2011 Examination for the
National Agricultural Mechanics Career Development Event:
Mark all answers on the Scantron sheet using a pencil. Read each question carefully and identify the single correct answer. Use the blank sheet(s) of paper to do all scratch work. Students will need a calculator to complete this examination, but they are not allowed to share a calculator with another student.

SECTION 1: MACHINERY & EQUIPMENT SYSTEMS Question 1-20

1. What is most likely the problem with a tractor’s hydraulic system if it has foaming hydraulic oil?
   A. The oil is dirty  
   B. Water is in the hydraulic oil  
   C. The oil level is too low  
   D. The hydraulic pump is going bad

2. What technique will reduce the condensation (very slight build up of water) in the fuel tank of a tractor?
   A. Refuel at end of day  
   B. Refuel at start of day  
   C. To reduce time required for warm up  
   D. Always (each morning) drain the water

3. If a tractor has 20% percent wheel slippage, what could be done to correct the tractor’s wheel slippage?
   A. No correction is needed, 20 percent wheel slippage is appropriate  
   B. Reduce tractor ballast  
   C. Increase tractor ballast  
   D. Double the tractor’s operating speed to reduce the percentage wheel slippage

4. The seeding tool uses two, 1 1/2-inch hydraulic rams to raise and lower its frame. If each ram receives a maximum pressure of 3,000 pounds per square inch, what is the maximum force that each lift cylinder can produce?
   Note: Force = (Pressure) x (Area of Piston)
   \[ \text{Area of circle} = \pi R^2 \]
   \[ \pi = 3.14 \]
   A. 1,688 pounds  
   B. 5,299 pounds  
   C. 6,750 pounds  
   D. 13,500 pounds
5. A tractor produces 100 PTO horsepower and has a power takeoff speed of 1000 revolutions per minute. Approximately how much torque, in foot-pounds, can this tractor produce?

Note: Torque = \( \frac{\text{PTO Horsepower} \times 5252}{\text{Rotational Speed}} \)

A. 5 foot-pounds
B. 100 foot-pounds
C. 525 foot-pounds
D. 973 foot-pounds

6. When boosting a "down" battery one should take care to connect the jumper cables in:

A. parallel
B. tandem
C. series
D. series-parallel

7. On a 4-stroke cycle engine, there is a power stroke during:

A. every revolution of the crankshaft
B. every other revolution of the crankshaft
C. every four revolutions of the flywheel
D. none of the above

8. A tractor PTO shaft rated at 540 RPM would have:

A. 6 splines
B. 12 splines
C. 20 splines
D. 21 splines

9. A slow moving vehicle (SMV) sign should be displayed on farm vehicles that will not be operated on public roads at speeds faster than:

A. 25 miles per hour
B. 30 miles per hour
C. 35 miles per hour
D. 40 miles per hour

10. What color fuel tank would minimize the vaporization of gasoline during the summer months?

A. John Deere green
B. Case IH red
C. New Holland blue
D. Case IH white

11. What is the greatest cause of wear in a tractor’s hydraulic systems?

A. moisture
B. dirt
C. rust
D. none of the above
12. The type of agricultural machinery that is most sensitive to variations in travel speed is:
   A. power take-off driven
   B. ground wheel driven
   C. hydraulic motor driven
   D. electrical motor driven

13. What is the name of the device used to measure tractor power take off (PTO) horsepower?
   A. Calorimeter
   B. Load cell
   C. Precision scale
   D. Dynamometer

14. The theoretical field capacity of a machine such as a mower conditioner is a function of what two factors?
   A. Type of grass/hay and working width
   B. Travel speed and working width
   C. Tractor power output and field terrain
   D. Machine rating and velocity

15. Which of the following components physically engages the flywheel to the drive train?
   A. Clutch
   B. Transmission
   C. Differential
   D. Final drives

16. Which of the following causes knock in a gasoline engine?
   A. Fuel igniting properly
   B. Fuel igniting too rapidly
   C. Fuel igniting too slowly
   D. Incomplete combustion

