

Iowa State FFA Agricultural Mechanics Career Development Event 2016

State of Iowa
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Department of Agricultural
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Structural Systems Carpentry Problem Solving

1. What is the tool displayed on the right?
 - a. Router
 - b. Sander
 - c. Jointer
 - d. Planer



2. What is the tool displayed on the right?
 - a. Orbital Sander
 - b. Belt Sander
 - c. Biscuit jointer
 - d. Table saw



3. What is the tool displayed on the right?
- a. Impact press
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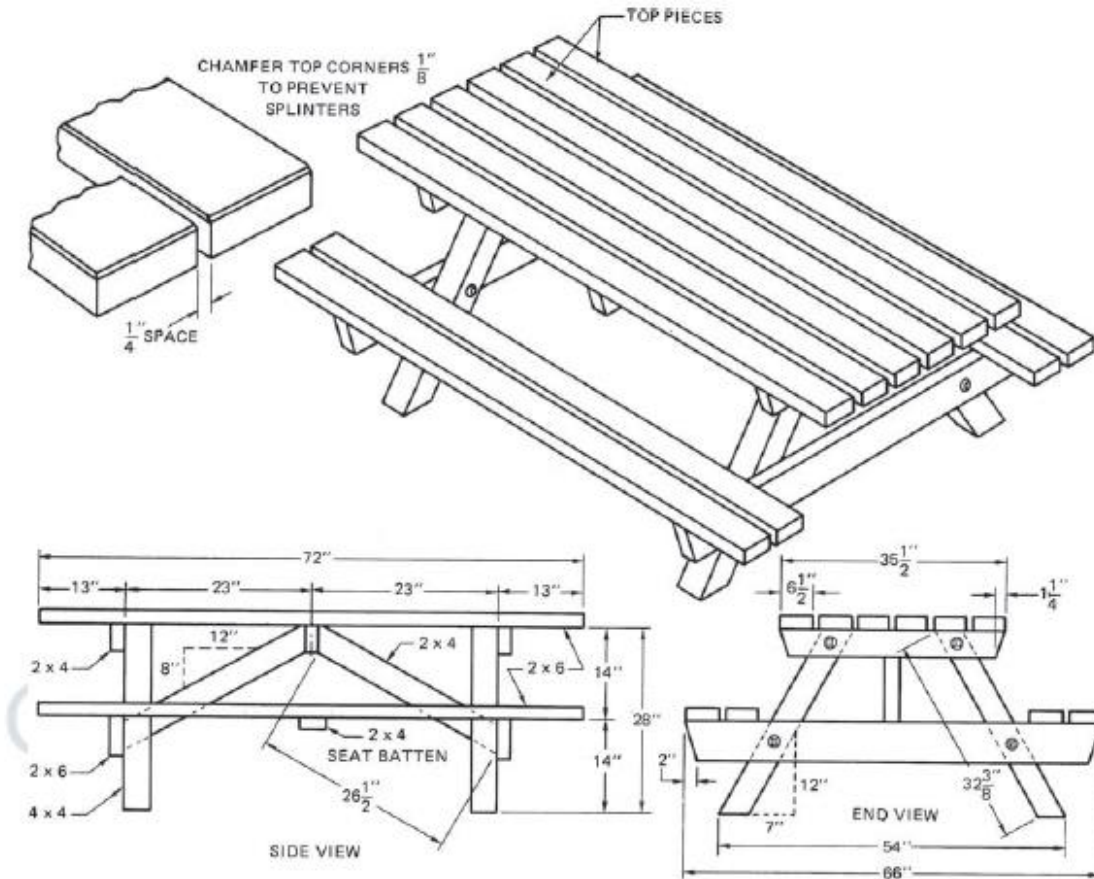
4. What is the tool displayed above?
- a. Reciprocating saw
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5. What grit of sand paper leaves a smoother surface?
- a. 40 grit
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6. What type of cut is demonstrated on this board?
- a. Cross cut
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Use the hand out to help answer questions 7-11

