

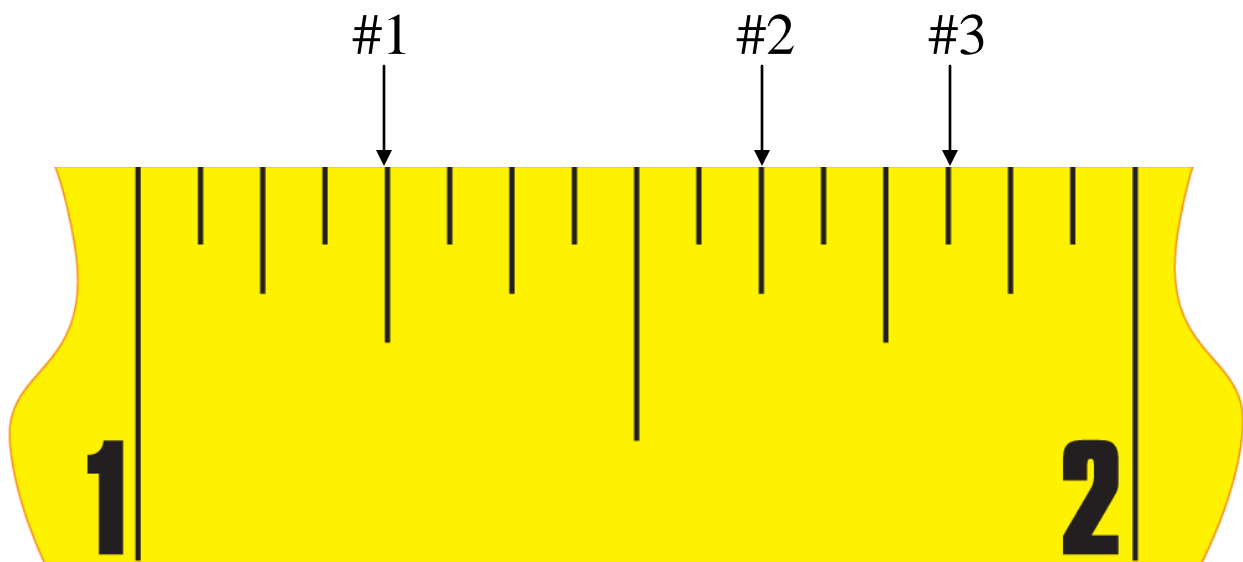
**Iowa State FFA Agricultural Mechanics Career Development Event
2017**

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**Environmental and Natural Resource Systems
Soil and Water Management Problem-solving Exam**

NOTE: Use the image below to answer questions 1 through 4.



Standard Tape Measure Showing Inch Breakdown

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

- A) $1 \frac{1}{4}$ " C) $1 \frac{1}{16}$ "
B) $1 \frac{1}{2}$ " D) $1 \frac{1}{8}$ "

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

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

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

A) $3/4''$

B) $1\ 13/16''$

C) $1\ 14/16''$

D) $1\ 9/16''$

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

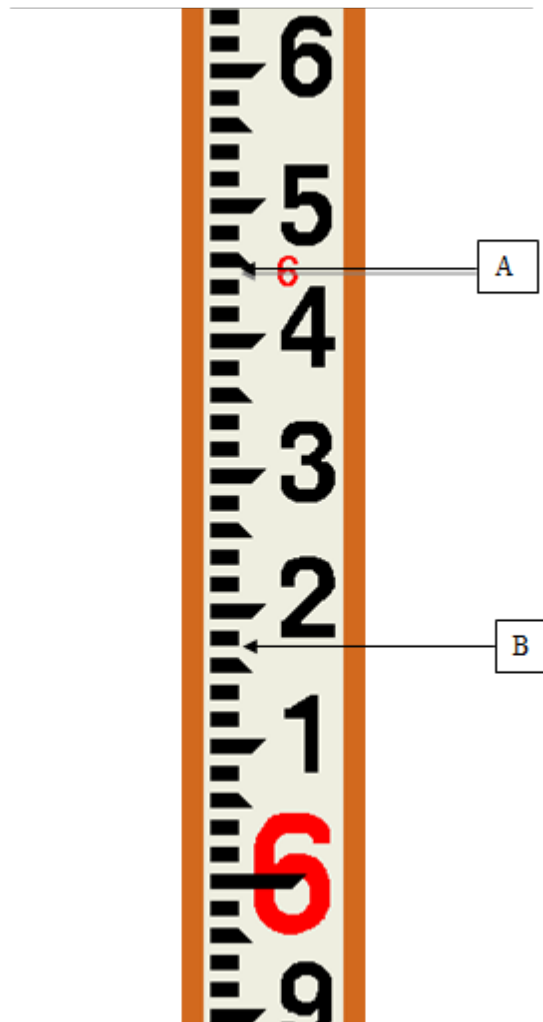
A) $1/2''$

B) $15/32''$

C) $7/16''$

D) $9/16''$

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



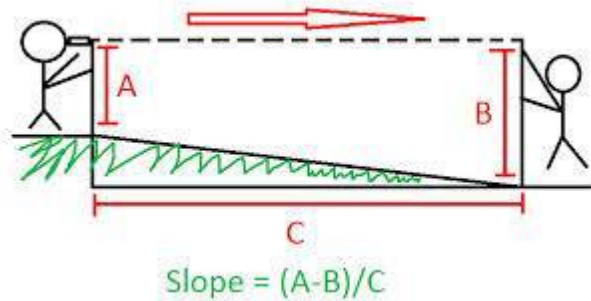
5) Using the surveying rod in the image on the previous page, what is the reading at “A”?

