

Iowa State FFA Agricultural Mechanics Career Development Event 2018

State of Iowa
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Iowa State University
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and Studies

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Environmental and Natural Resource Systems **Land Measurement Problem-solving Exam**

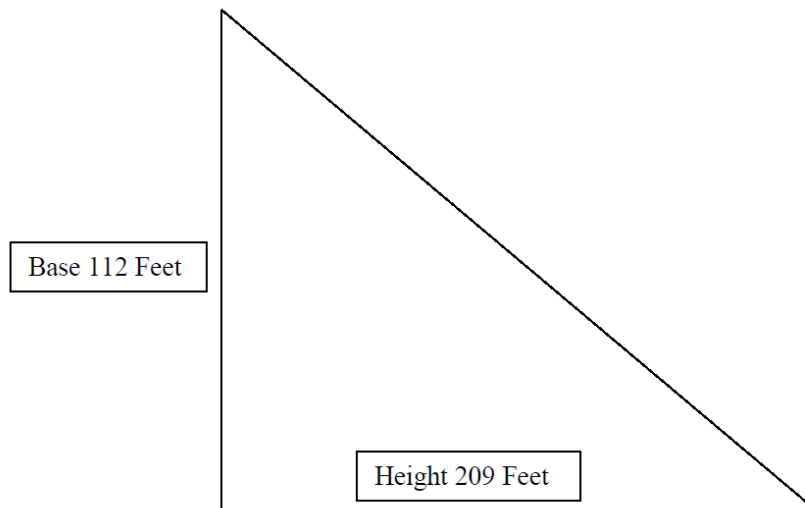
1) You have been asked to fertilize a family member's lawn. The bags of fertilizer that are available at the local agricultural supply store can, if applied properly, cover 250 square feet each. The yard that you would be applying fertilizer to is rectangular in shape and is 33 feet wide and 41 feet long. How many bags of fertilizer will you need to successfully complete the job?

- A) 2
B) 3
C) 6
D) 7

2) Your family member wants to pay you for the fertilizer as well as your time. You charge \$0.10 per square foot for your labor and overhead expenses. The fertilizer is on sale at \$23.00 per bag. How much does your relative owe you?

- A) \$153.00
B) \$135.30
C) \$273.30
D) \$275.00

3) What is the square footage of the land area shown below? Remember that to calculate area in a right triangle, the following formula is used: $\text{Base} \times \text{Height} \div 2 = \text{Area}$



- A) 23,408 yards
- B) 23,408 square feet

- C) 11,704 square inches
- D) 11,704 square feet

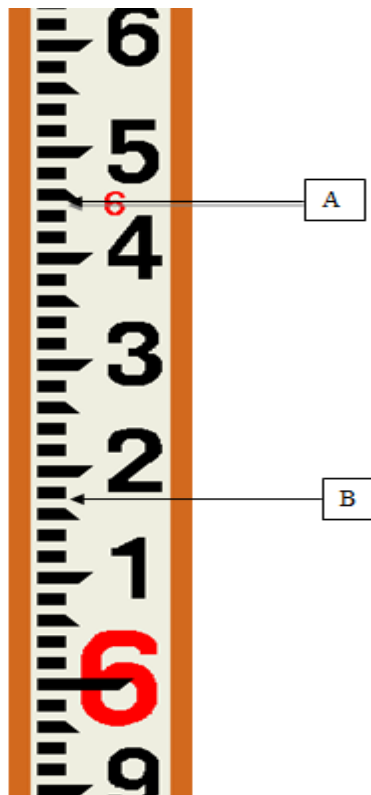
4) Refer back to the land area shown in question 3. How many acres are in this land area?
Remember that 1 acre = 43,560 square feet.

- A) 0.27 acres
- B) 0.54 acres

- C) 2.70 acres
- D) 5.40 acres

Note: Use this image below to answer questions 5 and 6.

Image A



5) Using image A, is the reading at “A”?

- A) 1.50
- B) 6.50

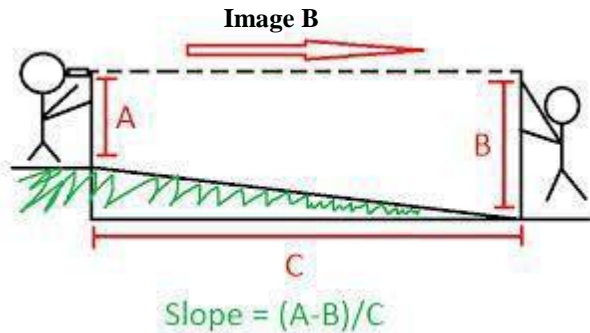
- C) 6.05
- D) 6.45

6) Using image A, what is the reading at “B”?

- A) 1.70
- B) 6.17

- C) 6.15
- D) 6.50

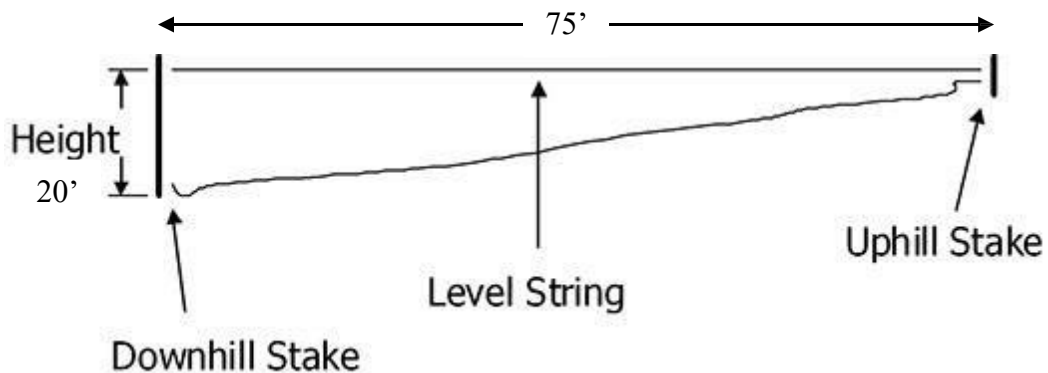
Note: Use this image below to answer question 7.