17. Which of the following would be considered a fuel conservation technique?
   A. Operating tractor at partial load
   B. Consistently operating the engine at rated rpm
   C. Shifting to a lower gear and “throttling” up under light load
   D. Shifting to a higher gear and “throttling” down under light load

18. A twenty-foot-long dump truck bed is 54 inches deep and 90 inches wide. What is the approximate capacity of the truck bed in cubic yards if a load is struck level across the top?
   Note: 1 yd$^3 = 27$ ft$^3$
   A. 25 yd$^3$
   B. 27 yd$^3$
   C. 29 yd$^3$
   D. 675 yd$^3$
19. Which type of corn harvesting loss is generally the highest?
   A. header ear loss
   B. header kernel loss
   C. combine cylinder loss
   D. Combine separator loss

20. From Portable Grinder-mixers, (Herrmann and Harnes) page 3 Tip speed of a hammer mill can be calculated by using a tachometer to determine shaft speed along with the simple formula for the circumference of a circle. The shaft speed of a hammer mill is discovered to be 3183.1 rpm and the radius to the hammer tip is 9 inches. Find the hammer tip speed (ft/min).
   A. 14,992.401 ft/min
   B. 89,951.580 ft/min
   C. 5,621.970 ft/min
   D. 179,908.812 ft/min

SECTION 2: INDUSTRY AND MARKETING SYSTEMS  Question 21-40

21. Farmer A writes a check to Farmer B so that Farmer A’s cattle can graze on Farmer B’s pasture. This is an example of a _______lease.
   A. Cash
   B. Credit
   C. Custom
   D. Livestock share

22. Commercial livestock feedlots must comply with the pollution regulations established by the _______ Act.
   A. Agricultural Animal Waste (AAW)
   B. Concentrated Animal Feeding Operations (CAFO)
   C. Livestock and Feedlot (LF)
   D. National Manure Management (MNM)

23. The cast iron housing on your mower must be welded as you cannot purchase a new cast iron replacement. You are forced to weld mild steel to cast iron. The filler rod you should select should be made from:
   A. Mild steel.
   B. Cast iron.
   C. Brazing rod.
   D. None of the above, the two cannot be joined using this type of welding equipment.

24. Livestock are considered to be _______ property.
   A. Inventory
   B. Personal
   C. Real
   D. Working
25. The National Electric Code (NEC) classifies a confinement livestock facility as a _____ building for wiring purposes.
   A. Dry
   B. Damp
   C. Dusty
   D. Hazardous

26. The electrical wiring symbol at right represents a_____.
   A. Duplex convenience outlet
   B. Single receptacle outlet
   C. Duplex special purpose outlet
   D. Single special purpose outlet

27. The electrical circuit schematic at right specifies a_____ switch.
   A. Double-pole single-throw (DPST)
   B. Double-pole double-throw (DPDT)
   C. Single-pole double throw (SPDT)
   D. Single-pole single-throw (SPST)

28. If conduit is used in wiring a confinement livestock building, the NEC indicates that _____ should be used.
   A. Electrical metallic tubing (EMC)
   B. Intermediate metallic conduit (IMC)
   C. Rigid metallic conduit (RMC)
   D. Rigid non-metallic conduit (RNMC)

29. Sows in a farrowing house would be considered a_____ floor load from a building design standpoint.
   A. Capacity
   B. Carrying
   C. Dead
   D. Live

30. The decrease in value of an asset over time, such as a dairy milking parlor, is called_____.
   A. Appreciation
   B. Capital recovery
   C. Depreciation
   D. Time-value of money

31. Which of the following is a variable cost associated with owning small grain machinery?
   A. Storage
   B. Depreciation
   C. Interest
   D. Tires
32. A farmer has determined that his combine field loss is between 1-4 percent. The farmer should:
   A. harvest, this loss is acceptable.
   B. adjust the reel speed to 1.12 times the forward speed.
   C. slow the combine travel speed from 3.5 mph to 3 mph.
   D. increase the combine travel speed from 3.5 mph to 4.5 mph.