- A) 1.50
- B) 6.50
- C) 6.05
- D) 6.45

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

- A) 1.70
- B) 6.17
- C) 6.15
- D) 6.50

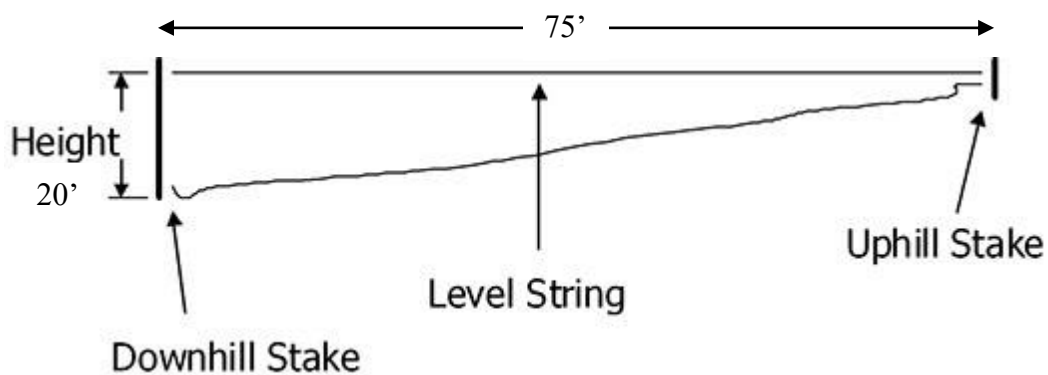
Note: Use this image below to answer question 7.



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 the image on the previous page, what is the percent slope?

- A) 0.27%
- B) 0.45%
- C) 2.7%
- 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.

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

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

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

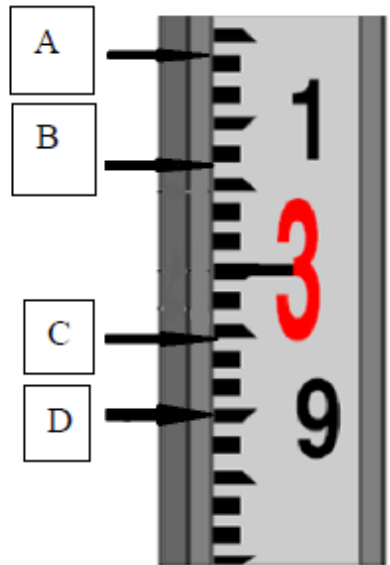
10) Approximately how many acres are in a rectangular field that measures 1000 by 375 yards?

Hints: 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 11-15.



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

C) 3.07 feet

B) 3 meters 7 cm

D) 3.07 meters

14) What is the measurement shown for the arrow "C"?

A) 2 feet 9.5 inches

C) 2.95 feet

B) 2 meters 9.5 cm

D) 2.95 meters

15) What is the measurement shown for the arrow "D"?

A) 9 feet

C) 2.90 meters

B) 2.90 feet

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
- B) Yellow

- C) Orange
- D) Neon Green

4) What is the name of this tool?



- A) Tape measure
- B) Toilet auger
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- 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
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- C) Length of the wires inside
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- A) Type of metal used in the wires
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- D) Number of wires inside

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) 14-3

- 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?

- A) Bare copper wire
- B) White wire

- C) Red wire
- D) Black wire

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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**Machinery and Equipment Systems
Small Engines Problem-solving Exam**

1) A four-stroke engine gets its name from _____.

- | | |
|---|--|
| A) The number of cylinders it has | C) The number of valves used in its design |
| B) The number of piston movements during a combustion cycle | D) The number of engineers who designed it |

2) A two-stroke engine gets its name from _____.

- | | |
|---|--|
| A) The number of cylinders it has | C) The number of valves used in its design |
| B) The number of piston movements during a combustion cycle | D) The number of engineers who designed it |

3) Which stroke follows the exhaust stroke?

- | | |
|----------------|----------|
| A) Compression | C) Power |
| B) Intake | D) Spark |

4) To complete one operating cycle, the crankshaft of a four-stroke engine must make _____.