7) Assume that you are assisting on a job site and want to help prepare the site to lay a level pad of cement for a new feed silo. In order to minimize costs, you will need to determine if there is any slope over the 6' site. If there is more than 3% slope, you will need to backfill the area that slopes off to ensure that costs remain low. Using the measurements taken at A and B in image A on the previous page, what is the percent slope?

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| A) 0.27% | C) 2.7% |
| B) 0.45% | D) 4.5% |

Note: Use this image below to answer question 8.



8) Using the information in the figure at the bottom of the previous page, calculate the percent slope for the worksite of your concrete pad.

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| A) 20% | C) 75% |
| B) 26% | D) 95% |

9) How many acres does one section of land contain?

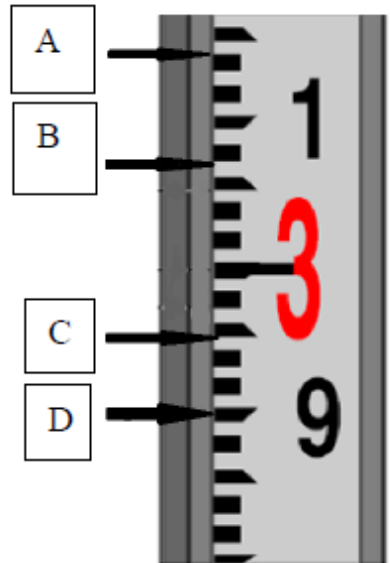
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| A) 660 | C) 640 |
| B) 740 | D) None of the above |

10) Approximately how many acres are in a rectangular field that measures 1000 by 375 yards?
Remember: The area of a rectangle is the length multiplied by the width; 1 yard = 3 feet;
1 acre = 43,560 ft²

- A) 8.61 acres
- B) 17.55 acres

- C) 77.48 acres
- D) 16,355,000,000 acres

Note: Use the arrows pointing to the Philadelphia rod to answer questions 11 through 15.



11) What is the measurement scale on the rod shown?

- A) Metric
- B) Engineer's
- C) Standard
- D) None of the above

12) What is the measurement shown for the arrow "A"?

- A) 3 meters 14 cm
- B) 3.14 meters
- C) 3 feet 1.4 inches
- D) 3.14 feet

13) What is the measurement shown for the arrow "B"?

- A) 3 feet 7 inches
- B) 3 meters 7 cm
- C) 3.07 feet
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14) What is the measurement shown for the arrow "C"?

- A) 2 feet 9.5 inches
- B) 2 meters 9.5 cm
- C) 2.95 feet
- D) 2.95 meters

15) What is the measurement shown for the arrow “D”?

A) 9 feet

B) 2.90 feet

C) 2.90 meters

D) 2 feet 9 inches

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Electrical Systems Electrical Problem-solving Exam

1) Identify this electrical tool.



- A) Receptacle tester
- B) Volt meter

- C) Digital multimeter
- D) Amperage determination tool

2) Identify this electrical tool.



- A) Receptacle tester
- B) Solenoid voltage tester

- C) Outlet detector
- D) Three-pronged switch

3) Regarding safety labels, a label box marked “Danger” is colored _____ and indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

- A) Red
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- C) Orange
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4) What is the name of this tool?



- A) Tape measure
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- C) Line measure
- D) Electrical tape

5) What is the purpose of the tool in question four?

- A) Mark wires
- B) Determine the distance between two points
- C) Guide wire through conduit
- D) Serve as a grapping hook

6) What does the 2 on a strip of 14-2 wire tell you?

- A) Type of metal used in the wires
- B) Wire gauge
- C) Length of the wires inside
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8) Which of the following wires is the largest in diameter?

- A) 20 gauge
- B) 14 gauge
- C) 30 gauge
- D) 12 gauge

9) Identify this electrical tool.



- A) Needle-point testers
- B) Dial caliper

- C) Digital multimeter
- D) Voltage indicator

10) Essentially, a four-way switch is two _____ circuits wired together.

- A) Single-pole
- B) Three-way

- C) Four-way
- D) Double-pole

11) In a structure on your family's farm, you are helping to install a light system that will be operated by a three-way switch. You are currently preparing to install wire that will run directly from the first switch to the second switch. Which of the following types of wire should you use?

- A) 14-2
- B) 12-3

- C) 12-2
- D) 12-2 w/ ground

12) In a typical strip of 12-3 wire, which wire is regarded as the traveler wire?

- A) Blue wire
- B) White wire

- C) Red wire
- D) Black wire

13) In a typical strip of 14-2 wire, which wire is regarded as the ground wire?

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14) Identify this electrical tool.



- A) Needle-point test
- B) Illuminated tester

- C) Test light
- D) Voltage indicator

15) Class ____ fires occur with electrical equipment, including outlets and electric motors.