33. During a hay harvesting operation, assume the field efficiency is 88 percent and the 13 ft wide mower conditioner being used will travel at 6.5 mph. If the hay field is 10.25 acres, how long will it take to cut the hay?
   A. 1 hour
   B. 1 hour and 8 minutes
   C. 1 hour and 16 minutes
   D. 1 hour and 30 minutes

34. You are applying for a fuel tax rebate. The amount of fuel road tax is 32 cents per gallon. If the refunding is 50% of this amount, what will be the refund for 8,000 gallons of fuel?
   A. $1,280
   B. $2,560
   C. $3,840
   D. $5,120

35. Which of the following items represents a fixed machinery cost?
   A. Fuel
   B. Repairs
   C. Depreciation
   D. Labor

36. Which of the following is the safest way to drive a skid steer loader uphill with a heavily loaded bucket?
   A. Drive forward straight up the hill
   B. Drive forward diagonally across the slope of the hill
   C. Back straight up the hill
   D. None of the above methods is safer than others

37. Which of the following is the cause for the majority of fatal tractor accidents?
   A. Falling from the tractor while in is being driven
   B. Tractor runs over the operator
   C. Power take off entanglements
   D. Tractor roll over
38. When pulling (towing) a heavy load behind a tractor where is the best place to attach a chain to the tractor?
   A. The tractor’s drawbar
   B. Around the tractor’s rear axel
   C. The top three point hitch of the tractor’s draft link
   D. Low on the tractor’s ROPS

39. A Kinze grain cart unloads 500 bushels/minute. Approximately how long would it take for a man (7.5 ft³) to be completely pulled into the grain tank? (Assume 1 bushel = 1.25 ft³)
   A. 0.72 sec
   B. 5.00 sec
   C. 53.00 sec
   D. 75.00 sec

40. A skid steer was purchased 5 years ago for $44,600 and has an estimated 10 year life. If the accumulated depreciation is $23,400 what is the current book value?
   A. $21,200
   B. $23,400
   C. $28,600
   D. $44,600

SECTION 3: ENERGY SYSTEMS  Question 41-60

41. In a service entrance panel, the 120-volt circuits should be planned and installed so that the total load on each of the two 120-volt ungrounded (hot) service conductors is approximately equal. What is the term that can best be used to refer to this condition?
   A. National Electric Code (NEC)
   B. Parallel Distribution
   C. Equal Series Service
   D. Balanced Load

42. Overhead service conductors that run from the service pole to a building are usually made out of what type of material?
   A. Copper
   B. Aluminum
   C. Steel
   D. A mixture of copper, aluminum and steel

43. Overhead service conductors often contain a bare neutral wire. What is the name often applied to this conductor?
   A. Messenger
   B. Grounder
   C. Relayer
   D. Commoner
44. When there are three wires supplying power to the service entrance panel, if two wires are properly hooked up to the main breaker terminal lugs, to what is the third wire connected?
   A. Neutral buss
   B. The grounding rod
   C. The 120-volt breaker
   D. The 220-volt breaker

45. Circuit breakers within the electrical panel may get weak or go bad. This condition is usually caused by what problem?
   A. Repeatedly tripping the breaker
   B. Nuisance tripping of a GFCI
   C. Oversizing the circuit breaker (against NEC)
   D. Using a breaker with an ampere rating of 15 amps

46. When turning on an electric panel for the first time after working on it, you should wear safety glasses and do what other safety precaution?
   A. Stand to the side of the panel and look away
   B. Always use a safety harness
   C. Keep a class A fire extinguisher handy
   D. Wear leather insulated gloves

47. On a receptacle, polarizing is accomplished by having one narrow slot longer than the other. What conductor goes to the terminal that is connected to the longer narrow slot?
   A. Neutral
   B. Hot
   C. Ground
   D. Nothing – it is an extra terminal

48. In a standard 120/240-volt service entrance panel, what should the voltage measure between the two hot supply lugs?
   A. 0-volts
   B. 120-volts
   C. 240-volts
   D. 480-volts

49. In a standard 120/240-volt service entrance panel, what should the voltage measure between the grounding bar and the neutral buss?
   A. 0-volts
   B. 120-volts
   C. 240-volts
   D. 480-volts
50. In a standard 120/240-volt service entrance panel, what should the voltage measure from a terminal on a double-pole (240-volt) circuit breaker to the neutral buss?
   A. 0-volts
   B. 120-volts
   C. 240-volts
   D. 480-volts