- | | |
|-----------------------------|---------------------|
| A) One-half of a revolution | C) Four revolutions |
| B) Three revolutions | D) Two revolutions |

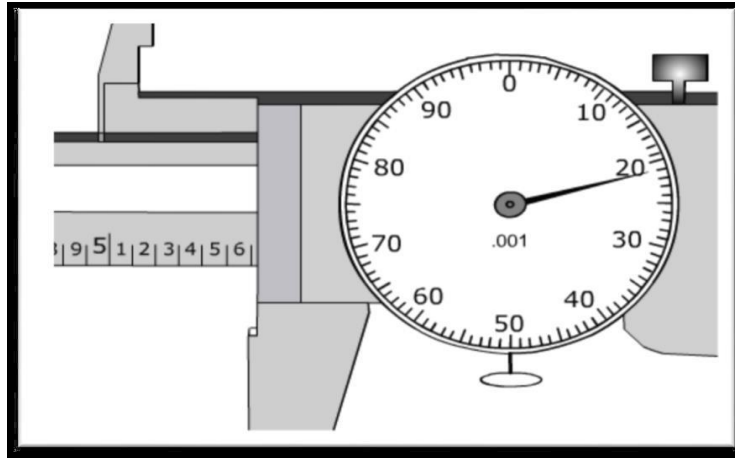
5) To complete one operating cycle, the crankshaft of a two-stroke engine must make _____.

- | | |
|-----------------------------|---------------------|
| A) One-half of a revolution | C) Four revolutions |
| B) One revolution | D) Two revolutions |

6) What is the correct order of the strokes in a four-stroke engine?

- | | |
|--|--|
| A) Intake, combustion, power, exhaust | C) Intake, compression, power, exhaust |
| B) Intake, compression, spark, exhaust | D) Exhaust, intake, power, compression |

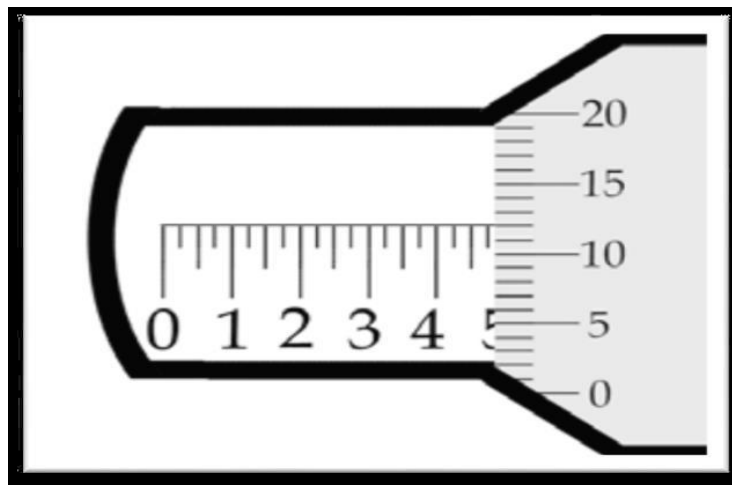
7) What measurement is indicated on the dial caliper below?



- 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 small gas engines.



- A) Piston
- B) Cylinder

- C) Connecting rod
- D) Cylinder hone

10) Identify this part commonly found within small gas engines.



- A) Valve
- B) Glow plug

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

11) Identify this part commonly found within small gas engines.



- A) Camshaft
- B) Crankshaft

- C) Gear wheel
- D) Engine pulley

12) Identify this part commonly found within small gas engines.



- A) Camshaft
- B) Crankshaft

- C) Gear wheel
- D) Engine pulley

13) Identify this tool commonly used in small gas engine repair.



- A) Ring compressor
- B) Cylinder cleaner

- C) Valve spring retainer
- D) Cylinder hone

14) Identify this tool commonly used in small gas engine troubleshooting.



- A) Pressure tester
- B) Spark plug cleaner

- C) Spark tester
- D) Sparkler

15) Identify this tool commonly used to make measurements on small gas engine parts.



- A) Vernier caliper
- B) Micrometer

- C) Ring compressor
- D) Valve clearance guide

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**Machinery and Equipment Systems
Shielded Metal Arc Welding Problem-solving Exam**

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

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

2) Identify this tool used during the SMAW process.



- A) Slag hammer
- B) Chipping hammer
- C) Wire hammer
- D) Angled hammer

3) Identify this tool used during the SMAW process.



- A) Grill brush
- B) Hair brush
- C) Wire brush
- D) Steel brush

4) What is the name of this tool?



- A) Tape measure
- B) Toilet auger
- 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 does the 60 on an E6013 welding electrode tell you?

- A) Position
- B) Tensile strength
- C) Filler rod type
- D) Current type

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

10) You are using an E7018 welding electrode to weld a butt joint. Assuming that the weld is performed correctly, how many pounds per square inch of tensile strength would it take to pull the joint apart?

- A) 70
- B) 70,000
- C) 60,000
- D) 18,000

11) You are using an E6011 welding electrode when welding mild steel. In which of the following positions could you use this electrode successfully?

