

2019 State Agricultural Mechanics Problem Solving - KEY

Directions: Place your name, chapter, and contestant number on the accompanying scantron form that you will receive from the test administrators. Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet (scantron form) as instructed by the test administrators. You may use the paper provided to work out the problems. Round all answers to two decimal places.

1. The motor on drill press is rated at 1150 rpm and came with a 3" pulley. What size pulley should be installed on the drill press to run it at 690 rpm? **$S \times D = S' \times D'$** (S = speed of motor, D = diameter of motor pulley, S' = speed of machine, and D' = diameter of machine pulley)
 - a. 5"
 - b. $5\frac{1}{2}$ "
 - c. 6"
 - d. $6\frac{1}{2}$ "
2. Vanessa is covering a flat-topped lean-to storage shed with a tin roof. The roof measures 10' wide by 22' long. The tin she is buying comes in sheets that measure 42" wide by 12' long. How many sheets of tin will Vanessa need to buy? (Round to the nearest whole number.)
 - a. 6
 - b. 8
 - c. 12
 - d. 16
3. If Barney uses the 1-2-3 mix (cement – sand – rock) for a concrete project that requires 8 cubic foot bags of cement and 16 cubic feet of sand, how many cubic feet of coarse aggregate will he need?
 - a. 4
 - b. 12
 - c. 16
 - d. 24
4. If the foundation for a 24' x 40' building is 24" high, how many 8" x 8" x 16" blocks are needed? (Hint: Feet long x $\frac{3}{4}$ = blocks per course, Feet high x $\frac{3}{2}$ = courses) **Allow 6% for waste and round the final answer to the nearest whole block.**
 - a. 156
 - b. 234
 - c. 288
 - d. 306

Use the information from Table 2019.1 to answer questions 5 – 8.

| Table 2019.1 Wire Sizes Needed to Carry Given Loads with 2% or Less Voltage Drop | | | | | | | | | | | | | | |
|--|-------------------------|----------------------------------|--|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|
| Copper up to 200 Amperes, 115 -120 Volts, Single Phase, Based on 2% Voltage Drop | | | | | | | | | | | | | | |
| Minimum Allowable Size of Conductor | | | Length of Run in Feet | | | | | | | | | | | |
| | | | Compare size shown below with size shown to the left of double line and use the larger size. (Smaller the number, the larger the size) | | | | | | | | | | | |
| Load in Amps | Type R, T, and TW Cable | Bare and Covered Overhead in Air | 30 | 40 | 50 | 75 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 500 |
| 15 | 12 | 10 | 12 | 12 | 10 | 10 | 8 | 6 | 4 | 4 | 4 | 3 | 2 | 1 |
| 20 | 12 | 10 | 12 | 10 | 10 | 8 | 6 | 4 | 4 | 3 | 2 | 2 | 1 | 0 |
| 30 | 10 | 10 | 10 | 8 | 8 | 6 | 4 | 4 | 2 | 1 | 1 | 0 | 00 | 000 |
| Aluminum up to 200 Amperes, 115 -120 Volts, Single Phase, Based on 2% Voltage Drop | | | | | | | | | | | | | | |
| 15 | 12 | 10 | 12 | 10 | 8 | 8 | 6 | 4 | 3 | 2 | 2 | 1 | 0 | 00 |
| 20 | 10 | 10 | 10 | 8 | 8 | 6 | 4 | 3 | 2 | 1 | 0 | 0 | 00 | 000 |
| 30 | 8 | 10 | 8 | 6 | 6 | 4 | 3 | 2 | 0 | 00 | 00 | 000 | 4/0 | 250 |

5. When using a load of 30 amps and Type R copper wire, at what length of run does the conductor size first change from 6 to 4?
 - a. 75
 - b. **100**
 - c. 150
 - d. 200

6. What is the minimum allowable size conductor for a 15-amp load using Type R aluminum?
 - a. **12**
 - b. 10
 - c. 8
 - d. 4

7. Which type wire has the same minimum allowable size for conductors regardless of load?
 - a. **Overhead in air**
 - b. Type R cable
 - c. Type T cable
 - d. Type TW cable

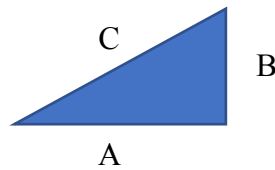
8. When using Type TW copper cable for a 40 run, the minimum size conductor allowed is:
 - a. 3 if carrying a 30 amp load
 - b. 4 if carrying a 30 amp load
 - c. 6 if carrying a 30 amp load
 - d. **8 if carrying a 30 amp load**

9. How many gallons of paint are needed to cover a 20' x 30' shop floor with two coats? (1 gallon covers 400 square feet) Round up to the nearest gallon.