51. To turn an overhead light on and off with wall switches from three different locations, the following number and types of light switches are necessary.
   A. Two 3-way switches and one 4-way switch
   B. One 3-way switch and two 4-way switches
   C. Two 3-way switches and one 2-way switch
   D. Three 4-way switches

52. If three different sized (watts) lights are connected to electrical power and the voltage available is equal throughout the circuit, these lights are wired:
   A. In series
   B. In parallel
   C. In a split connection with one light in series and two in parallel
   D. In a split connection with two lights in series and one in parallel

53. Which of the following motor types is most often used for a 120 volt portable single phase, electric drill?
   A. Capacitor start, induction run motor
   B. Shaded pole motor
   C. Split phase motor
   D. Universal

54. What current (amperage) is required for a 9000VA electric water heater when it operates at 240 volts? Assume a power factor of 1.
   Formula: Wattage = Voltage x Amperage x Power Factor
   1 kilowatt = 1000 Watts
   A. 15.0 amps
   B. 37.5 amps
   C. 40.0 amps
   D. 50 amps

55. If a wattmeter measures 6500 watts of power being used by a five horsepower electric motor, operating at 240 volt, and 29 amps, what is the approximate power factor for the motor?
   Formula: Wattage = Voltage x Amperage x Power Factor
   A. Power factor of 1
   B. 0.838 or 84% power factor
   C. 0.933 or 93% power factor
   D. 1.87 or 187% power factor
56. What type of wiring cable should be installed for a branch circuit in a facility for livestock confinement?
   A. underground feeder (UF)
   B. flexible armored (AC)
   C. non-metallic sheathed (NM)
   D. underground service entrance (USE)

57. According the NEC, the maximum allowable voltage drop for branch and feeder circuits for electrical motors is:
   A. 2%
   B. 4%
   C. 6%
   D. 8%

58. Assume convenience outlets will be placed a maximum of 20 feet apart along the outside walls in the farm machinery shed. If the shed is rectangular shaped, measuring 60 feet by 225 feet, what is the minimum number of convenience outlets required for this installation?
   A. 29
   B. 27
   C. 15
   D. 14

59. What year did the National Electric Code include the requirement that a GFCI protection should be installed in a livestock barn?
   A. 2002
   B. 2005
   C. 2008
   D. 2011

60. The thermal protection device found on many 120-volt electric motors would be classified as:
   A. single poled, normally open
   B. single poled, normally closed
   C. doubled poled, normally open
   D. doubled poled, normally closed

SECTION 4: STRUCTURAL SYSTEMS Questions 61-80

61. What is a metal called when it has two or more significant metallic elements?
   A. Alloy
   B. Ferrous
   C. Non-ferrous
   D. Carbon steel
62. What is another name for “stick” welding?
   A. Gas metal arc welding
   B. Tungsten inert gas welding
   C. Shielded metal arc welding
   D. Flux core arc welding

63. What does the third digit in the electrode identification designation E6011 indicate?
   A. The tensile strength of the core wire material in pounds per square inch
   B. The electrode can be used to weld in all positions
   C. The electrode can be used only to make flat or horizontal fillet welds
   D. The electrode flux contains iron oxide

64. What is the approximate temperature of the arc in shielded metal arc welding?
   A. 1250-1850 degrees Fahrenheit
   B. 2000-3500 degrees Fahrenheit
   C. 4000-5500 degrees Fahrenheit
   D. 6500-7000 degrees Fahrenheit

65. What is the average no-load (or open circuit) amperage and voltage in a direct current (DC) arc welding circuit?
   A. 100 amperes and 240 volts
   B. 100 amperes and 120 volts
   C. 0 amperes and 60-80 volts
   D. 0 amperes and 240 volts

66. What is the name of the mix of base metal and filler rod that remains after a weld is complete?
   A. Slag
   B. Bead
   C. Crater
   D. Electrode