- A) Overhead
- B) Vertical
- C) Flat
- D) All positions

12) You are using an E6013 welding electrode when welding mild steel plate, and your welding machine is set up to run either alternating or direct current. Which of the current types could you use to successfully weld with this particular electrode?

- A) AC-
- B) DC+
- C) DC-
- D) All current types

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
Concrete Problem-solving Exam**

1) Identify this tool used in concrete masonry.



- A) Edger
- B) Wood float
- C) Finishing trowel
- D) Bull float

2) How tall, or high, is a standard block (without a mortar joint)?

- A) 16"
- B) 15 5/8"
- C) 8"
- D) 7 5/8"

3) Identify this tool used in concrete masonry.

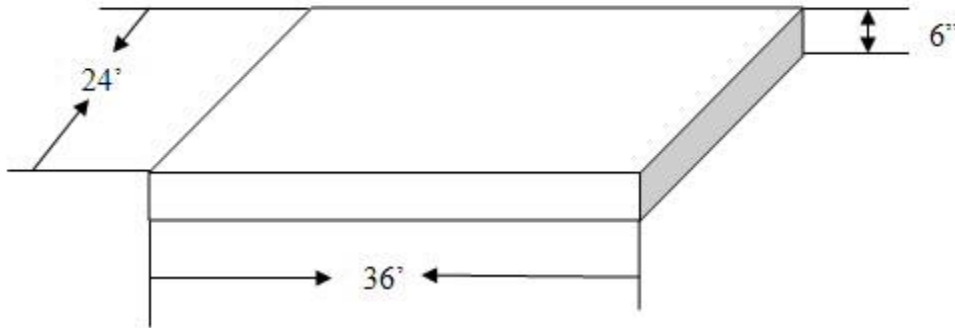


- A) Edger
- B) Wood float
- C) Finishing trowel
- D) Bull float

4) How long is a standard block (without a mortar joint)?

- A) 16"
- B) 15 5/8"
- C) 8"
- D) 7 5/8"

5) Prior to construction, a materials handling facility will need a concrete pad poured that will measure 24' wide by 36' long, and the concrete pad will need to be 6" thick. Based on these requirements, how much concrete, in cubic yards, will be needed? Round to the nearest whole yard.



- A) 15 yds³
- B) 16 yds³
- C) 13 yds³
- D) 17 yds³

6) Based on your calculations from question five, how much would it cost to pour the pad for this building if concrete costs \$93.95 per cubic yard? Round to the nearest whole dollar.

- A) \$1,502
- B) \$1,600
- C) \$1,500
- D) \$1,503

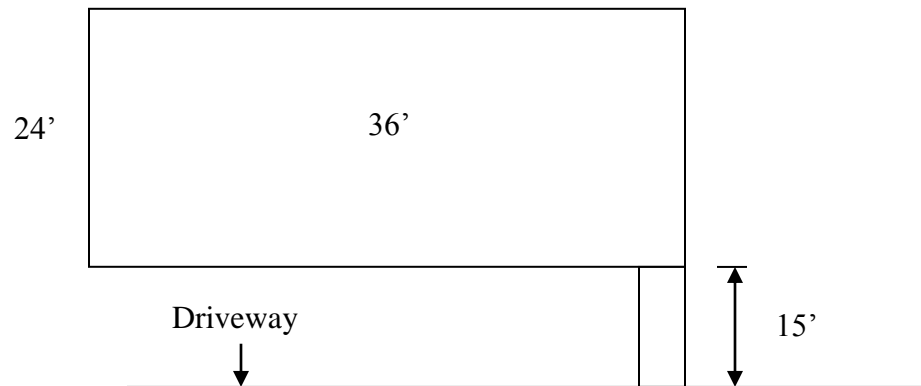
7) Refer back to question five. Suppose that the facility is built as specified in question one, and you are now being asked to calculate how much concrete would be necessary to pour a 30"-wide sidewalk from the side entrance to the driveway of your house, which is a length of approximately 15'. Assuming that this sidewalk's thickness will be 6", how much concrete, in cubic yards, will be needed? Round to the nearest whole yard.

- A) 2 yds³
- B) 1 yd³
- C) 3 yd³
- D) 0.5 yd³

8) Based on your calculations from question seven, how much would it cost to pour the pad for this building if concrete now costs \$95.00 per cubic yard?

- A) \$92
- B) \$96
- C) \$95
- D) \$87

9) Using the dimensions on the picture below, determine the total perimeter of the facility pad project (in feet) from question five, including the sidewalk. Do not include the short ends of the sidewalk in your calculations. NOTE: Sidewalk is 30" wide.



- A) 147' 6"
- B) 148'

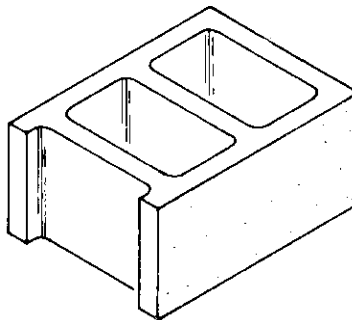
- C) 147'
- D) 150'

10) When curing concrete, which of these materials may be used to help retain moisture within concrete?

