

STUDENTS DO NOT OPEN THIS TEST OR BEGIN UNTIL INSTRUCTED TO START

2023 Examination for the National Agricultural Technology and Mechanical Systems Career Development Event

Do Not Distribute

- *If a diagram, picture, or table is needed to answer a question, the question will refer to the appropriate figure/page.*
- *Read each question carefully and determine the single correct answer.*
- *If a mark on the scan sheet needs to be changed, completely erase the incorrect answer and clearly mark the appropriate answer on the answer sheet.*
- *Each student needs a calculator to complete this examination, but calculators may not be shared between students.*
- *Formulas and conversion values are provided. Do not round off intermediate answers when using the calculator to solve these problems.*

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 during the CDE, students should contact a CDE official immediately for assistance.

This exam begins on the back of this sheet.

2023 Written Examination for the National Agricultural Technology & Mechanical Systems Career Development Event

Mark all answers on the scan sheet using a pencil. Read each question carefully and mark the single correct answer on the scan sheet. Each student needs a calculator to complete this examination, but calculators may not be shared between students. Information written on this exam will not be graded.

1. **Machinery:** A combine costs \$1.55 per acre, what is the cost to operate the combine for a rectangular field measuring 2147 meters by 0.85 miles? 1 acre = 43, 560 square feet 1 hectare = 2.47 acres 1 acre = 0.4045 Hectares

Area of Rectangle = length x width

1 mile = 5,280 feet

1 foot = 0.3048 meter

- A. \$578.60
- B. \$613.50
- C. \$1,123.50
- D. \$1,124.90

2. **Electrical:** A variety of incandescent lights are all operating on a single 120-volt electrical circuit in a livestock barn. The circuit includes ten 150-watt lights, three 300-watt lights, and twelve 40-watt lights. What is the amperage of the circuit with all of these lights operating?

Total Wattage = Voltage x Amperage

- A. 13.2 amps
- B. 17.5 amps
- C. 23.2 amps
- D. 24.0 amps

3. **Compact Equipment:** For a naturally aspirated engine, what component mixes air and fuel in the proper ratio for efficient combustion?

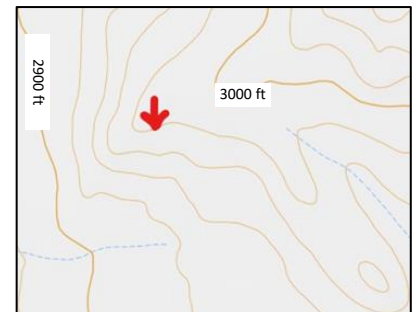
- A. Throttle Body
- B. Choke Valve
- C. Carburetor
- D. Injector

4. **Structural:** Steel angle iron is sold for \$1.79 per linear foot, steel tubing is sold for \$2.11 per linear foot, and rebar is sold for 56 cents per linear foot. If 112 feet of angle iron, 95 feet of tubing, and twelve 20-foot lengths of rebar are purchased, and 6.67% taxes are paid with the purchase, what is the approximate total price for the metal?

- A. \$ 474.96
- B. \$ 493.96
- C. \$ 524.96
- D. \$ 571.04

5. **Environmental:** Refer to the enlarged view of contour lines (in feet) on the topographic map at the right of the page. What is the elevation of the line marked by the arrow?

- A. 2980 feet
- B. 3500 feet
- C. 4100 feet
- D. 4600 feet



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6. **Environmental:** Using the foresight rod measurement marked with the arrow in the image provided, what is the elevation of the unknown point? Assume a benchmark elevation of 1,252 feet and a backsight of 2.45. A Philadelphia rod is used.

A. 1,242.20 feet
 B. 1,247.02 feet
 C. 1,254.45 feet
 D. 1,261.80 feet



7. **Machinery:** For a hydraulic cylinder, which dimension determines the output force in psi?

A. Diameter of the cylinder
 B. Length of the cylinder
 C. SAE grade of the hydraulic oil
 D. The horsepower of the hydraulic pump

8. **Electrical:** Circuit protection devices for motor circuits incorporate a time-delay component to allow for a brief period of overload needed for electric motor _____.

A. controllers
 B. cool-down
 C. starting
 D. shifting

9. **Compact Equipment:** Which component would not be at fault when troubleshooting the fuel delivery system of a gravity-feed float bowl style carburetor?

A. Fuel pump
 B. Emulsion tube
 C. Fuel hose
 D. Float-needle

10. **Structural:** For a non-family placement/internship agricultural production SAE, what is the FLSA maximum height that a person under 16 years old may work from using a ladder or scaffold?

A. 15 feet
 B. 18 feet
 C. 20 feet
 D. 25 feet

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11. **Structural:** Which roof type is the most used for agricultural structures?