During the Iowa State Fair, has contracted your FFA chapter to build picnic tables for the fair grounds. (Note: answers are based on commercial surfaced lumber dimensions)



Courtesy of T. J. Wakeman and V. L. McCoy, The Farm Shop, The Macmillan Company, 1960

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 - a. 6'
 - b. 8'
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11. What type of lumber would be best suited for a picnic table that will be exposed to outdoor conditions?
- a. Treated
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12. On a saw blade what does TPI stand for?
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3. What tool is pictured in the image to the right?
 - a. Fish tape
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4. What is the purpose of the tool in question 3?
 - a. Measure the distance in between two points
 - b. Clean a clog out of a toilet and/or drain
 - c. To measure electrical current
 - d. To pull electrical lines through conduit
5. Using the wiring schematic, troubleshoot the circuit and determine why the breaker is tripping. What is the problem?
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Electrical Calculation Formulas

$$I=E/R$$

$$R=E.I$$

$$E = IR$$

$$P=IV$$

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10. $\frac{1}{746}$ of 1 horsepower and is the base unit of electrical power:
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11. Resistance is measured in:
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12. Which of the following formulas describes ohm's law?
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14. Find the resistance of a circuit that draws 0.02 amperes with 24 volts applied.
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15. A DC electric motor transforms 3 kW of electrical power into mechanical form. If the motor's operating voltage is 1500 volts, how much current does it "draw" when operating at full load (full power output)?
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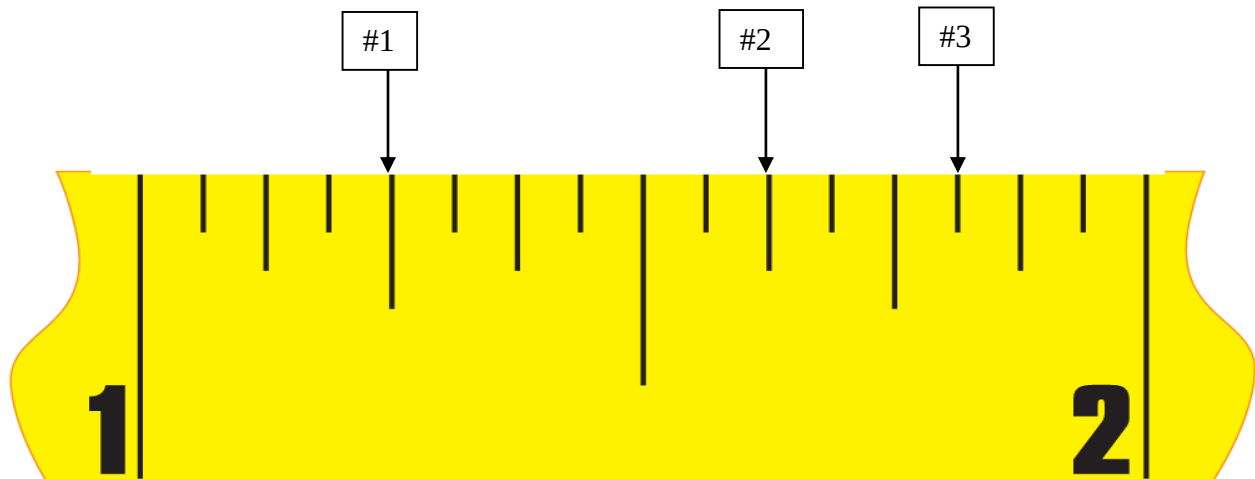
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**Environmental/Natural Resource Systems
Land Measurement Problem Solving**

