2022 (On-line) Written Examination
for the
National Agricultural Technology and Mechanical Systems Career and Leadership Development Event

You have 1.5 hours to complete this exam.

Directions for completing this on-line exam: ***T Y P E H E R E***

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1. **Machinery: If a tractor travels at 28.5 kilometers per hour, what approximate length of time (in hours and minutes) is required to travel 29.5 miles?**
   1 mile = 1.6 kilometers 1 hour = 60 minutes

   A. 1 hour and 2.1 minutes
   B. 1 hour and 16.8 minutes
   C. 1 hour and 39.4 minutes
   D. 2 hours and 11.7 minutes

2. **Electrical: What is the approximate annual power consumption (kilowatt-hours = kWh) of a 120-volt electrical installation with 24 incandescent lights, with each light using 1.5 amps and operating 8 hours per day and 28 days per month?** 1 year = 12 months Kilowatt = 1000 Watts
   Watts = Volts × Amps
   Volts = Amps × Resistance in Ohms
   Kilowatt-hours = Kilowatts × Hours

   A. 11,612 kWh
   B. 116,122 kWh
   C. 1,161,216 kWh
   D. 11,612,160 kWh

3. **Compact Equipment: During the repair of an engine, a pilot-hole must be drilled to accommodate a 5/8" tap that will cut 'tight fit' threads (for a 5/8" bolt) in the wall of the pilot-hole. The tap table indicates that the pilot-hole must have a 0.6406" diameter. All of the available twist drills have fractional rather than decimal measurements. What approximate size twist drill should be used to drill the pilot-hole?** 1/4" = 0.25" 1/2" = 0.5" 3/4" = 0.75"

   A. 19/32 inch
   B. 41/64 inch
   C. 21/32 inch
   D. 43/64 inch

4. **Structural: A small section of a tape measure with numerical values in inches is shown below. The entire length of the tape measure is not shown. What length is indicated when measured from the end of the tape measure (not shown at the left of picture) to where the arrow touches the tape measure? Answer should be in feet, inches, and fractions of an inch.**

A. 1’ 3~3/4”
B. 1’ 4~3/16”
C. 1’ 4~11/16”
D. 1’ 6~7/8”

5. **Environmental: Approximately how many acres are in a rectangular field that has a length of 1109 meters and a width of 928 yards?**
1 acre = 43, 560 square feet 1 hectare = 2.47 acres 1 acre = 0.41 Hectare
Area of Rectangle = length × width 1 yard = 3 feet 1 foot = 0.3048 meter

A. 2.4 acres
B. 23.6 acres
C. 232.5 acres
D. 2325.4 acres

6. **Environmental: An available electronic thermometer is calibrated in degrees Celsius (ºC). A pesticide label specifies that the maximum allowable temperature for spray applications is 85 degrees Fahrenheit (ºF). What is the approximate temperature equivalent in degrees Celsius?**
ºF = (9/5 ºC) + 32 ºC = 5/9 (ºF - 32)
Water freezes at 32 ºF Water boils at 212 ºF

A. 11.7 ºC
B. 29.4 ºC
C. 61.7 ºC
D. 127.0 ºC

7. **Machinery: Each cylinder in a eight cylinder tractor engine has a bore (diameter) of 4.75 inches and a piston stroke of 5.9 inches. What is the approximate total displacement of this engine in liters?**
Area of a cylinder bore = $(\pi) \times (\text{radius})^2$ $\pi = 3.14$ radius = (diameter ÷ 2)
Displacement of a cylinder = (length of piston stroke) x (area of the cylinder bore)
1 liter = 61 cubic inches 1 cubic inch = 0.0164 liter

A. 1.7 liters
B. 2.8 liters
C. 13.7 liters
D. 54.8 liters

8. Electrical: A kilowatt-hour meter records 5.9 kilowatts of power being used by an eight-horsepower electric motor during one hour when it is operating at 230 volts and using 28 amps. What is the approximate power factor for this motor?
Voltage = Amperage × Resistance 1kilowatt = 1000 hours
Wattage = Voltage × Amperage × Power Factor

A. 0.92 power factor
B. 0.97 power factor
C. 1.09 power factor
D. 9.16 power factor

9. Compact Equipment: What is the approximate speed, in miles per hour, for a riding mower that travels 80 meters in 39.5 seconds? 5,280 ft = 1 mile
3600 seconds = 1 hour 1 foot = 0.3048 meter