- A) E
- B) B

- C) C
- D) A

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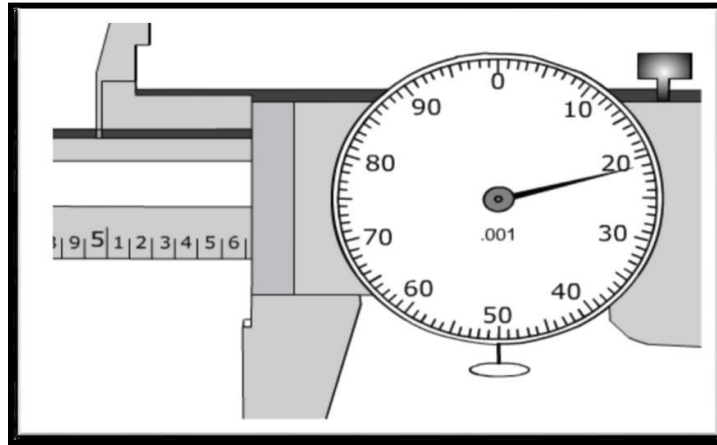
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Machinery and Equipment Systems Tractor Systems Problem-solving Exam

- 1) The diesel engine was originally designed to operate on _____.
- A) Peanut and vegetable oil
B) Diesel fuel
C) Gasoline
D) Transmission fluid
- 2) What is the correct order of the strokes in a four-stroke diesel engine?
- A) Intake, combustion, power, exhaust
B) Intake, compression, spark, exhaust
C) Intake, compression, power, exhaust
D) Exhaust, intake, power, compression
- 3) A diesel engine uses _____ to ignite diesel fuel.
- A) Spark plug
B) Hot compressed air
C) Cylindrical force
D) A low compression ratio
- 4) As air temperatures drop, engines need lighter weight oil to combat issues with viscosity. Which of the following oil types would be most desirable during an Iowa winter?
- A) SAE 15W-40
B) SAE 140
C) SAE 10W-30
D) SAE 40
- 5) What is the purpose of a thermostat in a warm liquid-cooled engine?
- A) Mix water and antifreeze together
B) Control exhaust pressure
C) Prevent coolant from circulating
D) Allow coolant to circulate
- 6) The fuel system of a tractor diesel engine consists of a filtering system and _____.
- A) Fuel tank, injector pump, and injectors
B) Oil pump, fuel tank, and thermostat
C) Cylinder, fuel injectors, and injector pump
D) Diesel fuel, air pump, and carburetor

7) What measurement is indicated on the dial caliper below?



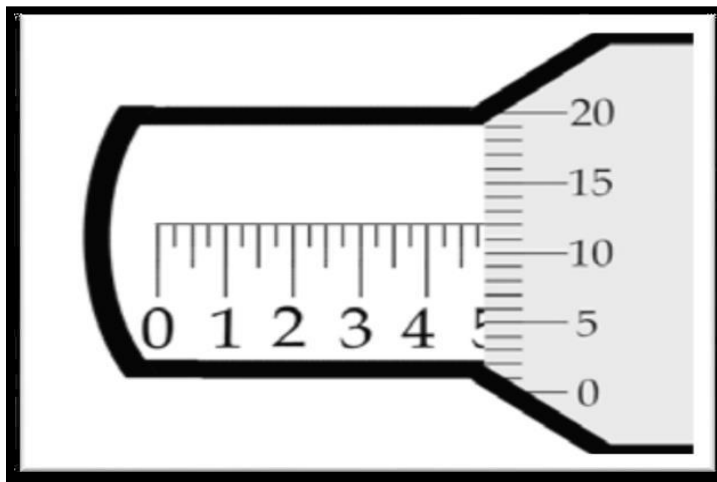
A) 5.623

B) 5.621

C) 6.520

D) 5.622

8) What measurement is indicated on the micrometer below?



A) .512

B) .500

C) .487

D) .475

9) Identify this part commonly found within diesel tractor engines.



- A) Spark plug
- B) Fuel injector

- C) Injector pump
- D) Nozzle

10) Identify this part commonly found within gasoline tractor engines.



- A) Valve
- B) Glow plug

- C) Spark plug
- D) Fuel-air mixture igniter

11) What is the typical compression ratio of a diesel engine?

- A) 9:1
- B) 18:1

- C) 25:1
- D) 16:1

12) Which of the following is a symptom of head gasket failure in an engine?

- A) Engine overheating
- B) Loss of compression

- C) Loss of coolant
- D) All of the above

13) Which of the following is a typical symptom of a failing oil cooler in a diesel engine?

- A) Coolant in the engine oil
- B) Dirty fuel bowl

- C) Excessive hard starting
- D) Cylinder wear

14) Which of the following is a cause of injector failure in a diesel engine?

- A) Excessive injection
- B) Internal deposits in the injector
- C) Poor quality diesel fuel
- D) All of the above

15) In reference to both diesel and gasoline engines, what do the letters “EGT” refer to?

- A) Excellent gas temperatures
- B) Exhaust gas temperatures
- C) Extreme gas temperatures
- D) Excessive gas temperatures

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Metals and Welding **Gas Metal Arc Welding Problem-solving Exam**

1) The minimum shade of lens that should be used during the GMAW process is a number ____ lens.

- A) 10
- B) 5
- C) 8
- D) 12

2) What is the identity of this tool?



- A) Bench grinder
- B) Wire wheel
- C) Angle grinder
- D) Hand file

3) What is the primary issue visibly associated with this weld?



- A) Undercut
- B) Porosity
- C) Overcut
- D) Overlap

4) What is the name of this tool?



- A) Tape measure
- B) Weld measurer
- C) Line measure
- D) Electrical tape

5) What is the primary purpose of the tool in question four?

- A) Mark spots for welding
- B) Determine the distance between two points
- C) Serve as a straight edge
- D) Serve as a grapping hook

6) _____ is the amount of time in a 10-minute period that the welding machine can be operated at a specified current without overheating.

- A) Duty cycle
- B) Operating period
- C) Duty period
- D) Cycle of operation

7) What is the primary issue visibly associated with this weld?