Please use this image to answer 1-4



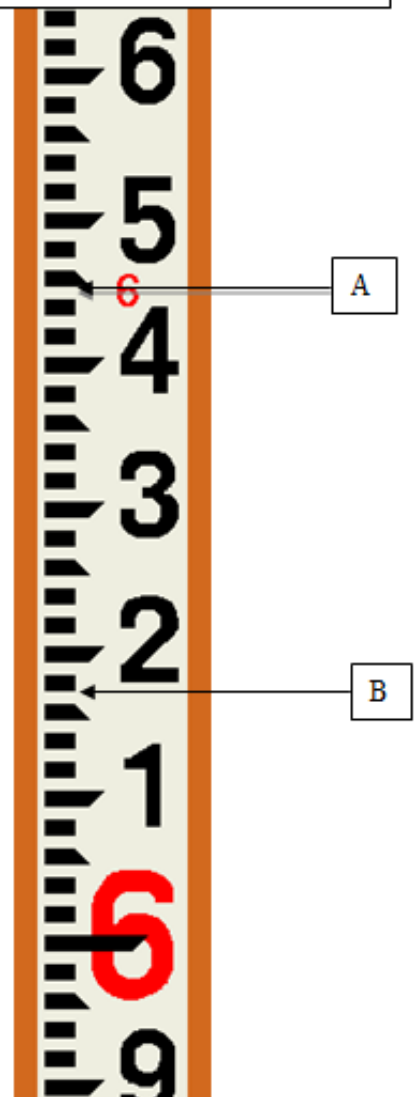
Standard Tape Measure Showing Inch Breakdown

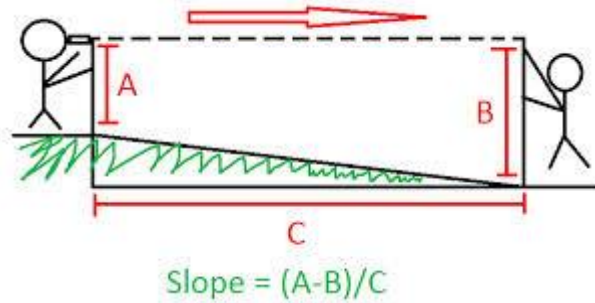
1. What is the measurement of #1 in the image above?
 - a. $1 \frac{1}{4}$ "
 - b. $1 \frac{1}{2}$ "
 - c. $1 \frac{1}{16}$ "
 - d. $1 \frac{1}{8}$ "
2. What is the measurement of #2 in the image above?
 - a. $\frac{5}{8}$ "
 - b. $1 \frac{10}{16}$ "
 - c. $1 \frac{5}{8}$ "
 - d. $1 \frac{3}{4}$ "

3. 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. $1 \frac{9}{16}$ "
4. What is the distance between 1 & 3 on the tape measure?
- a. $\frac{1}{2}$ "
 - b. $\frac{15}{32}$ "
 - c. $\frac{7}{16}$ "
 - d. $\frac{9}{16}$ "

Use this image to answer questions 5 & 6

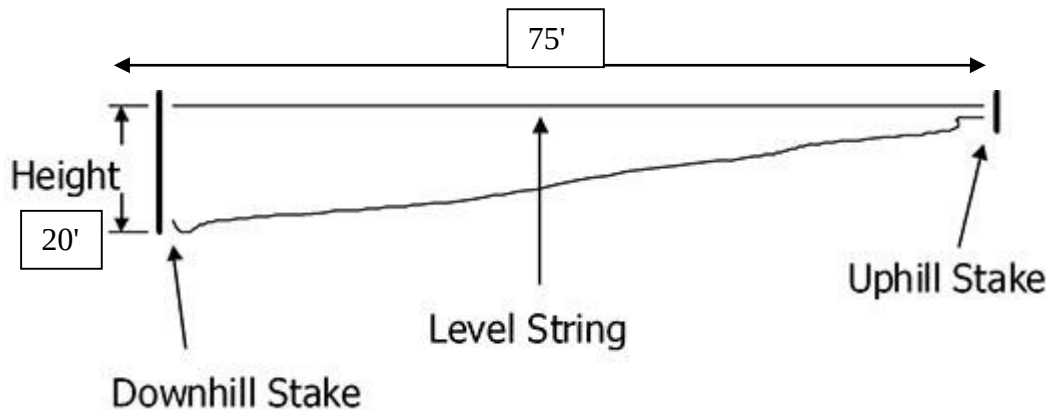
5. Using the surveying rod in the image on the previous page, what is the reading at A?
- a. 1.50
 - b. 6.50
 - c. 6.05
 - d. 6.45
6. Using the surveying rod in the image on the previous page, what is the reading at B?
- a. 1.70
 - b. 6.17
 - c. 6.15
 - d. 6.50