- A) Straw
- B) Sawdust

- C) Plastic
- D) All of the above

11) What type of block is shown here?



- A) Sash
- B) Corner

- C) Jamb
- D) Stretcher

12) How many blocks are needed to build a wall that measures 12' long and 8' high? Assume that each block is 16" long and 8" high with a 3/8"-thick mortar joint.

- A) 110
- B) 100

- C) 108
- D) 112

13) How many courses high is a block wall that measures 12' long and 8' high? Assume that each block is 16" long and 8" high with a 3/8"-thick mortar joint.

- A) 12
- B) 10
- C) 11
- D) 13

14) What is the purpose of this concrete masonry tool?



- A) Edging
- B) Separating concrete from the form
- C) Finishing
- D) Jointing

15) How long is it recommended that concrete cure prior to use?

- A) Three days
- B) Up to one week
- C) One day
- D) Five hours

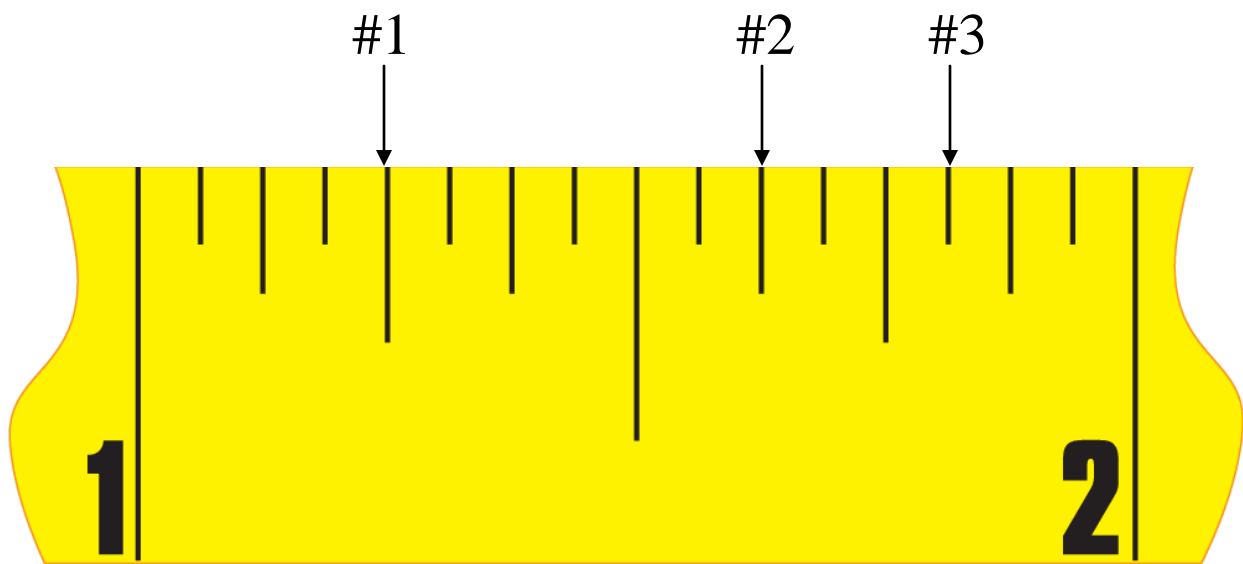
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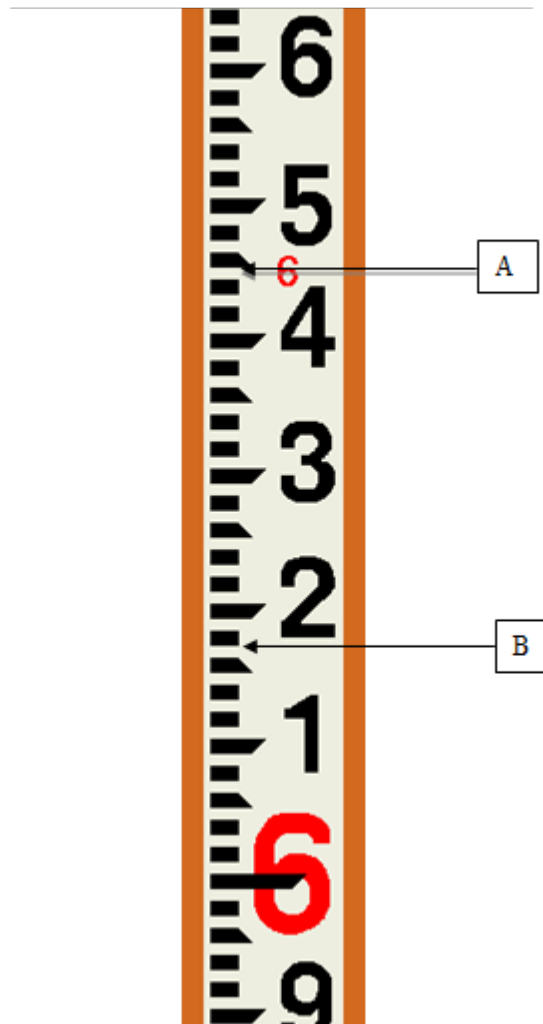
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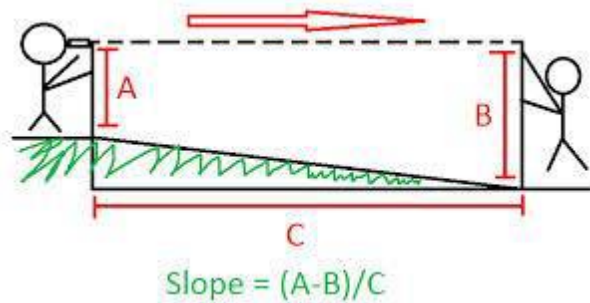
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- D) **6.45**

