2012 Examination for the
National Agricultural Technology and Mechanical Systems
Career Development Event

Name ____________________________________________

Print Name Legibly

Read the following instructions:

Mark all answers on the Scantron sheet using a pencil.

You have one hour to complete this exam.

You may write on this exam, but information on this exam is not graded. Blank sheets are provided if additional space is needed.

If a reference sheet (diagrams, pictures, tables) is needed to answer a question, the question will refer to the appropriate reference sheet.

Read each question carefully and calculate the single correct answer. If a marked Scantron answer needs to be changed, completely erase the incorrect answer and clearly mark the appropriate answer.

Students need a calculator to complete this examination, but they are not allowed to share a calculator with another student.

Students are NOT allowed to use any type of electronic communication device, including but not limited to cellular telephones, pagers, two way radios, or PDAs, during the CDE on Wednesday or Thursday. If a student uses, handles, or accesses any type of electronic communication device, she or he may be disqualified. If a personal emergency should arise, students should contact a CDE official immediately for assistance.

This exam begins on the back of this sheet.
2012 Written Examination for the
National Agricultural Technology & Mechanical Systems
Career Development Event

Mark all answers on the Scantron sheet using a pencil. Read each question carefully and mark the single correct answer on the Scantron sheet. Students need a calculator to complete this examination, but they are not allowed to share a calculator with another student. Information written on this exam will not be graded.

SECTION 1: MACHINERY & EQUIPMENT SYSTEMS Questions 1-5

1. A diesel tank has the capacity to hold 95.2 liters of fuel. What is the approximate capacity of the tank in gallons? Information: 1 liter = 0.26 gallon 1 gallon = 3.79 liters
A. 15 gallons
B. 25 gallons
C. 85 gallons
D. 365 gallons

2. The torque requirement for a bolt is listed as 4 foot-pounds. If the only torque wrench available is calibrated in inch-pounds, how many inch-pounds are required to equal 4 foot-pounds? Information: 1 foot = 12 inches 1 pound = 16 ounces
A. 0.33 inch-pounds
B. 12 inch-pounds
C. 48 inch-pounds
D. 96 inch-pounds

3. If the average weight of wheat is 60 pounds per bushel, approximately how many bushels of wheat can be transported in a rail car with a maximum carrying capacity of 94.2 tons? Information: 1 ton = 2000 pounds 1 bushel 2.44 cubic feet
A. 1,287 bushels
B. 2,162 bushels
C. 3,140 bushels
D. 4,225 bushels

4. A hydraulic cylinder that operates the arm of a skid steer loader has a bore diameter of 3 inches and a stroke of 36 inches. The tractor’s hydraulic system produces a maximum pressure of 2,900 pounds per square inch. Approximately, what is the maximum force the cylinder can exert on the lift arm? Information: Area of a cylinder bore = \( \pi \times (radius)^2 \) \( \pi = 3.14 \) radius = (diameter \( \div 2 \))
A. 20,490 pounds
B. 40,640 pounds
C. 60,810 pounds
D. 81,950 pounds

5. Each cylinder in a six cylinder tractor engine has a bore diameter of 4.1 inches and a piston stroke of 6.4 inches. What is the approximate total displacement of this engine in liters? Information: Area of a cylinder bore = \( \pi \times (radius)^2 \) \( \pi = 3.14 \) radius = (diameter \( \div 2 \))
Volumetric displacement of a single cylinder = (length of piston stroke) x (the area of the cylinder bore)
1 liter = 61 cubic inches 1 cubic inch = 0.0164 liter
A. 1.4 liters
B. 8.3 liters
C. 33.2 liters
D. 506.7 liters

You may write on this exam, but information written on this exam is not graded.
Mark all answers on the Scantron form.
SECTION 2: ELECTRICAL SYSTEMS  Questions 6-10

6. If each outlet on an electrical circuit theoretically uses 1.5 amperes, approximately how many outlets may safely be installed on a circuit sized to carry a maximum of 20 amperes?
   A. 10 outlets
   B. 13 outlets
   C. 18 outlets
   D. 20 outlets

7. What is the approximate power consumption (Wattage) of a 120 volt electrical circuit (wired in parallel) with 6 incandescent (resistance) lighting loads, each load using 1.75 amps?
   Information: Wattage = Voltage × Amperage
   Voltage = Amperage × Resistance
   A. 210 Watts
   B. 728 Watts
   C. 1260 Watts
   D. 6448 Watts

8. The monthly charge to operate an electric pump is 9.5 cents per kilowatt hour (kWh) for the first 1000 hours and 8.25 cents for each kWh greater than 1000 hours. If this pump uses 2669 kWhs of electricity during a single month, what is the approximate monthly cost to operate the pump?
   Information: 1 kilowatt = 1000 Watts 100 cents = $1.00 1 hour = 60 minutes
   A. $138
   B. $159
   C. $233
   D. $253