67. What angle should be maintained between the base metal and the electrode while welding in the flat (down-hand) position?
   A. 75-80 degrees with the direction of travel
   B. 45 degrees with the direction of travel
   C. 75-80 degrees opposite the direction of travel
   D. 45 degrees opposite the direction of travel

68. To reduce the risk of hydrogen cracking, which electrode would you select?
   A. E7014
   B. E7018
   C. E7024
   D. E7010
69. Assume you have just purchased the hoses and regulators for an oxyacetylene welder. The 
hose that would be used to contain the oxygen would most likely be_________in color and the 
 fittings would have_________threads.
   A. Green, left-hand
   B. Green, right-hand
   C. Red; left-hand
   D. Red; right-hand

70. What is the device inside the power supply of an AC/DC SMAW welding machine that 
changes AC to DC?
   A. Rectifier
   B. Transformer
   C. Inverter
   D. Choke

71. How many board feet are 15 pieces 1” x 4” lumbers that are 8 ft long (use nominal not 
actual measurements)?
   A. 15
   B. 40
   C. 60
   D. 66

72. The horizontal lumber that is attached to rafters so that metal sheeting can be attached in 
pole building construction is called:
   A. purlins
   B. headers
   C. girt
   D. poles

73. The highest quality grade listed below for plywood is:
   A. N
   B. A
   C. B
   D. C
   E. E

74. SMAW cutting of galvanized metal should be avoided because it:
   A. increases the danger of a flashback
   B. can result in zinc poisoning
   C. increases the danger of a fire
   D. None of the above are correct
75. Assume you have a 30' x 60' farm shop with an equal sided gable roof. The roof has a four inches rise per foot of run. Assume a 2 ft overhang beyond the exterior wall. What will the approximate length of the common rafter when you are ready to install the rafter?

\[ a^2 + b^2 = c^2 \]

A. 15' 9 3/4"
B. 17' 11"
C. 15' 2 1/8"
D. 17' 1 1/4"

76. The portion of the common rafter which sets on the top plate is called the:
A. birds mouth
B. sill
C. rafter notch
D. valley notch

77. Roof pitch is a ratio of:
A. rise per foot of run
B. run per foot of rise
C. rise over span
D. run over span

78. On a typical shielded metal arc welding E7018 electrode, the 70 indicates what value for tensile strength?
A. 70 psi tensile strength
B. 700 psi tensile strength
C. 7,000 psi tensile strength
D. 70,000 psi tensile strength

79. A total of 478.5 feet of steel rod is used to construct a hay feeding rack and the rod weighs 0.658 pounds per foot of length. If the filler metal from welding adds an additional 2.8 pounds to the overall weight, what is the approximate total weight of the hay feeding rack?
A. 224 pounds
B. 273 pounds
C. 318 pounds
D. 329 pounds

80. Steel angle iron is sold for $1.95 per linear foot, steel rod is sold for $1.43 per linear foot, and steel pipe is sold for $2.86 per linear foot. If 5.9 feet of angle iron, 75.12 feet of rod, and 25.22 feet of pipe are purchased, what is the total price for the metal before taxes?
A. $ 91.82
B. $111.64
C. $131.48
D. $191.06
SECTION 5: ENVIRONMENTAL AND NATURAL RESOURCE SYSTEMS

Question 81-100

81. How many gallons of water are found in two acre-inches of water?
   A. 1,000 gallons
   B. 27,152 gallons
   C. 43,560 gallons
   D. 54,305 gallons

   Note: 7.48 gal = 1 ft³

82. What does a humidistat measure?
   A. Moisture in the air
   B. Amount of rainfall
   C. Oxygen levels in the soil
   D. pH levels in the soil

83. What type of irrigation pump is designed to pump water from deep wells?
   A. Centrifugal pump
   B. Gear pump
   C. Vertical turbine pump
   D. Siphon pump

84. What device is used to measure soil moisture levels?
   A. Humidistat
   B. Thermostat
   C. Manometer
   D. Tensiometer

85. In a Contained Animal Feeding Operation (CAFO), at what level does Carbon dioxide gas (CO₂) affect animals causing them to become dizzy and even unconscious?
   A. 4% CO₂
   B. 10% CO₂
   C. 14% CO₂
   D. 25% CO₂