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- A) 1.70
- B) **6.17**
- C) 6.15
- D) 6.50

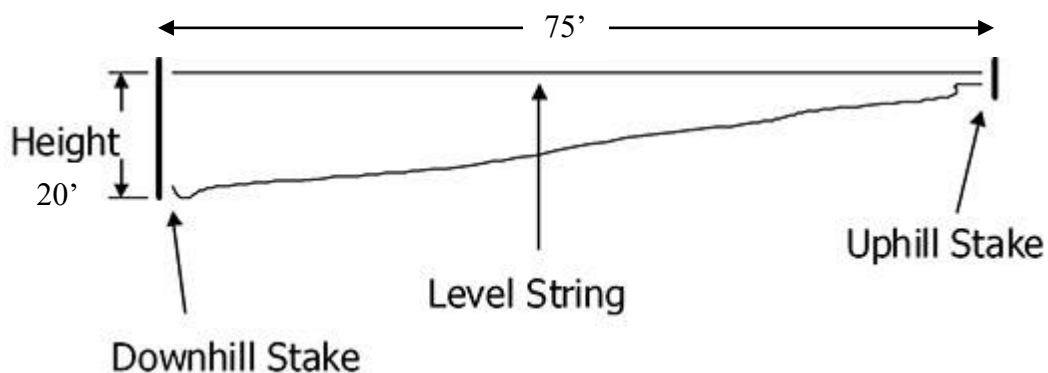
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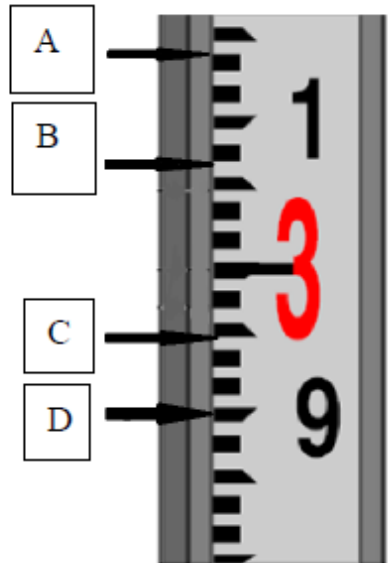
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D) 3.14 feet

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

A) 3 feet 7 inches

B) 3 meters 7 cm

C) 3.07 feet

D) 3.07 meters

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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8) Which of the following wires is the largest in diameter?

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- B) 14 gauge

- C) 30 gauge
- D) **12 gauge**

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- B) Dial caliper

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

- A) Single-pole
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- B) 14-3**

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

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- 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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2017**

State of Iowa
Department of Education
Iowa State University
Department of Agricultural Education
and Studies

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**Machinery and Equipment Systems
Small Engines Problem-solving Exam**

1) A four-stroke engine gets its name from _____.

- A) The number of cylinders it has
B) The number of piston movements during a combustion cycle
C) The number of valves used in its design
D) The number of engineers who designed it

2) A two-stroke engine gets its name from _____.

- A) The number of cylinders it has
B) The number of piston movements during a combustion cycle
C) The number of valves used in its design
D) The number of engineers who designed it

3) Which stroke follows the exhaust stroke?

- A) Compression
B) Intake
C) Power
D) Spark

4) To complete one operating cycle, the crankshaft of a four-stroke engine must make _____.