7. Assuming that you are assisting on a job site and want to prep the job site to lay a level pad of cement in a pig pen. In order to minimize costs you will need to determine if there is any slope over the 6' site. If there is more than a 3% slope you will need to backfill the area that slopes off to ensure that costs remain low. Using the measurements taken at A & 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%



8. Using the information in the figure above calculate the percent slope for the worksite of your next concrete pad.

- a. 20%
- b. 26%
- c. 75%
- d. 95%

9. A concrete slab is needed for the wash bay at the hog barn at the Iowa State Fair. The wooden forms to pour the concrete slab have inside dimensions of 12 feet by 36 feet and provide for a uniform slab thickness of 6 inches. What approximate volume of concrete (in cubic yards) is needed to fill the forms?

Hint: 1 cubic yard = 27 cubic feet 1 foot = 12 inches

- a. 1.2 cubic yards
- b. 8 cubic yards
- c. 96 cubic yards
- d. 69984 cubic yards

10. Approximately how many acres are in a rectangular field measuring 1000 by 375 yards?

Hints: Area of a rectangle is the length times the width

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

- a. 8.61 acres
- b. 17.55 acres
- c. 77.48 acres
- d. 16,335,000,000 acres

11. You have been asked to place wood shavings in all of the pig pens at the Iowa State Fair. The bags of wood shavings that are available at the local Co-Op if applied properly can cover 25 square feet per bag. The pens that you will be applying the wood shavings to are 6 x 6 square in shape. How many bags of wood shavings will you need for all 250 pens?

- a. 6
- b. 25
- c. 250
- d. 360

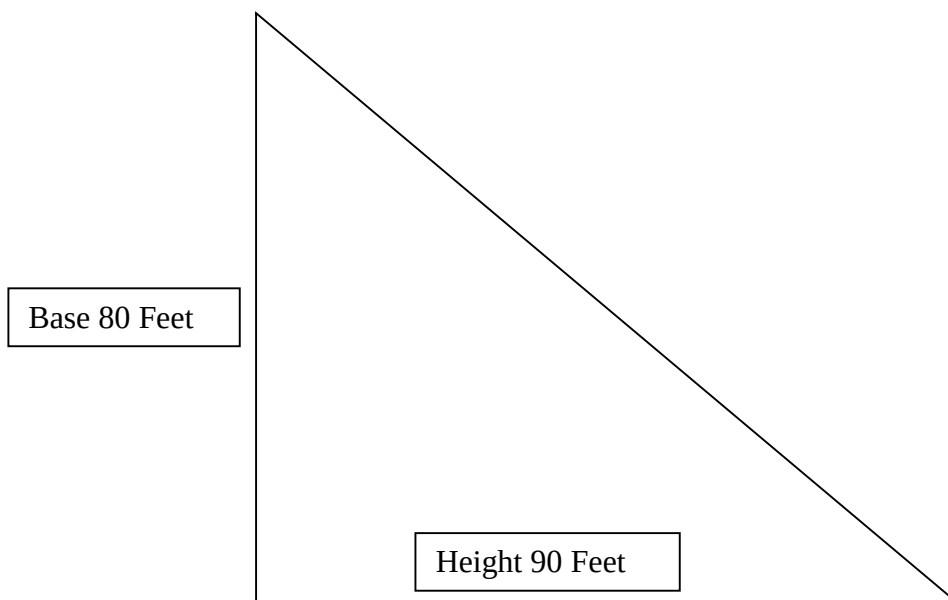
12. The Iowa State Fair wants to pay your FFA chapter for the wood shavings and your time. You charge \$0.10 per square foot for your labor and overhead expenses. The wood shavings are on sale at \$3 per bag. How much does the Iowa State Fair owe your chapter?