- A) Undercut
- B) Porosity
- C) Overcut
- D) Overlap

8) Breathing in zinc when welding galvanized metal can result in experiencing ____-like symptoms.

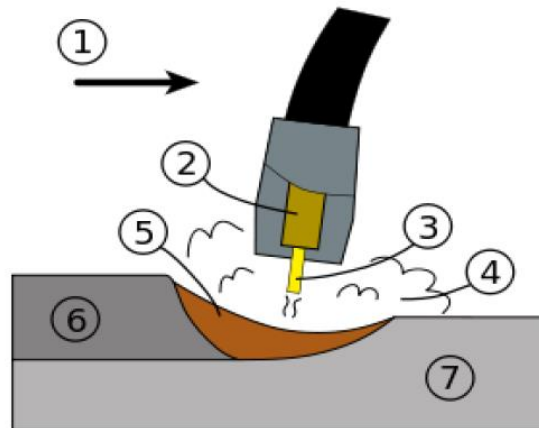
- A) Cold
- B) Sinus infection
- C) Flu
- D) Allergy

9) _____ is the process in which metal pieces are joined by heating them to a temperature high enough to cause them to melt and fuse into a single piece.

- A) Brazing
- B) Welding

- C) Soldering
- D) Arcing

NOTE: Use the images below to answer questions 10 through 12.



10) Item number one above illustrates which of the following items?

- A) Direction of travel
- B) Molten puddle

- C) Direction to welder
- D) Current flow

11) Item number six above illustrates which of the following items?

- A) Direction of travel
- B) Shielding gas

- C) Molten weld metal
- D) Solidified weld metal

12) Item number three above illustrates which of the following items?

- A) Molten weld metal
- B) Shielding gas

- C) Electrode
- D) Contact tip

13) Which of the following issues is the most likely to cause a thin, narrow, string-like welding bead?

- A) Travel speed too fast
- B) Travel speed too slow

- C) Arc length too short
- D) No electricity

14) Which of the following issues is the most likely to cause an overly wide and thick-looking welding bead?

- A) Travel speed too fast
- B) Travel speed too slow

- C) Arc length too long
- D) Too much electricity

15) Which of the following issues is the most likely to cause undercut in a welding bead?

- A) Travel speed too fast
- B) Correct electrode size and type

- C) Arc length too short
- D) Welding current too high

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Structural Systems Carpentry Problem-solving Exam

1) Identify this tool used in carpentry.



- A) Plumb bob
- B) Wood float
- C) String bob
- D) Pointed balancer

2) What is the actual size of a 4 x 4 board?

- A) 4" x 4"
- B) 3" x 3"
- C) 3 ½" x 3 ½"
- D) 4 ½" x 4 ½"

3) What are the items shown below?

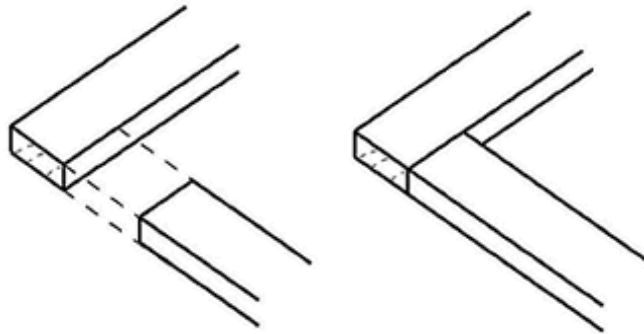


- A) Wooden footballs
- B) Jointers
- C) Burritos
- D) Biscuits

4) Which grit of sandpaper leaves the smoothest finish?

- A) 60-grit
- B) 100-grit
- C) 80-grit
- D) 220-grit

5) Which of the following joint types is depicted below?



- A) Miter
- B) Butt

- C) Rabbet
- D) Dado

6) _____ is a clear, durable, water-resistant finish that requires no separate sealer.

- A) Polyurethane
- B) Lacquer

- C) Varnish
- D) Sealer

7) Why of the following is the best reason for not attempting to use wood glue to join two painted wood surfaces together?

- A) The glue will become tacky and hard
- B) The glue will become watery and dissolve

- C) The glue will spontaneously combust
- D) The glue will not adhere to the paint

8) What is the proper name for this carpentry tool?



- A) Skill saw
- B) Circular saw

- C) Miter saw
- D) Portable saw

9) Wall studs are typically placed _____ inches on center.

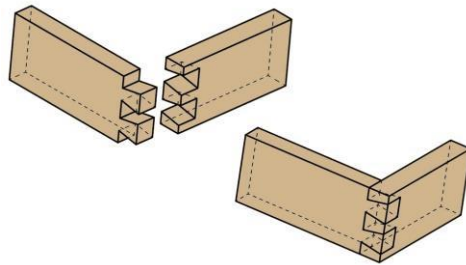
- A) 14
- B) 10

- C) 16
- D) 12

10) Which of the power tools listed below would be best for making short, straight cuts across a 2 x 4 board?