- A. Gambrel
- B. Gable
- C. Arch
- D. Hip and Gable

12. **Environmental:** The Revised Universal Soil Loss Equation is composed of six factors to predict the long-term average annual soil loss and one of those values is the soil erodibility factor (K factor). What is the soil texture with the highest K factor range?

- A. Sandy loam
- B. Silt loam
- C. Clay
- D. Silt

13. **Machinery:** What is the approximate speed, in miles per hour, for a fertilizer spreader that travels 176 yards in 1 minute and 53.5 seconds?

5,280 ft = 1 mile 60 seconds = 1 minute 60 minutes = 1 hour 1 foot = 0.3048 meter

- A. 2.95 miles per hour
- B. 3.17 miles per hour
- C. 3.95 miles per hour
- D. 4.34 miles per hour

14. **Electrical:** In a series-wound motor , the stator windings are connected in series with the armature, while in a _____, wound-motor the stator windings are parallel.

- A. perpendicular
- B. resistance
- C. reverse
- D. shunt

15. **Compact Equipment:** Each cylinder in a three-cylinder engine has a circumference of 11.6 inches and a piston stroke of 6.5 inches. What is the approximate total displacement of the engine in liters?

Information: 1 liter = 61 cubic inches Circumference of a circle = $2 \times \pi \times \text{radius}$
 Area of a cylinder bore = $\pi \times \text{radius}^2$ $\pi = 3.14$ radius = diameter $\div$ 2
 Displacement of a single cylinder = (length of piston stroke) x (the area of the cylinder bore)

- A. 3.4 liters
- B. 4.1 liters
- C. 4.6 liters
- D. 5.1 liters

- 16. Compact Equipment:** A gasoline mower's power takeoff (PTO) produces 20 horsepower and turns at 1500 revolutions per minute. Approximately how much torque, in foot-pounds, can this PTO produce?

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

- A. 65.02 foot-pounds
- B. 70.03 foot-pounds
- C. 85.02 foot-pounds
- D. 95.03 foot-pounds

- 17. Structural:** Concrete is poured inside a vertical tube form to construct a pylon. If 1.50 cubic yards of concrete are needed to fill the pylon that is 12 feet 5 inches tall, what is the approximate inside diameter of the pylon in inches?

1 cubic yard = 27 cubic feet

1 cubic foot = 1728 cubic inches

1 foot = 12 inches

Volume of cylinder = $\pi \times (\text{cylinder radius})^2 \times \text{cylinder height}$

$\pi = 3.14$ diameter = $(2 \times \text{radius})$

- A. 12.23 inches
- B. 15.65 inches
- C. 24.46 inches
- D. 28.55 inches

- 18. Environmental:** What flood control mechanism serves to contain excess water runoff temporarily to allow the water to slowly drain or evaporate?

- A. detention pond
- B. retention pond
- C. swale
- D. culvert

- 19. Machinery:** A recommendation for a CNC plasma table is to ensure an air pressure of 80 psi for high quality cuts. The air compressor provides 235 psi, what component should be installed to ensure high quality cuts?

- A. gouging torch tip
- B. voltmeter
- C. oil injection pump
- D. pressure regulator

- 20. Electrical:** When wiring to control the same light from three different locations, what switch combination must be used?

- A. (2) three-way switches
- B. (2) three-way switches and a four-way switch
- C. (3) four-way switches and a three-way switch
- D. (3) DPDT switches

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21. **Electrical:** A water supply station used to refill pesticide tanks has a 3-horsepower electrical pump that operates at 120 volts. If the motor is 90 percent efficient and has a 0.8 power factor, what is the approximate amperage of the motor? $\text{horsepower} = \frac{\text{voltage} \times \text{amperage} \times \text{power factor} \times \text{efficiency}}{746}$
 1 horsepower = 746 Watts

- A. 8.1 amps
- B. 26.0 amps
- C. 32.5 amps
- D. 259.1 amps

22. **Compact Equipment:** What does the pictorial represent?

- A. safety alert
- B. slow moving vehicle alert
- C. service alert
- D. tire pressure alert



23. **Structural:** Which construction material would have the highest K-value but the lowest R-value?

- A. Polyurethane foam
- B. 2x4 Wood stud
- C. Concrete block
- D. Cellulose insulation

24. **Environmental:** What computer software is used to map, model, query, and analyze large quantities of data within a single database according to georeferenced data?

- A. Variable-rate technology
- B. Site-specific management
- C. Global positioning system
- D. Geographic information system

25. **Machinery:** When driving agricultural machinery traveling at speeds 25 miles per hour or less on public roads, what should be visible from at least 500 feet from the rear of the equipment?

- A. Speed Identification Sign
- B. Operator Station
- C. Slow Moving Vehicle Emblem
- D. Registration and License Plate

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