A. 3.5 miles per hour
B. 4.5 miles per hour
C. 5.5 miles per hour
D. 6.5 miles per hour

10. Structural: A round concrete column is fabricated using 5.8 cubic yard of concrete. If the concrete column is 40 inches in diameter, what is the approximate height of the column?
1 cubic yard = 27 cubic feet 1 cubic foot = 1728 cubic inches
1 foot = 12 inches diameter = (2 × radius) $\pi = 3.14$
Volume of cylinder = π × (cylinder radius)^2 × cylinder height

A. 17.95 feet
B. 18.45 feet
C. 18.95 feet
D. 19.45 feet

11. Structural: Steel angle iron is sold for $1.83 per linear foot, steel rod is sold for $1.61 per linear foot, and steel pipe is sold for $2.94 per linear foot. If 19.5 feet of angle iron, 15.5 feet of rod, and 12 feet of pipe are purchased, what is the approximate total price for the metal before taxes?

A. $ 9.59
B. $ 95.92
C. $ 959.92
D. $ 9599.20

12. Environmental: A concrete slab will be installed to prevent contamination of the ground at a mixing and cleaning site for pesticide equipment. The inside dimensions of the slab's form boards are 24 feet wide by 14 feet long and the concrete forms provide an approximate depth of 5 inches. Order an additional 10 percent concrete to allow for the irregularity of the ground surface and note that pre-mixed concrete is sold/delivered in quarter-yard quantities (such as: 3 yd^3, 6.25 yd^3, 10.75 yd^3, 15.5 yd^3). Approximately how many cubic yards (yd^3) of pre-mixed concrete should be ordered?

1 cubic yard = 27 cubic feet 1 cubic foot = 1728 cubic inches
1 foot = 12 inches
Volume of rectangular prism = Length × Width × Height

A. 3.50 yd^3
B. 5.25 yd^3
C. 5.75 yd^3
D. 68.50 yd^3

13. Machinery: There are 195 acres of corn with an average yield of 96.5 bushels per acre. Due to moisture content, a bushel has an average weight of 64.2 pounds. If the price is 14.2 cents per pound of harvested corn, what is the approximate income for the crop? 1 ton = 2000 pounds 1 bushel = 2.44 cubic feet

A. $ 120,808
B. $ 171,548
C. $ 1,208,084
D. $ 1,715,479

14. Electrical: An inefficient electrical motor (identified as motor A) is to be replaced with a new high efficiency motor (identified as motor B). Motor A was operated 6 hours per day, 325 days each year, and its annual electrical bill averaged $12,553. The purchase price for motor B is $1,120 and the installation charge is $345. Motor B will be operated the same number of hours as motor A and will have an average cost of $6.07 per hour to operate. Approximately how many months will motor B need to operate to payback the purchase and installation cost of the new motor?

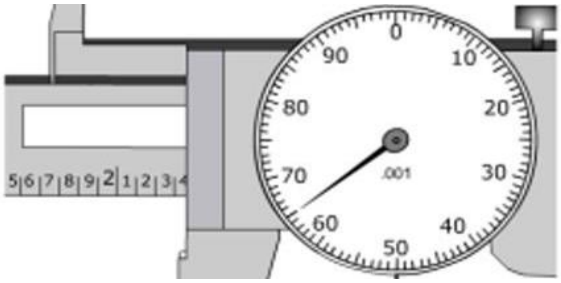
1 year = 12 months 1 day = 24 hours 1 year = 365 days

$$\text{Payback} = \frac{\text{total cost for new high efficient equipment}}{\text{average saving in energy cost per month}}$$

A. 24.5 months
B. 96.2 months
C. 125.3 months
D. 294.4 months

15. Compact Equipment: A partial picture of a 6-inch dial caliper is shown in the space below. The measurement displayed on the dial caliper is between 2 inches and 3 inches. What measurement is displayed on the dial caliper?

A. 2.365 inches
B. 2.465 inches
C. 2.653 inches
D. 2.654 inches



16. Compact Equipment: Which of the following will have the greatest weight in pounds: 4.6 gallons of gasoline, 4.1 gallons of diesel, 3.8 gallons of 15W-40 engine oil, or 3.9 gallons of automatic transmission fluid?

1 gallon of gasoline = 6.3 pounds 1 gallon of diesel = 6.943 pounds
1 gallon 15W-40 engine oil = 7.3 pounds
1 gallon automatic transmission fluid = 7.298 pounds

A. 4.6 gallons of gasoline
B. 4.1 gallons of diesel
C. 3.8 gallons of15W-40 engine oil
D. 3.9 gallons of automatic transmission fluid

17. Structural: Which of the following quantities of lumber has the <u>smallest</u> number of board-feet?

1 board-foot = 144 cubic inches 1 square foot = 144 square inches

A. 24 boards measuring 1 inches by 8 inches by 14 feet
B. 27 boards measuring 2 inch by 4 inches by 12 feet
C. 22 boards measuring 2 inches by 6 inches by 10 feet
D. 20 boards measuring 1 inch by 8 inches by 16 feet

18. Environmental: A pesticide label specifies that 0.5 pint of pesticide concentration is to be diluted (mixed) with 25 gallons of water for each acre treated (amount applied per acre). Approximately how many gallons of pesticide concentration are required to treat a 640-acre field?

