2013 State Agricultural Technology & Mechanical Systems Problem Solving

Directions: Place your name, chapter and contestant number on the accompanying scantron form that you 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 this paper to work out the problems.

Area: Energy Systems

Ohm’s Law: Watts = Volts x Amps

1. Mr. Blair has a 24’ x 40’ workshop. He uses 8 ceiling fans rated at 50 watts and 8 four-bulb florescent lights. If each fixture is equipped with 60-watt bulbs, how many watts of electricity will the fans and lights use during a 30-day period if they operate for 8 hours per day?

   a. 55,056
   b. 96,000
   c. 460,800
   d. 556,800

   \[
   \text{Fans: } 8 \text{ fans} \times 50 \text{ watts} = 400 \text{ watts/8 hr} = 3,200 \text{ watts/day} \\
   \text{Lights: } 8 \text{ bulbs} \times 60 \text{ watts/8 hr} = 480 \text{ watts/day} \\
   \text{Total: } 3,200 \text{ watts/day} + 480 \text{ watts/day} = 3,680 \text{ watts/day} \\
   \text{30 days: } 3,680 \text{ watts/day} \times 30 \text{ days} = 110,400 \text{ watts} \\
   \]

2. Mr. Cole’s shop has the same lights and fans as Mr. Blair’s shop in problem one. However, he will also be using the electrical devices in the table below. What will be the electrical bill for the shop for 30 days if electricity costs $.10619 per kwh? (Round the cost to the nearest cent.)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>WATTAGE</th>
<th>VOLTAGE/appliance</th>
<th>AMPERAGE/appliance</th>
<th>HOURS USED PER DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 HP Air Compressor</td>
<td>-</td>
<td>220</td>
<td>6.8</td>
<td>1.5</td>
</tr>
<tr>
<td>Three Lincoln 225 AC Welders</td>
<td>9000</td>
<td>-</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>Three 3/8 inch portable electric drills</td>
<td>110</td>
<td>-</td>
<td>4.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Two 7 inch Rigid Angle Grinders</td>
<td>110</td>
<td>-</td>
<td>13.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

   \[
   \text{3 drills: } 110 \text{ V} \times 4 \text{ A} = 440 \text{ watts} \\
   \text{Welders: } 3 \times 900 \text{ watts} = 2,700 \text{ watts} \\
   \text{Grinders: } 2 \times 110 \text{ V} \times 13.5 \text{ G} = 3,150 \text{ watts} \\
   \text{Lights: } 556,800 \div 1,000 = 556.8 \text{ kwh} \\
   \text{Air comp: } 67,320 \div 1,000 = 67.3 \text{ kwh} \\
   \text{Total: } 4075.3 \text{ kwh} \times .10619 = 432.76 \text{ dollars} \\
   \]

\[
\text{(Round to the nearest cent.)}
\]
3. The current rate for electricity is $.10619. However, the rate will go up to $.10706 on July 1st. Mr. Bowden has the same lights and equipment as Mr. Blair and Mr. Cole. How much more than Mr. Cole will it cost for him to run his lights and equipment during the month of July than in the month of June, if they are run for the same time period that Mr. Blair and Mr. Cole run theirs? (Round the cost to the nearest cent.)

a. $2.69
b. $3.54
c. $3.77
d. $4.05

4. Ms. Taylor has a 12” Delta Table Saw wired on a 220-volt circuit. The saw motor requires 4600 watts to start, but once started will run on 2000 watts. How many amperes of electricity are required to start the saw than to keep it running? (Round the answer to the nearest hundredth.)

a. 9.96
b. 10.14
c. 11.82
d. 12.17

5. Mr. McPherson produces corn on 600 acres. The diesel fuel required for 250 acres of corn planted using conventional tillage is 6 gallons per acre at a cost of $3.87 per gallon. On 350 acres he uses no till and saves 46% of the fuel cost per acre. How much more will Mr. McPherson spend on the 250 acres of corn planted by conventional tillage than he does on the 350 acres of corn planted no till? (Round to the nearest cent.)