- a. \$900.00
- b. \$1080.00
- c. \$1980.00
- d. \$1991.00

13. The Polk County Fair Board members are really impressed with your work habit and the how the pens look for the State Fair. The County Fair Board wants to hire you to apply the same wood chips in their pens at the same application rate. Your chapter is typically busy during the county fair, but is willing to complete the job at a higher rate to entice your members to volunteer. The prices have increased to cover your labor and overhead expenses to \$0.12 per square foot. How many square feet is their show ring? Please see the image below to determine square footage.

Fields with Right Triangles: $\text{Base} \times \text{Height} \div 2 = \text{Area}$

- a. 3,600
- b. 7,200
- c. 1,704
- d. 1, 352



14. Using the information provided in question # 13, how much will you charge to spread the wood shavings in the show ring?

- a. \$432
- b. \$360
- c. \$720
- d. \$864

15. How much will the Polk County Fair board owe your FFA chapter for the wood shavings and labor?

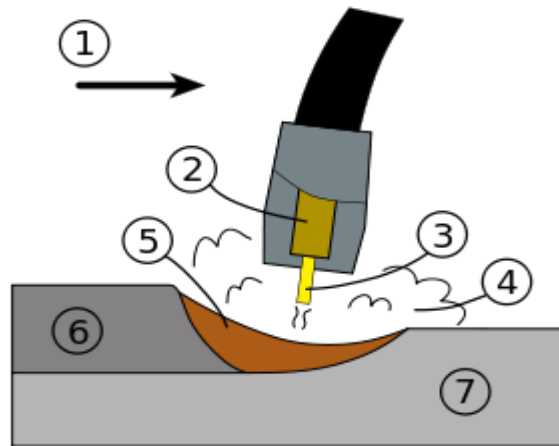
- a. \$288
- b. \$432
- c. \$864
- d. \$1296

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Metals & Welding Systems
Gas Metal Arc Welding Problem Solving



Answer questions 1-5 using the diagram above

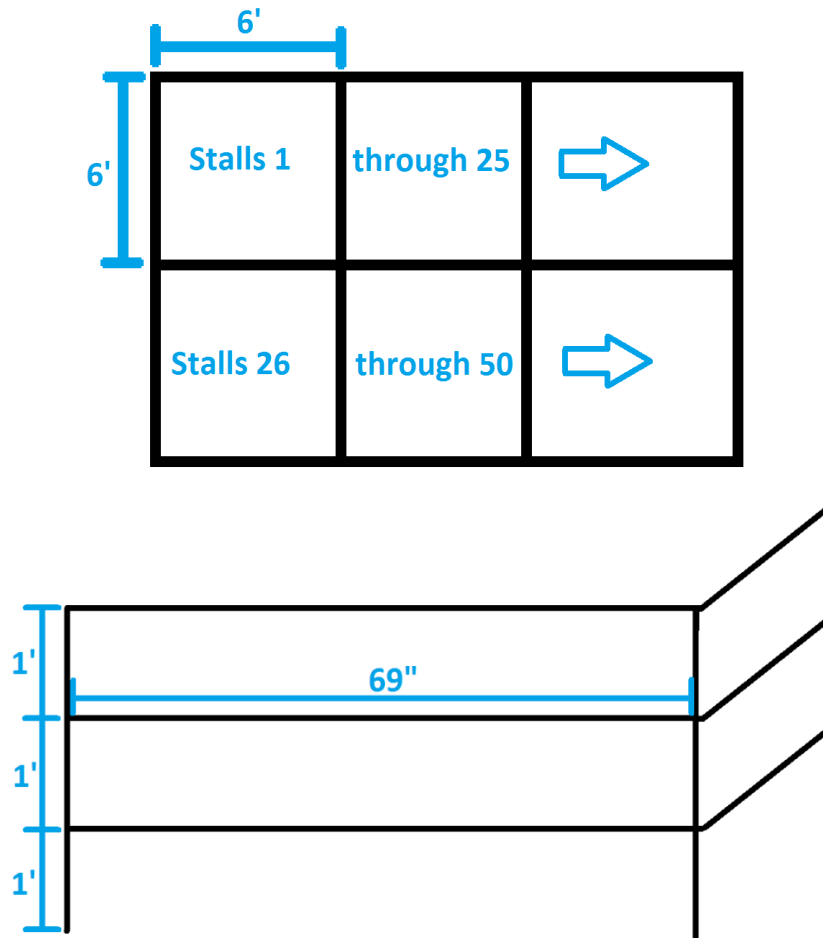
1. Using the Miller Welding Calculator sheet using 75%Ar25%CO₂ shielding gas and .045" wire and you are planning to weld 3/16 mild steel, what should the machines voltage be set at?
 - a. 19-20 volts
 - b. 18-19 volts
 - c. 17-18 volts
 - d. 16-17 volts
2. Using the Miller Welding Calculator sheet using 75%Ar25%CO₂ shielding gas and .045" wire and you are planning to weld 3/16 mild steel, what should the wire feed be set at?
 - a. 320-340 ipm
 - b. 160-175 ipm
 - c. 120-130 ipm
 - d. 360-380 ipm