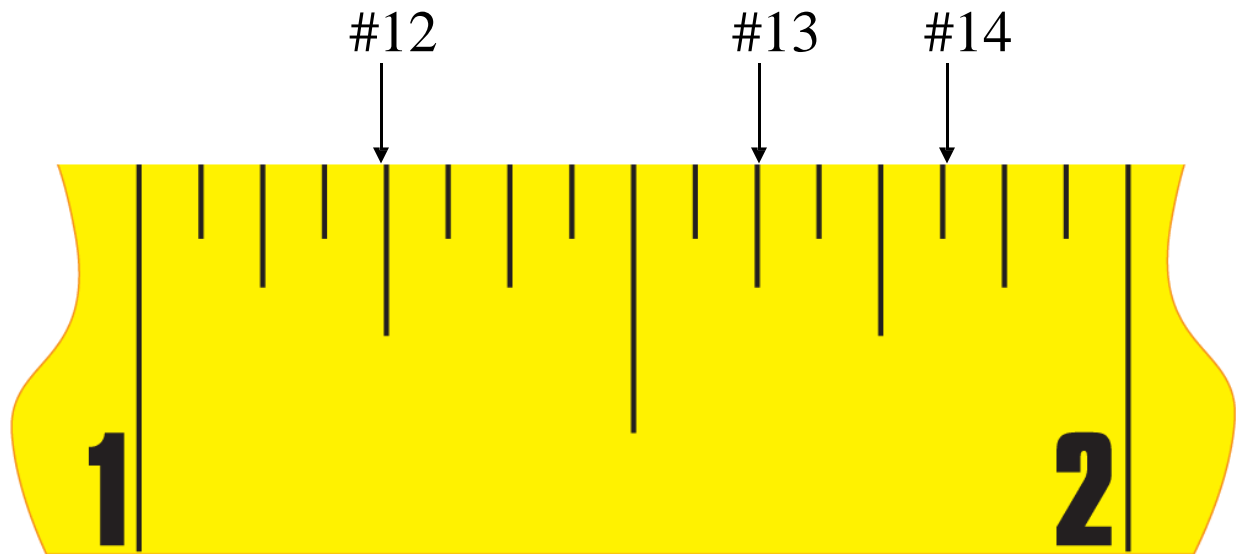
- A) Jig saw
- B) Hand saw
- C) Circular saw
- D) Coping saw

11) Which of the following joint types is shown below?



- A) Dovetail
- B) Corner
- C) Lap
- D) Stretcher

NOTE: Use the image below to answer questions 12 through 15.



Standard Tape Measure Showing Inch Breakdown

12) What is the measurement of #12 in the image above?

- A) 1 1/4"
- B) 1 1/2"
- C) 1 1/16"
- D) 1 1/8"

13) What is the measurement of #13 in the image above?

- | | |
|-----------------------|---------------------|
| A) $\frac{5}{8}$ " | C) $1\frac{5}{8}$ " |
| B) $1\frac{10}{16}$ " | D) $1\frac{3}{4}$ " |

14) What is the measurement of #14 in the image above?

- | | |
|-----------------------|-----------------------|
| A) $\frac{3}{4}$ " | C) $1\frac{14}{16}$ " |
| B) $1\frac{13}{16}$ " | D) $1\frac{9}{16}$ " |

15) What is the distance between #12 and #14 on the tape measure?

- | | |
|----------------------|---------------------|
| A) $\frac{1}{2}$ " | C) $\frac{7}{16}$ " |
| B) $\frac{15}{32}$ " | D) $\frac{9}{16}$ " |

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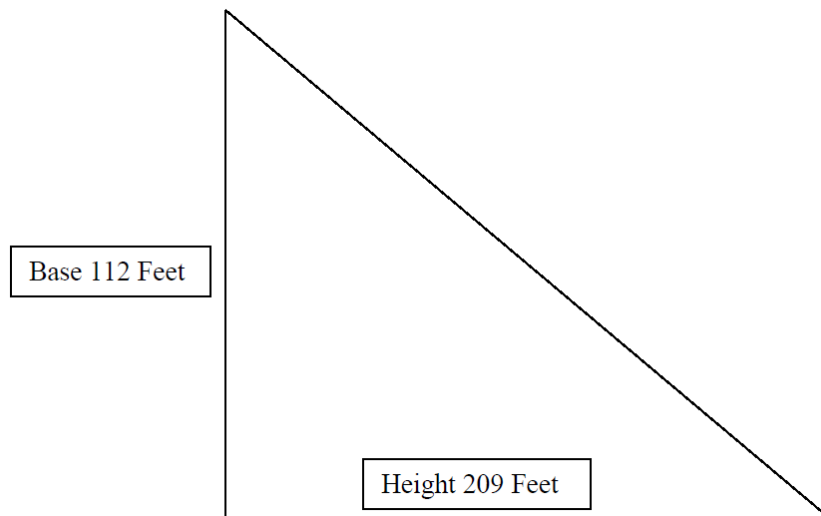
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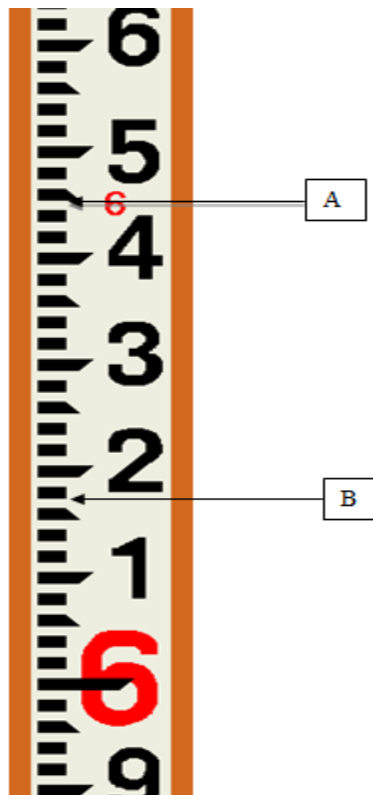
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5) Using the surveying rod in the image on the previous page, what is the reading at “A”?