a. $1,324.00
b. $1,416.00
c. $1,556.00
d. $1,637.00

6. Mr. Everett is determining field loss for a farmer’s corn harvest. He found an average seed count of 3 kernels per square foot left in the field. If there are 80,120 kernels of corn in one bushel and corn is selling for $7.00 per bushel, how much money is lost for the 300 acres the farmer planted? 1 acre = 43,560 square feet (Round the answer to the nearest hundredth.)

a. $3,189.21
b. $3,247.23
c. $3,425.24
d. $3,533.19
7. Mr. Gordon’s “Clean Cut Lawn Care” mows grass an average of 50 hours per week for 18 weeks during the months of June, July, August, and September. His company mows an average of 30 hours per week for 8 weeks during May and October. Dull lawn mower blades increase fuel cost by 21%. A mower with sharp blades uses 1 gallon of fuel per hour. If gasoline cost $3.33 per gallon, how much will his company save in one season by keeping the blades sharp?

\[
\begin{align*}
\text{a.} & \quad $797.20 \\
\text{b.} & \quad $805.20 \\
\text{c.} & \quad $813.20 \\
\text{d.} & \quad $819.20
\end{align*}
\]

8. Mr. Bennett’s flex-fuel pickup averages 18 miles per gallon for regular unleaded gasoline. However, when he uses E85, the fuel mileage drops to 14 miles per gallon. What percentage drop is that?

\[
\begin{align*}
\text{a.} & \quad 12.22 \\
\text{b.} & \quad 14.33 \\
\text{c.} & \quad 17.77 \\
\text{d.} & \quad 22.22
\end{align*}
\]

Area: Industry and Marketing Systems

9. Mr. Cole’s students at Triton High School use a Plasma cam and Torch mate to make the FFA emblems in the picture below. If his students can make 20 emblems from one 4 x 8 sheet of 16 gauge metal and the sheet cost $64.00, how much money will the FFA Chapter make if they sell each emblem for $40.00? Consider scrap portions of the sheet will be used to make other ornaments valued at $128.00 when sold.

\[
\begin{align*}
\text{a.} & \quad $682 \\
\text{b.} & \quad $740 \\
\text{c.} & \quad $800 \\
\text{d.} & \quad $864
\end{align*}
\]

10. If a can of paint will cover 4 emblems with one coat, how much cost will be added for the 20 emblems in the above problem, if Mr. Cole’s class applies three coats to each emblem? The paint cost $1.49 per can. Add 6.75% sales tax to the cost of the paint. (Round the final answer to the nearest cent.)

\[
\begin{align*}
\text{a.} & \quad $21.36 \\
\text{b.} & \quad $23.86 \\
\text{c.} & \quad $24.96 \\
\text{d.} & \quad $25.16
\end{align*}
\]

11. If Mr. McPherson is building a trailer that requires he purchase an additional 6 pieces of 1/4" x 1 1/2" x 1 1/2" x 10' angle iron at a cost of $1.81 per foot and 12 pieces of 2" x 8" x 10' at $1.20 per board foot, how much additional money will he need? Add 6.75% for sales tax.

\[
\begin{align*}
\text{(BF = pieces X T" x W" x L')} \\
\text{a.} & \quad $272.69 \\
\text{b.} & \quad $298.19 \\
\text{c.} & \quad $320.89 \\
\text{d.} & \quad $328.29
\end{align*}
\]
12. Mr. Blair’s agricultural shop needs 50 lbs. of 1/8 inch E-6011 electrodes. Machine Welding Supply has a special promotion on Lincoln Fleetwood 180 electrodes for $10.95 for a five lb. box. Regular price is $121.50 for a 50 lb. box. How much money will he save by buying enough five lb. boxes to equal one 50 lb. box?

\[
\begin{align*}
\text{a. } & \$11.00 \\
\text{b. } & \$12.00 \\
\text{c. } & \$13.00 \\
\text{d. } & \$14.00
\end{align*}
\]

\[
\begin{align*}
\text{Area: Machinery and Equipment Systems}
\end{align*}
\]