- a. 1
- b. 2
- c. **3**
- d. 4

10. Horace is purchasing landscaping border and is trying to determine how much border he needs to buy to line the entire area outlined below. He has measured the distance of side B as 18' and the distance of side A as 24'. How much total landscaping border should Horace buy to enclose the entire area?

- a. 25'
- b. 30'
- c. 42'
- d. **72'**



11. If a pipe has a friction loss rate of 90 gallons per hour, what is the loss in gallons per minute?

- a. .66 gallons
- b. **1.5 gallons**
- c. 6.6 gallons
- d. 15 gallons

12. What is the resistance for an electric motor that operates on 110 volts with 5 amps of electrical flow? $E = IR$, E = volts, I = amperes, and R = Resistance

- a. .045 ohms
- b. .045 watts
- c. **22 ohms**
- d. 22 watts

13. How many watts of electricity will a 1.8 – ampere motor running on 220 volts of electricity consume during a 30-day period if it operates for 12 hours per day? $W = VA$

- a. 360
- b. 396
- c. 118,950
- d. **142,560**

Use the table below to answer questions 14 – 16. Ms. Hampton is building picnic tables in her class and she wants to calculate costs for the project. The chart below shows the list of materials as well as the unit prices for the materials to build one picnic table.

| Qty | Description | Unit Price | Total Price |
|----------|---------------------------------|--------------------|-------------|
| 2 | Treated 2"x 6" x 12' #1 lumber | \$9.44 | |
| 2 | Treated 2" x 12" x 8' #1 lumber | \$15.57 | |
| 5 | Treated 2" x 10" x 8' #1 lumber | \$10.27 | |
| 2 | 2" x 2" x 1/4" x 10' Angle Iron | \$11.74 | |
| 50 | 5/16" x 3 1/2" Carriage Bolts | \$0.25 each | |
| 1 gallon | Thompson Weather Sealer | \$16.47 /gallon | |
| 2 | Paint Brushes | \$2.98 | |
| | | | |
| | | SUBTOTAL | |
| | | Sales Tax (7.25%) | |
| | | Grand Total | |

14. What is the SUBTOTAL cost to buy the materials for one picnic table based on the list of items above?

- a. **\$159.78**
- b. \$171.36
- c. \$197.20
- d. \$207.56

15. How much sales tax would be charged on the materials to build one picnic table?

- a. **\$11.58**
- b. \$115.84
- c. \$15.97
- d. \$159.78

16. How much would the grand total cost be to build 6 picnic tables?

- a. \$171.36
- b. \$958.68
- c. \$1014.99
- d. **\$1028.16**

17. Mr. Ray is installing 19 wooden shelves that are 10' long by 12" wide by 3/4" thick. Lumber is \$3.00 per board foot. How much will Mr. Ray spend on lumber for this project?

- A. \$18.00
- B. \$180.00
- C. **\$427.50**
- D. \$472.50

18. Alex is pouring a 4" thick sidewalk that is 6' wide and stretches 125' long. If concrete is \$125 per cubic yard, how much would the concrete expense be for the entire sidewalk?
- a. \$875
 - b. \$1125
 - c. **\$1250**
 - d. \$1375
19. Clay purchases an older flatbed trailer that is 94" wide and 16' long. The wood flooring is rotten and needs to be replaced. How many 2" x 6" x 16' does he need to purchase to complete the job? (Finished lumber reduces the width and thickness so the accurate dimensions are 1½" x 5½" x 16')
- a. 15
 - b. **17**
 - c. 19
 - d. 21
20. A farm shop has eight four-bulb florescent light fixtures on a 120-volt circuit. Each fixture is equipped with 40-watt bulbs and the current rate for electricity is \$.10219 per Kwh. However, the rate will go up to \$.10706 on July 1st. How much more will it cost to run the lights during the month of July than in the month of June, if they are run for eight hours per day and 20 days per month? **(Round the cost to the nearest cent.)**
- a. **\$1.00**
 - b. \$1.28
 - c. \$1.74
 - d. \$2.21