- A) One-half of a revolution
B) Three revolutions
C) Four revolutions
D) Two revolutions

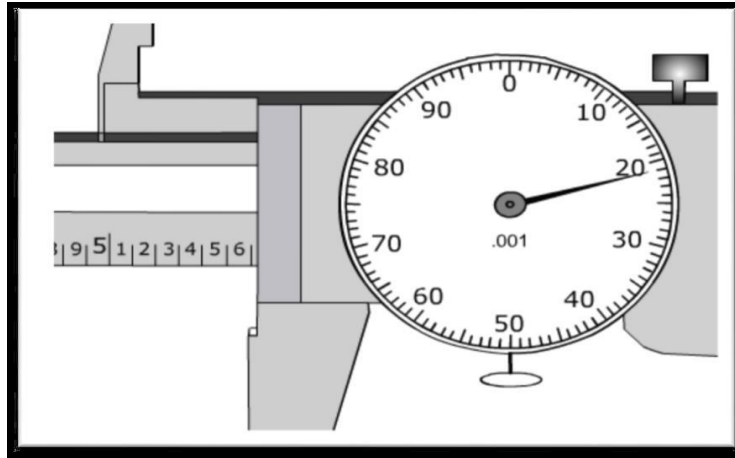
5) To complete one operating cycle, the crankshaft of a two-stroke engine must make _____.

- A) One-half of a revolution
B) One revolution
C) Four revolutions
D) Two revolutions

6) What is the correct order of the strokes in a four-stroke engine?

- A) Intake, combustion, power, exhaust
B) Intake, compression, spark, exhaust
C) **Intake, compression, power, exhaust**
D) Exhaust, intake, power, compression

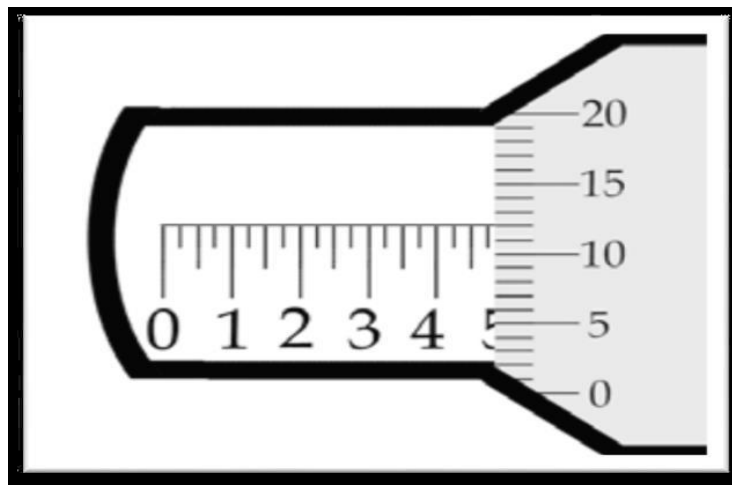
7) What measurement is indicated on the dial caliper below?



- 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 small gas engines.



- A) **Piston**
- B) Cylinder

- C) Connecting rod
- D) Cylinder hone

10) Identify this part commonly found within small gas engines.



- A) Valve
- B) Glow plug

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

11) Identify this part commonly found within small gas engines.



- A) **Camshaft**
- B) Crankshaft

- C) Gear wheel
- D) Engine pulley

12) Identify this part commonly found within small gas engines.



- A) Camshaft
- B) Crankshaft**

- C) Gear wheel
- D) Engine pulley

13) Identify this tool commonly used in small gas engine repair.



- A) Ring compressor
- B) Cylinder cleaner

- C) Valve spring retainer
- D) Cylinder hone**

14) Identify this tool commonly used in small gas engine troubleshooting.



- A) Pressure tester
- B) Spark plug cleaner

- C) Spark tester**
- D) Sparkler

15) Identify this tool commonly used to make measurements on small gas engine parts.



- A) Vernier caliper
- B) Micrometer**

- C) Ring compressor
- D) Valve clearance guide

4) What is the name of this tool?



- A) **Tape measure**
- B) Toilet auger
- 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 does the 60 on an E6013 welding electrode tell you?

- A) Position
- B) **Tensile strength**
- C) Filler rod type
- D) Current type

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

10) You are using an E7018 welding electrode to weld a butt joint. Assuming that the weld is performed correctly, how many pounds per square inch of tensile strength would it take to pull the joint apart?

- A) 70
- B) 70,000**
- C) 60,000
- D) 18,000

11) You are using an E6011 welding electrode when welding mild steel. In which of the following positions could you use this electrode successfully?

- A) Overhead
- B) Vertical
- C) Flat
- D) All positions**

12) You are using an E6013 welding electrode when welding mild steel plate, and your welding machine is set up to run either alternating or direct current. Which of the current types could you use to successfully weld with this particular electrode?

- A) AC-
- B) DC+
- C) DC-
- D) All current types**

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

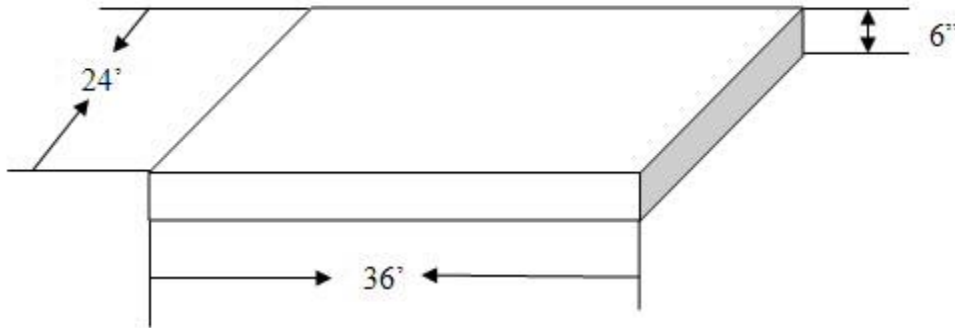
15) Which of the following issues is the most likely to cause undercut in a welding bead?