9. The Occupational Safety and Health Administration (OSHA) lists the daily permissible noise level exposure during an eight-hour work day as 90 decibels (dB) followed by at least ten hours of recovery time where the noise level must be at 70 dB or lower. If the noise level is elevated to 95 dB, the daily permissible noise level exposure is limited to 4 hours. The OSHA guidelines indicate that for every 5 dB above the permissible level it reduces the permissible exposure time by 50 percent. Approximately how much time can a person be safely exposed to 92.5 dB?
   Information: 50% = 0.5 8 hours exposure - (8 hours × 50% reduction) = 4 hours exposure
   A. 6.0 hours
   B. 6.5 hours
   C. 7.0 hours
   D. 7.5 hours

10. A work environment exposes employees to Sound 1 for approximately 5 hours and 24 minutes and Sound 2 for approximately 3 hours and 9 minutes. The safe exposure time for Sound 1 is 6 hours and Sound 2 is 7 hours. When the daily noise exposure is composed of two or more periods of noise exposure, the combined effect determines safe exposure levels. What is the approximate Combined Exposure Value for these two sounds? Information: 1 hour = 60 minutes
   Sound Exposure Is Safe When: (Exposure Time ÷ Allowed Exposure Time) = Value that is less than or equal to 1
   Sound Exposure Is Unsafe When: (Exposure Time ÷ Allowed Exposure Time) = Value that is greater than 1
   Combined Exposure Value = \( \frac{E_1}{T_1} + \left( \frac{E_2}{T_2} \right) \)
   \( E_1 = 1^{st} \text{Exposure Time} \quad E_2 = 2^{nd} \text{Exposure Time} \quad T_1 = 1^{st} \text{Safe Exposure Time} \quad T_2 = 2^{nd} \text{Safe Exposure Time} \)
   A. 1.11 CEV
   B. 1.26 CEV
   C. 1.35 CEV
   D. 1.48 CEV
SECTION 3: ENERGY SYSTEMS  Questions 11-15

11. A wattmeter measures 6477 Watts of power being used by a eight horsepower electric motor (induction load), when it is operating at 220 volts and using 32 amps. What is the approximate power factor for this motor? Information: Voltage = Amperage × Resistance Wattage of Induction Load = Voltage × Amperage × Power Factor

A. 0.92 power factor  
B. 0.94 power factor  
C. 0.96 power factor  
D. 0.98 power factor

12. A portable auger has a 6 inch diameter pulley on the drive shaft and the auger needs to turn at 880 revolutions per minute. The auger will be powered by an electric motor that rotates at 1725 revolutions per minute. What is the approximate diameter of the pulley needed on the motor shaft to rotate the auger at the correct speed? Information: 1 foot = 12 inches Pulley Size Formula: (Diameter of Pulley 1 × Speed of Pulley 1) = (Diameter of Pulley 2 × Speed of Pulley 2)

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

13. A waterline that is used 24 hours each day has three different leaks and the amount of water lost at each leak is measured during a 30 minute time period. The three quantities of water from the leaks are (a) 78 ounces, (b) 29 ounces, and (c) 112 ounces. Approximately how many gallons will be lost from the waterline during each day of operation? Information: 1 gallon = 128 ounces 24 hours = 1 day 60 minutes = 1 hour

A. 41 gallons per day  
B. 82 gallons per day  
C. 164 gallons per day  
D. 1970 gallons per day

14. The available electronic thermometer is calibrated in degrees Fahrenheit (°F), but the requirements to anneal (soften) a machined part lists the temperature as a range from 32 to 38 degrees Celsius (°C). What is the approximate temperature range for annealing in degrees Fahrenheit? Information: °F = (9/5 °C) + 32 °C = 5/9 (°F - 32) Water freezes at 32 °F

A. 0 to 3 °F  
B. 0 to 10 °F  
C. 64 to 70 °F  
D. 90 to 100 °F

15. An old electrical motor burned out and must be replaced. The old motor operated an average of 8 hours each day, 312 days each year, and its average annual electrical bill was $14,985. The replacement cost for a motor (identified as A) that is identical to the old motor sells for $990 dollars and the installation charge is $285. An energy efficient motor (identified as B) sells for $1,490 and the installation charge is $325. Motor B will have an average cost of $5.87 per hour to operate. Approximately how many months must motor B operate to make up for (payback) the higher cost to purchase and install the energy efficient motor B? Information: 1 year = 12 months 1 day = 24 hours Burnout Payback = (total cost for high efficient equipment) - (total cost for identical equipment) (average saving in energy cost per month)