- A) 1.50
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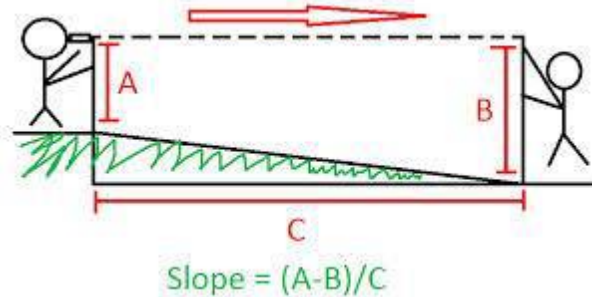
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- A) 1.70
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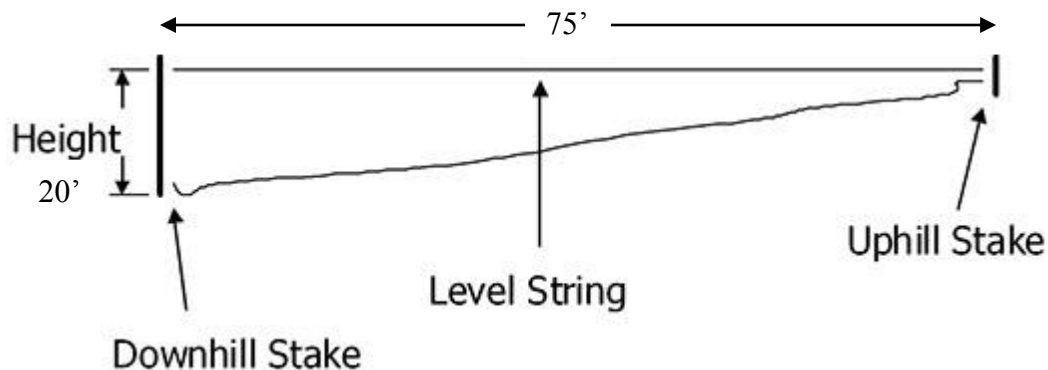
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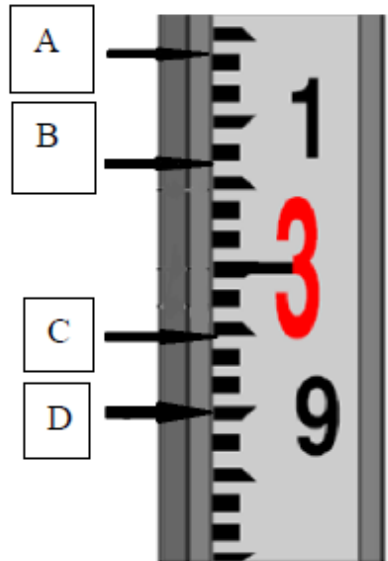
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- B) 2 meters 9.5 cm

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C) 2.90 meters

B) 2.90 feet

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- B) B

- C) C**
- D) A

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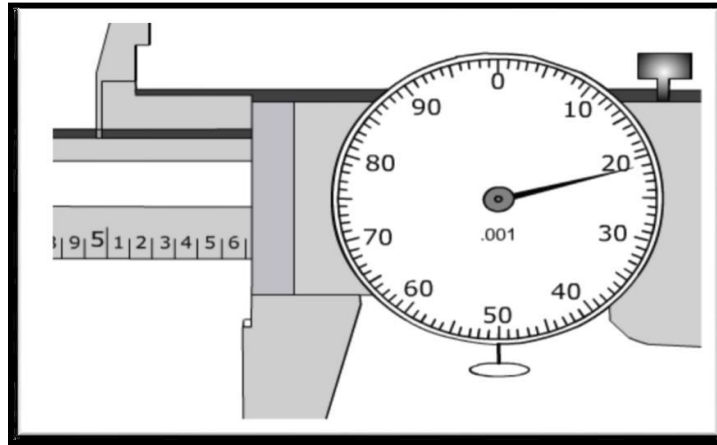
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Machinery and Equipment Systems **Tractor Systems Problem-solving Exam**

- 1) The diesel engine was originally designed to operate on _____.
- A) **Peanut and vegetable oil** C) Gasoline
B) Diesel fuel D) Transmission fluid
- 2) What is the correct order of the strokes in a four-stroke diesel engine?
- A) Intake, combustion, power, exhaust C) **Intake, compression, power, exhaust**
B) Intake, compression, spark, exhaust D) Exhaust, intake, power, compression
- 3) A diesel engine uses _____ to ignite diesel fuel.
- A) Spark plug C) Cylindrical force
B) **Hot compressed air** D) A low compression ratio
- 4) As air temperatures drop, engines need lighter weight oil to combat issues with viscosity. Which of the following oil types would be most desirable during an Iowa winter?
- A) SAE 15W-40 C) **SAE 10W-30**
B) SAE 140 D) SAE 40
- 5) What is the purpose of a thermostat in a warm liquid-cooled engine?
- A) Mix water and antifreeze together C) Prevent coolant from circulating
B) Control exhaust pressure D) **Allow coolant to circulate**
- 6) The fuel system of a tractor diesel engine consists of a filtering system and _____.
- A) **Fuel tank, injector pump, and injectors** C) Cylinder, fuel injectors, and injector pump
B) Oil pump, fuel tank, and thermostat D) Diesel fuel, air pump, and carburetor

7) What measurement is indicated on the dial caliper below?