128 ounces = 1 gal 16 ounces = 1 pint

A. 25 gallons
B. 30 gallons
C. 35 gallons
D. 40 gallons

19. Machinery: A tractor's power takeoff produces 275 horsepower and turns at 1000 revolutions per minute. Approximately how much torque, in foot-pounds, can this PTO produce?

Torque in foot-pounds = $\frac{\text{PTO Horsepower x 5252}}{\text{Revolutions / Minute}}$

A. 1111 foot-pounds
B. 1222 foot-pounds
C. 1333 foot-pounds
D. 1444 foot-pounds

20. Electrical: The interior electrical lighting of a farm structure is being replaced with high efficiency lighting. The 20 incandescent, 200-Watt lights will be replaced with 20 LED, 50-Watt lights. If the lights are operated 88 hours per month and electricity cost 10 cents per kilowatt-hour (kWh), what is the approximate reduction in electrical power costs each month?

1000 Watts = 1 kilowatt

A. $ 26.40
B. $ 41.50
C. $ 62.60
D. $ 88.70

21. Electrical: The monthly charge to operate an electrical water pump is 12.75 cents per kilowatt hour (kwh) for the first 1000 hours and 13.9 cents for each kwh greater than 1000 hours. If the pump uses 6.75 kilowatts per hour and it operates 22 days each month for 12 hours each day, what is the approximate monthly kwh charge to operate the pump?

1 kilowatt = 1000 Watts 100 cents = $1.00

A. $ 196.30
B. $ 236.20
C. $ 274.10
D. $ 314.00

22. Compact Equipment: A 25 horsepower single-cylinder engine is operating at 3,480 feet above sea level. What approximate horsepower can be produced by the engine if the engine's power is reduced 1.5 percent for each 1000 feet of elevation above sea level?

A. 23.1 horsepower
B. 23.7 horsepower
C. 24.3 horsepower
D. 24.9 horsepower

23. Structural: A 21-foot length of unthreaded black pipe is to be cut into 13 pieces of equal length. Both ends of the 21-foot pipe are already cut square (90 degrees) and the 13 pieces will also have square cut ends. The metal saw being used cuts a kerf (material removed by saw blade) that is 5/32 inch wide. Other than the material lost by the saw kerf, none of the pipe is wasted or unused in cutting the 13 pieces of equal length. What is the approximate length (in feet, inches and fraction of an inch) of each piece of the pipe.

Information: 1 foot = 12 inches 5/32 inch = 0.15625 inch

A. 1 foot, 6 and 7/16 inches
B. 1 foot, 6 and 15/32 inches
C. 1 foot, 7 and 1/4 inches
D. 1 foot, 7 and 3/8 inches

24. Environmental: Water flows (horizontally) through 86 feet of pipeline that includes three 90-degree elbows. The water flow rate is 6.5 gallons per minute where the water exits the 86-foot pipeline. The pressure loss through the pipeline is equivalent to 6.2 vertical feet of head (pressure) loss per 100 feet of horizontal run. The head loss through each elbow is equivalent to that of 4.75 feet of additional horizontal length. Approximately, what is the vertical head (pressure) loss for this horizontal pipeline?

A. 5.3 feet of head loss
B. 6.2 feet of head loss
C. 100.3 feet of head loss
D. 533.2 feet of head loss

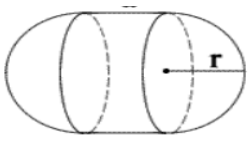
25. Machinery: The center section of a fuel storage tank has a cylindrical shape (capsule) that is 6.5 feet long with an inside diameter of 3.5 feet. Each end of the tank has a half-sphere shape (two halves of a sphere), each with an internal radius of 21 inches. What is the approximate total storage capacity of the tank in gallons? 1 gallon = 231 cubic inches 1 foot = 12 inches $\pi = 3.14$

Diameter = 2 × (radius)

Volume of a Cylinder = $(\pi) \times (\text{radius})^2 \times (\text{length})$

Volume of Sphere = $4/3 \times (\pi) \times (\text{radius})^3$

A. 515 gallons
B. 575 gallons
C. 635 gallons
D. 695 gallons



Picture of Capsule