A. 1.6 months  
B. 6.5 months  
C. 18.0 months  
D. 19.4 months
SECTION 4: STRUCTURAL SYSTEMS Questions 16-20

16. Which of the following quantities of lumber has the greatest number of board-feet?
Information: 1 board-foot = 144 cubic inches  1 square foot = 144 square inches
A. 12 boards measuring 2 inches by 4 inches by 10 feet
B. 10 boards measuring 1 inch by 8 inches by 12 feet
C. 6 boards measuring 2 inches by 6 inches by 10 feet
D. 8 boards measuring 1 inch by 12 inches by 12 feet

17. Approximately how many sheets of standard sized plywood, three-quarters inch thick, are needed to completely cover a floor measuring 36 feet by 24 feet?  
Information: Plywood measures 4 feet by 8 feet
A. 12 sheets of plywood
B. 17 sheets of plywood
C. 22 sheets of plywood
D. 27 sheets of plywood

18. An irregularly shaped metal tank weighs 47 pounds empty. When it is filled with water, the tank and water weighs 440 pounds. Approximately how many gallons of water are required to fill this tank?  
Information: 1 gallon water = 8.34 pounds  1 gallon = 231 cubic inches
A. 6 gallons
B. 47 gallons
C. 53 gallons
D. 392 gallons

19. A 20-foot length of square tubing is to be cut into 14 pieces of equal length. Both ends of the 20-foot tubing are already cut square (90 degrees) and the 14 pieces will also have square cut (90 degrees) ends. The metal saw being used cuts a kerf (material removed by saw blade) that is 3/16 inch wide. Other than the material lost by the saw kerf, none of the tubing is wasted or unused in cutting the 14 pieces of equal length. What is the approximate length (in feet, inches ~ fraction of an inch) of each piece of the square tubing?  
Information: 1 foot = 12 inches  3/16 inch = 0.1875 inch
A. 1 foot, 4~29/32 inches
B. 1 foot, 4~15/16 inches
C. 1 foot, 4~31/32 inches
D. 1 foot, 5~1/32 inches

20. A round concrete column is fabricated using one cubic yard of concrete. If the concrete column is 15 feet in length, what is the approximate diameter of the column?  
Information: 1 cubic yard = 27 cubic feet  1 cubic foot = 1728 cubic inches  1 foot = 12 inches
Volume of cylinder = \( \pi \times (\text{cylinder radius})^2 \times \text{cylinder height} \)  
\( \pi = 3.14 \) \( \text{diameter} = (2 \times \text{radius}) \)
A. 0.8 inch diameter
B. 1.5-inch diameter
C. 15.7-inch diameter
D. 18.2-inch diameter
You may write on this exam, but the Scantron sheet is graded.

SECTION 5: ENVIRONMENTAL & NATURAL RESOURCE SYSTEMS Questions 21-25

21. Approximately how many hectares are in a rectangular field measuring 1210 feet by 336 feet?

   Information: 1 acre = 43,560 square feet  
   1 hectare = 2.47 acres  
   1 acre = 0.41 Hectares

   Area of Rectangle = length \times width

   A. 3.8 hectares
   B. 5.4 hectares
   C. 7.6 hectares
   D. 9.6 hectares

22. Use reference sheet A to answer this question. The diagram on reference sheet A shows the perimeter and dimensions of an irregularly shaped pasture. What is the area of the triangular shaped portion of land in the lower right-hand corner that is not part of the irregularly shaped pasture?

   Information: Area of Triangle = \frac{1}{2} (Base Length \times Height)

   1 acre = 43,560 square feet  
   1 mile = 5,280 feet

   A. 57.9 acres
   B. 65.7 acres
   C. 73.6 acres
   D. 115.8 acres

23. Use reference sheet A to answer this question. The diagram on reference sheet A shows the perimeter and dimensions of an irregularly shaped pasture. What is the area of the rectangular portion of land in the lower left-hand corner that is not part of the irregularly shaped pasture?

   Information: Area of Rectangle = length \times width

   1 acre = 43,560 square feet  
   1 mile = 5,280 feet

   A. 98.6 acres
   B. 107.7 acres
   C. 117.1 acres
   D. 129.6 acres

24. Use reference sheet A to answer this question. The diagram on reference sheet A shows the perimeter and dimensions of an irregularly shaped pasture. What is the approximate area of the irregularly shaped pasture in sections, given the measurements and other information provided on the diagram?

   Information: 1 section of land = 640 acres  
   1 mile = 5,280 feet

   Area of Rectangle = length \times width

   1 yard = 3 feet  
   1 acre = 43,560 square feet

   A. 1.1 section
   B. 2.2 sections
   C. 3.3 sections
   D. 4.4 sections

25. Water flows 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

You may write on this exam, but information written on this exam is not graded.
Mark all answers on the Scantron form.