86. In a swine Contained Animal Feeding Operation (CAFO), what is the optimum pipe discharge size for a manure pump that you would use to pump solid manure?
   A. 0 to 1 inch
   B. 1.5 to 2 inch
   C. 3.0 to 4 inch
   D. 5.0 to 6 inch

87. When used for manure storage, what rainfall frequency and amount should the holding pond be designed to withstand?
   A. 10 year, 48 hour rainfall
   B. 25 year, 24 hour rainfall
   C. 50 year, 24 hour rainfall
   D. 100 year, 72 hour rainfall
88. For a Contained Animal Feeding Operation (CAFO), what alternative method is an approved method to limit runoff other than a holding pond?
   A. Infiltration area
   B. Levee
   C. Sand bags
   D. Anaerobic lagoon

89. What type of biological treatment system is designed for the biodegradation of animal waste and does not use oxygen?
   A. Aerobic
   B. Composting
   C. Methane generation
   D. Anaerobic

90. What percentage of solids can most irrigation systems handle when applying manure for fertilization purposes?
   A. 0% solids
   B. 1% solids
   C. 4% solids
   D. 10% solids

91. What are the two most common locations where wet or spoiled grain is likely to be found in a grain bin that is filled level to the eaves of the bin? Note: The bin does not have a spreader/leveler but it does have a natural air drying system.
   A. Top and bottom of the grain bin
   B. Top-center of the grain bin and next to the wall of the bin
   C. Bottom-center of the grain bin and next to the wall of the bin
   D. Center of the grain bin and near the perforated floor of grain

92. What is the optimal percent moisture content for alfalfa hay when it is baled into large round (dry, not silage) bales?
   A. 10-15%
   B. 20-30%
   C. 40-60%
   D. 80-90%

93. A rod is commonly used to determine the acres of a field. A rod equals 16.5 feet. Assume you are measuring a 40 acre field. If this field is ½ mile long, how many rods wide is the field?
   A. 160 rods
   B. 320 rods
   C. 80 rods
   D. 40 rods
94. When grain will be used for seed, what is the safe temperature for drying the grain?
   A. 110°F
   B. 120°F
   C. 150°F
   D. 175°F

95. Which of the following grain drying fan types is quietest?
   A. Centrifugal
   B. Axial
   C. Van axial
   D. Shaded pole

96. A home development company has been pushing you for several years to sell some of your farm ground. The price they have given you is based on a per square foot basis. How many square feet are in the N ½, NW ¼, SW ¼ of Section 30? Note: 1 acre = 43,560 square feet.
   A. 435,600 ft²
   B. 871,200 ft²
   C. 1,742,400 ft²
   D. 3,484,800 ft²

97. What is the approximate combined total weight of a trailer weighing 10,000 pounds when it is loaded with 500 bushels of shelled corn that weighs 58 pounds per bushel?
   A. 29,000 lbs
   B. 34,000 lbs
   C. 39,000 lbs
   D. 42,000 lbs

98. Approximately how much time is required to remove 600 round hay bales from a field if bale transport can be completed at an average hauling rate of 9.5 bales per hour?
   A. 63 hours and 10 minutes
   B. 64 hours and 48 minutes
   C. 65 hours and 2 minutes
   D. 65 hour and 13 minutes

99. A tractor fueled by No. 2 diesel burns 8.00 gallons per hour. When the same tractor is fueled with B20 biodiesel it burns 66 gallons of fuel in eight hours. Approximately how many more gallons of fuel will the tractor use during eight hours of operation if it is fueled by B20 biodiesel rather than No. 2 diesel?
   A. 2.0 gallons
   B. 3.0 gallons
   C. 3.5 gallons
   D. 4.0 gallons
100. Determine the volume of a 6-foot diameter round bale that is 5-feet long? What is the weight of the bale if the density of the bale is 14 lbs/ft\(^3\)?

Note: Volume of cylinder = \(\pi \times (r)^2 \times \text{length} \) (\(\pi = 3.14\), \(r = \text{radius}\))

A. 1,850#s
B. 1,979#s
C. 2,220#s
D. 2,375#s

End of Examination