- A) Travel speed too fast
- B) Correct electrode size and type
- C) Arc length too short
- D) Welding current too high**

4) How long is a standard block (without a mortar joint)?

- A) 16"
B) **15 5/8"**
C) 8"
D) 7 5/8"

5) Prior to construction, a materials handling facility will need a concrete pad poured that will measure 24' wide by 36' long, and the concrete pad will need to be 6" thick. Based on these requirements, how much concrete, in cubic yards, will be needed? Round to the nearest whole yard.



- A) 15 yds³
B) **16 yds³**
C) 13 yds³
D) 17 yds³

6) Based on your calculations from question five, how much would it cost to pour the pad for this building if concrete costs \$93.95 per cubic yard? Round to the nearest whole dollar.

- A) \$1,502
B) \$1,600
C) \$1,500
D) **\$1,503**

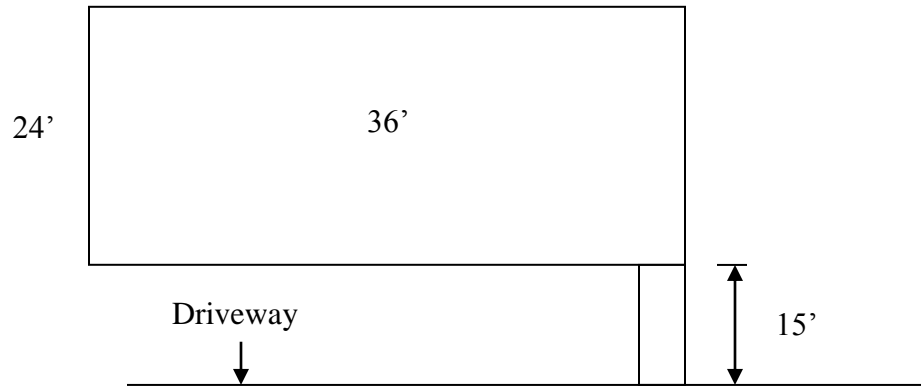
7) Refer back to question five. Suppose that the facility is built as specified in question one, and you are now being asked to calculate how much concrete would be necessary to pour a 30"-wide sidewalk from the side entrance to the driveway of your house, which is a length of approximately 15'. Assuming that this sidewalk's thickness will be 6", how much concrete, in cubic yards, will be needed? Round to the nearest whole yard.

- A) 2 yds³
B) **1 yd³**
C) 3 yd³
D) 0.5 yd³

8) Based on your calculations from question seven, how much would it cost to pour the pad for this building if concrete now costs \$95.00 per cubic yard?

- A) \$92
B) \$96
C) **\$95**
D) \$87

9) Using the dimensions on the picture below, determine the total perimeter of the facility pad project (in feet) from question five, including the sidewalk. Do not include the short ends of the sidewalk in your calculations. NOTE: Sidewalk is 30" wide.



- A) 147' 6"
- B) 148'

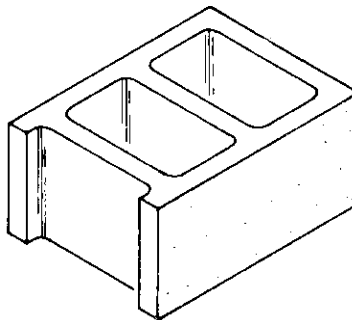
- C) 147'
- D) 150'

10) When curing concrete, which of these materials may be used to help retain moisture within concrete?

- A) Straw
- B) Sawdust

- C) Plastic
- D) **All of the above**

11) What type of block is shown here?



- A) Sash
- B) **Corner**

- C) Jamb
- D) Stretcher

12) How many blocks are needed to build a wall that measures 12' long and 8' high? Assume that each block is 16" long and 8" high when including a 3/8"-thick mortar joint.

- A) 110
- B) 100

- C) **108**
- D) 112

13) How many courses high is a block wall that measures 12' long and 8' high? Assume that each block is 16" long and 8" high when including a 3/8"-thick mortar joint.

- A) **12**
- B) 10

- C) 11
- D) 13

14) What is the purpose of this concrete masonry tool?



- A) **Edging**
- B) Separating concrete from the form

- C) Finishing
- D) Jointing

15) How long is it recommended that concrete cure prior to use?

- A) Three days
- B) **Up to one week**

- C) One day
- D) Five hours