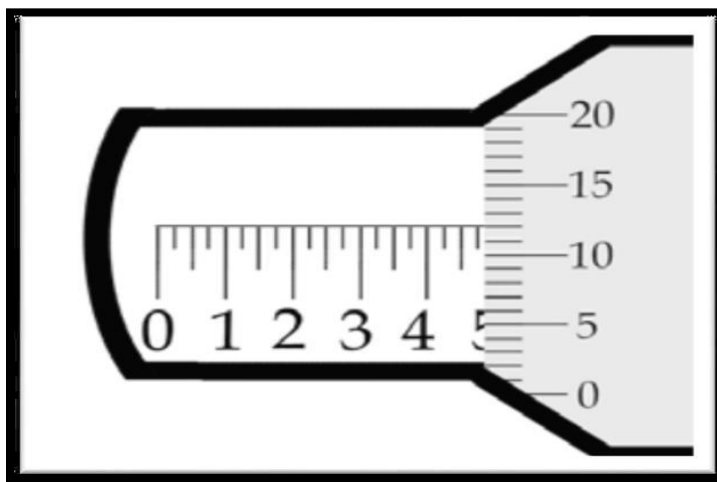
A) 5.623

B) 5.621

C) 6.520

D) 5.622

8) What measurement is indicated on the micrometer below?



A) .512

B) .500

C) .487

D) .475

9) Identify this part commonly found within diesel tractor engines.



- A) Spark plug
- B) Fuel injector**

- C) Injector pump
- D) Nozzle

10) Identify this part commonly found within gasoline tractor engines.



- A) Valve
- B) Glow plug

- C) Spark plug**
- D) Fuel-air mixture igniter

11) What is the typical compression ratio of a diesel engine?

- A) 9:1
- B) 18:1**

- C) 25:1
- D) 16:1

12) Which of the following is a symptom of head gasket failure in an engine?

- A) Engine overheating
- B) Loss of compression

- C) Loss of coolant
- D) All of the above**

13) Which of the following is a typical symptom of a failing oil cooler in a diesel engine?

- A) Coolant in the engine oil**
- B) Dirty fuel bowl

- C) Excessive hard starting
- D) Cylinder wear

14) Which of the following is a cause of injector failure in a diesel engine?

- A) Excessive injection
- B) Internal deposits in the injector
- C) Poor quality diesel fuel
- D) All of the above**

15) In reference to both diesel and gasoline engines, what do the letters “EGT” refer to?

- A) Excellent gas temperatures
- B) Exhaust gas temperatures**
- C) Extreme gas temperatures
- D) Excessive gas temperatures

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Metals and Welding **Gas Metal Arc Welding Problem-solving Exam**

1) The minimum shade of lens that should be used during the GMAW process is a number ____ lens.

- A) **10**
- B) 5
- C) 8
- D) 12

2) What is the identity of this tool?



- A) Bench grinder
- B) Wire wheel
- C) **Angle grinder**
- D) Hand file

3) What is the primary issue visibly associated with this weld?



- A) Undercut
- B) **Porosity**
- C) Overcut
- D) Overlap

4) What is the name of this tool?



- A) **Tape measure**
- B) Weld measurer

- C) Line measure
- D) Electrical tape

5) What is the primary purpose of the tool in question four?

- A) Mark spots for welding
- B) **Determine the distance between two points**

- C) Serve as a straight edge
- D) Serve as a grapping hook

6) _____ is the amount of time in a 10-minute period that the welding machine can be operated at a specified current without overheating.

- A) **Duty cycle**
- B) Operating period

- C) Duty period
- D) Cycle of operation

7) What is the primary issue visibly associated with this weld?



- A) **Undercut**
- B) Porosity

- C) Overcut
- D) Overlap

8) Breathing in zinc when welding galvanized metal can result in experiencing ____-like symptoms.

- A) Cold
- B) Sinus infection

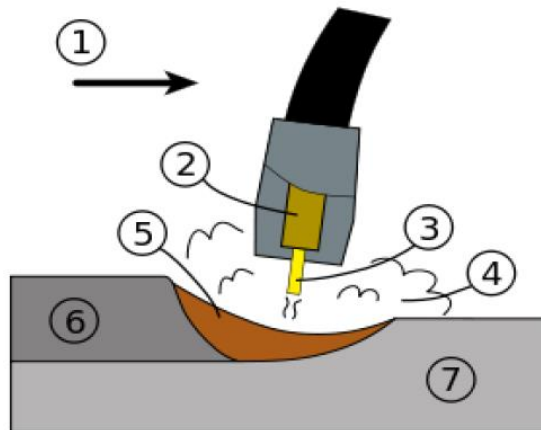
- C) **Flu**
- D) Allergy

9) _____ is the process in which metal pieces are joined by heating them to a temperature high enough to cause them to melt and fuse into a single piece.

- A) Brazing
- B) Welding**

- C) Soldering
- D) Arcing

NOTE: Use the images below to answer questions 10 through 12.



10) Item number one above illustrates which of the following items?

- A) Direction of travel**
- B) Molten puddle

- C) Direction to welder
- D) Current flow

11) Item number six above illustrates which of the following items?

- A) Direction of travel
- B) Shielding gas

- C) Molten weld metal
- D) Solidified weld metal**

12) Item number three above illustrates which of the following items?

- A) Molten weld metal
- B) Shielding gas

- C) Electrode**
- D) Contact tip

13) Which of the following issues is the most likely to cause a thin, narrow, string-like welding bead?

- A) Travel speed too fast**
- B) Travel speed too slow

- C) Arc length too short
- D) No electricity

14) Which of the following issues is the most likely to cause an overly wide and thick-looking welding bead?

- A) Travel speed too fast
- B) Travel speed too slow**

- C) Arc length too long
- D) Too much electricity

15) Which of the following issues is the most likely to cause undercut in a welding bead?

- A) Travel speed too fast
- B) Correct electrode size and type

- C) Arc length too short
- D) Welding current too high**

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Structural Systems Carpentry Problem-solving Exam

1) Identify this tool used in carpentry.



- A) **Plumb bob**
- B) Wood float

- C) String bob
- D) **Pointed balancer**

2) What is the actual size of a 4 x 4 board?