13. If an electric motor has a rated speed of 1750 rpm, which size pulley should be installed on the motor to drive a drill press with a four-inch pulley at 875 rpm? Formula: \( S \times D = S' \times D' \), \( S = \text{Speed of motor}, D = \text{Diameter of motor pulley}, S' = \text{Speed of equipment and } D' = \text{Diameter of equipment pulley.} \)

\[
\begin{align*}
a. & \ 1750 M = 875 (4) \\
b. & \ 1750 M = 3500 \\
c. & \ M = \frac{3500}{1750} \\
d. & \ M = 2
\end{align*}
\]

14. How many acres can Mr. Everett harvest if his combine speed is 4.6 miles per hour and he has a grain head that is 28 feet wide? Mr. Everett begins harvesting at 10 a.m. and works until 9 p.m., stopping 30 minutes to eat and an additional two hours to unload the harvested grain. Formula: acres per hour = width of machinery in feet \( \times \) speed in miles per hour divided by 10.

\[
\begin{align*}
a. & \ 28 \times 4.6 = \frac{128.8}{10} = 12.88 \text{ ac/hr} \\
b. & \ 109.48 \\
c. & \ 115.42 \\
d. & \ 119.88
\end{align*}
\]

15. If during a calibration time of 1 minute and 30 seconds Ms. Taylor’s feed auger delivers 119.5 pounds of feed to a container weighing 9.5 pounds, how many pounds of feed does the auger deliver per minute of operation?

\[
\begin{align*}
\text{a. } & \ 68.2 \\
\text{b. } & \ 73.2 \\
\text{c. } & \ 77.2 \\
\text{d. } & \ 81.2
\end{align*}
\]

16. What size motor pulley will Mr. Bowden need to use on a Dayton 3NLF fan with a motor speed of 1750 rpm if the fan pulley is 6" and the fan speed is 875 rpm? Formula: \( S \times D = S' \times D' \), \( S = \text{Speed of motor}, D = \text{Diameter of motor pulley}, S' = \text{Speed of fan, and } D' = \text{Diameter of fan pulley.} \)

\[
\begin{align*}
\text{a. } & \ 1750 D = 875 (6) \\
\text{b. } & \ D = \frac{5250}{1750} \\
\text{c. } & \ D = 3
\end{align*}
\]
17. Mr. Britt is pouring a 36’ x 58’ concrete pad for a metal building. If concrete cost $123.00 per cubic yard, what will be the cost of concrete to pour the pad 8 inches thick? A cubic yard of concrete = 27 cubic feet and Cu. Ft. = T’ x W’ x L’. (Hint: Round up to the nearest cubic yard when calculating concrete needed.)

- a. $5,047.00
- b. $6,396.00
- c. $6,564.00
- d. $7,329.00

18. Mr. Warren is building the foundation for his shop with 8 inch concrete block. If the blocks cost $1.54 each and the foundation is 2’ high x 20’ long x 12’ wide, how much will the blocks cost to build the foundation? Allow for a 6’ door opening in one of the 20’ sides. (Round up to the next whole block.)

(Hint: To determine blocks needed per wall: Height x 3/2 = courses and length of wall x 3/4 = blocks per course.)

- a. $176.43
- b. $200.97
- c. $215.35
- d. $222.71

19. Ms. Smith is building a 20’ long x 12’ wide x 8’ high utility barn for her garden equipment. She has 32 pieces of 16’ siding left over from a former project. How many additional pieces of 16’ siding will she need to complete her project if the siding is 8’ wide and she allows 1 inch to lap over? Do not allow for windows and doors. (Round calculations to the nearest hundredth and the answer to the nearest whole piece.)

- a. 13
- b. 18
- c. 23
- d. 28

20. What will it cost to paint Ms. Smith’s building in the previous problem if she applies two coats of paint at a cost of $28.00 per gallon? Add 6.75% sales tax to get the total bill for paint. (Assume 1 gallon of paint will cover approximately 400 square feet.) (Round up to the next whole gallon.)

- a. $89.67
- b. $91.35
- c. $93.52
- d. $95.48