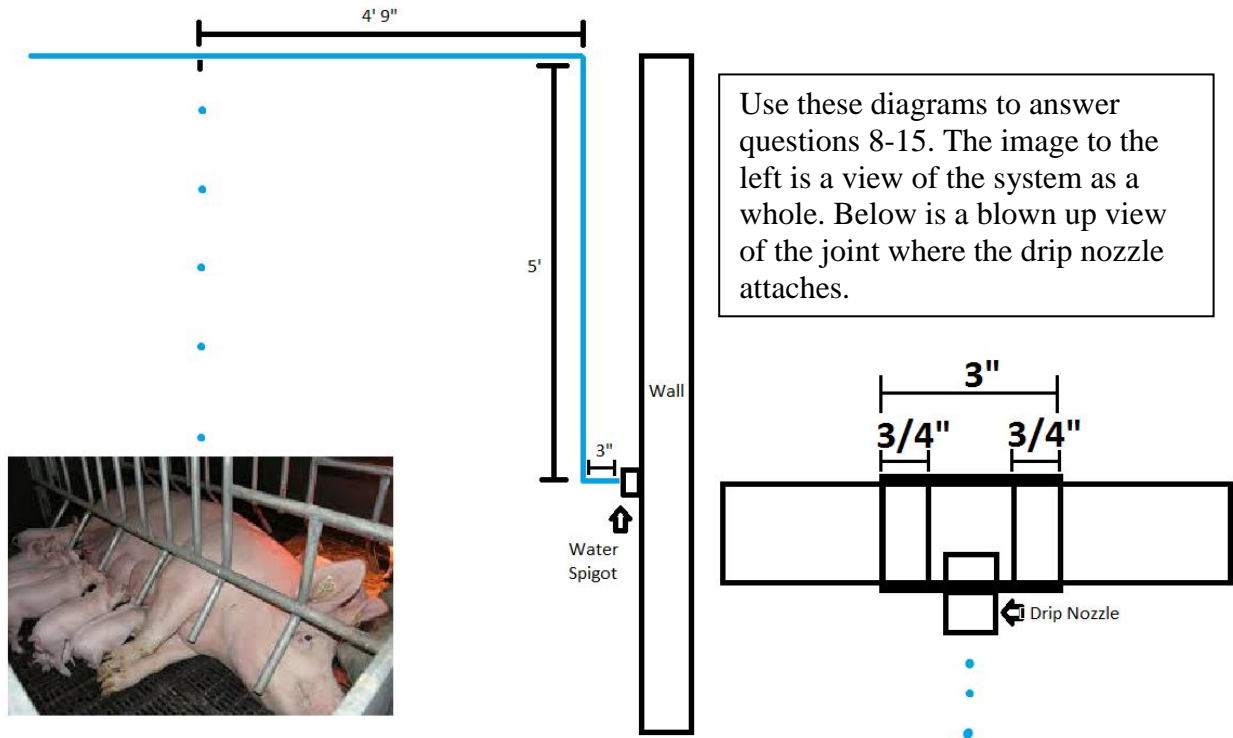
5. What is the purpose of the fitting in the image in #4?
 - a. Stop the flow of water.
 - b. Increase the flow of water
 - c. Change the direction of flow 90 degrees.
 - d. Change the direction of flow 180 degrees.

6. What do the letters "PVC" stand for?
 - a. Poly Vinyl Chloride
 - b. Pipe Vent Cleanser
 - c. Plastic Varnished Compound
 - d. Primed Vapor Conduit

7. Which of the following is NOT a benefit of using primer on PVC joints?
 - a. Primer helps remove dirt, grease etc. from the surface.
 - b. Primer softens the joint materials.
 - c. Primer removes surface coating from manufacturer.
 - d. Primer helps the glue dry much faster

8. How does CPVC differ from PVC?
 - a. CPVC is not as well suited as PVC for high temperature fluids.
 - b. CPVC is better suited than PVC for high temperature fluids.
 - c. CPVC is less flexible.
 - d. CPVC is less crush resistant.

You have just added a new farrowing building to your swine farm operation. Summer is heating up and you know you will need to find a way to keep your sows cool, so you decided you want to install an overhead drip system. There is a water spigot on the inner wall of the building, so you can bring the water in from that point. First we will figure out how to get water to drip on the closest sow.



9. Looking at the diagram above, how many elbow fittings will you need?
 - a. 0
 - b. 1
 - c. 2
 - d. 3

10. Excluding the fittings, how much PVC length will you need to reach from the water spigot to the first dripper?
 - a. 9' 9"
 - b. 10'
 - c. 9' 6"
 - d. 9" 6'

11. If the PVC pipe costs \$1.91 per 10 foot section, how much will it cost to buy enough pipe to reach the first sow?
 - a. \$1.86
 - b. \$1.91
 - c. \$1.81
 - d. \$1.29

12. Add \$0.28 each for the number of elbow fittings needed, \$0.21 for 1 coupling, and \$0.85 for the drip nozzle to your answer in question 11. What is the total cost for getting water to the first sow, excluding glue/primer?
- \$3.48
 - \$3.43
 - \$2.91
 - \$3.53
13. How much would it cost to extend the drip system another 3' to the next sow? Be sure to include all previous costs as well as the fittings and nozzle needed for the additional unit. (Keep in mind that PVC is bought in 10 foot sections, so you would need to purchase a whole 10 foot section for this 3 foot extension.)
- \$5.11
 - \$5.06
 - \$6.50
 - \$5.16
14. If you already have a cap and enough left over pieces to close off the system, what would it cost to extend the system to a TOTAL of 60 sections before capping it? Assume 3' between sows.
- \$100.45
 - \$104.27
 - \$108.62
 - \$110.29
15. Which of the following would be an additional cost to consider with this system?
- Primer and glue
 - Connecting fitting to the water spigot
 - Mounting brackets
 - All of the above would be additional costs to consider.