- A) 4" x 4"
- B) 3" x 3"

- C) **3 ½" x 3 ½"**
- D) 4 ½" x 4 ½"

3) What are the items shown below?



- A) Wooden footballs
- B) **Jointers**

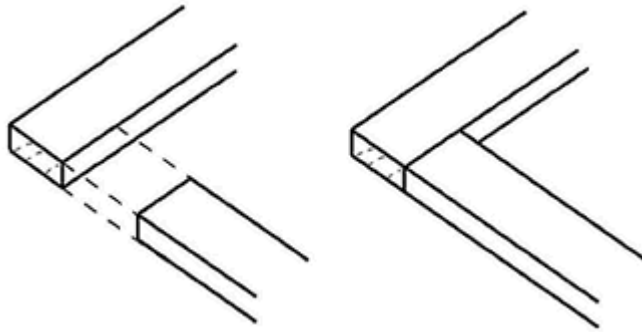
- C) Burritos
- D) **Biscuits**

4) Which grit of sandpaper leaves the smoothest finish?

- A) 60-grit
- B) 100-grit

- C) 80-grit
- D) **220-grit**

5) Which of the following joint types is depicted below?



A) Miter

B) Butt

C) Rabbet

D) Dado

6) _____ is a clear, durable, water-resistant finish that requires no separate sealer.

A) Polyurethane

B) Lacquer

C) Varnish

D) Sealer

7) Why of the following is the best reason for not attempting to use wood glue to join two painted wood surfaces together?

A) The glue will become tacky and hard

B) The glue will become watery and dissolve

C) The glue will spontaneously combust

D) The glue will not adhere to the paint

8) What is the proper name for this carpentry tool?



A) Skill saw

B) Circular saw

C) Miter saw

D) Portable saw

9) Wall studs are typically placed _____ inches on center.

A) 14

B) 10

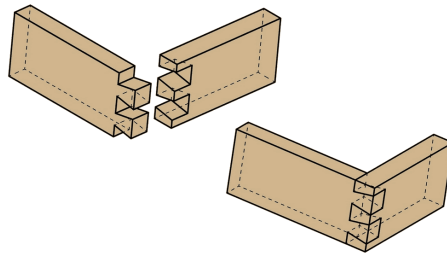
C) 16

D) 12

10) Which of the power tools listed below would be best for making short, straight cuts across a 2 x 4 board?

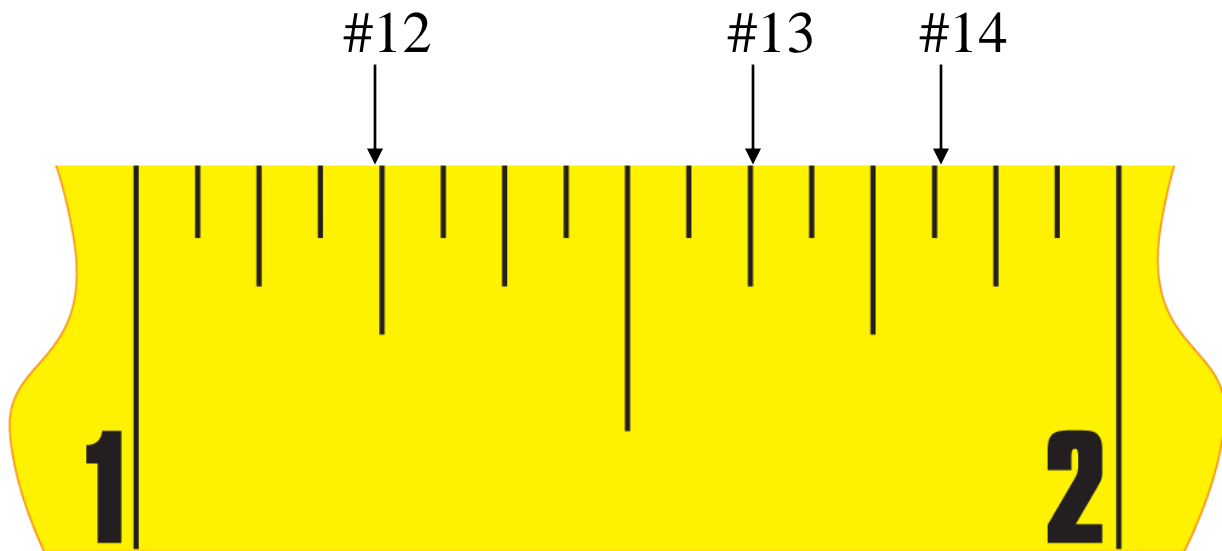
- A) Jig saw
- B) Hand saw
- C) **Circular saw**
- D) Coping saw

11) Which of the following joint types is shown below?



- A) **Dovetail**
- B) Corner
- C) Lap
- D) Stretcher

NOTE: Use the image below to answer questions 12 through 15.



Standard Tape Measure Showing Inch Breakdown

12) What is the measurement of #1 in the image above?

- A) **1 1/4"**
- B) 1 1/2"
- C) 1 1/16"
- D) 1 1/8"

13) What is the measurement of #2 in the image above?

A) $\frac{5}{8}$ "

B) $1\frac{10}{16}$ "

C) **$1\frac{5}{8}$ "**

D) $1\frac{3}{4}$ "

14) What is the measurement of #3 in the image above?

A) $\frac{3}{4}$ "

B) **$1\frac{13}{16}$ "**

C) $1\frac{14}{16}$ "

D) $1\frac{9}{16}$ "

15) What is the distance between 1 and 3 on the tape measure?

A) $\frac{1}{2}$ "

B) $\frac{15}{32}$ "

C) $\frac{7}{16}$ "

D) **$\frac{9}{16}$ "**