3. If you buy flux-cored wire what shielding gas combination will you need to use?
 - a. 100% Ar
 - b. 75% Ar 25% CO₂
 - c. Stargon
 - d. Flux core does not require the use of gas
4. What can a damage liner cause the machine to do?
 - a. Improper grounding
 - b. Excessive wire speed
 - c. Bird nesting
 - d. Stream transfer

Items 5-7 will require you to identify items or issues with actual welds provided to you

5. What item needs to be replaced?
 - a. Gas Nozzle
 - b. Gas Diffuser
 - c. Gas liner
 - d. Contact Tip
6. Identify the weld joint shown
 - a. T-joint
 - b. Lap joint
 - c. Butt joint
 - d. Corner
7. You produced the following weld, identify the major issue associated with this weld
 - a. Travel Speed Too Slow
 - b. Wire Speed Too Fast
 - c. Arc length Too Far Away
 - d. No Shielding Gas

You are preparing for the Iowa State Fair and need to build 50 hog stalls. You have a limited amount of space and metal to build all of the hog stalls and come up with the design below. There will be 25 stalls in a straight line and another 25 located directly behind. All stalls are equal in size.



8. What length of 1/8"x 1.5"x 1.5" Square tube will you need to build the legs?
 - a. 36"
 - b. 72"
 - c. 10'
 - d. 12'
9. What length of 1/8"x 1.5"x 1.5" Square tube will be needed to complete the first stall?
 - a. 70'
 - b. 81'
 - c. 117'
 - d. 142'

- 10.** The current cost for a 6' 1/8"x1.5"x1.5" Square tube is \$0.35 (including tax) per foot, how much should you budget for your first hog stall?
- a. \$28.35
 - b. \$30.35
 - c. \$55.96
 - d. \$56.00
- 11.** How much additional square tubing will you need to complete a second stall to your existing one calculated above?
- a. 49' 3"
 - b. 50' 4"
 - c. 55' 5"
 - d. 57' 9"
- 12.** What is the additional cost to adding the second stall?
- a. \$16.45
 - b. \$20.21
 - c. \$19.42
 - d. \$55.32
- 13.** How much metal will you need if you decide to construct stalls 1 through 25 in a straight line?
- a. 502'
 - b. 1,148'
 - c. 1,323'
 - d. 1,467'
- 14.** What is the total amount of steel you will need to purchase in order to complete all 50 stalls?
- a. 1200'
 - b. 2424' 9"
 - c. 1895'
 - d. 957' 9"
- 15.** What is going to be the total cost to build all 50 stalls?
- a. \$848.66
 - b. \$490.08
 - c. \$780.65
 - d. \$1,023.45

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Machinery Systems **Skid Steer Problem Solving**

For this problem solving activity, use the Skid Steer Loader (SSL) Operation and Maintenance Manual look up the needed information for a 246D Skid Steer.

1. Reading the CAT product identification number (PIN) the underlined area CAT 0789BG 6SL12345 identifies the...?
 - a. Caterpillar's World Manufacture Code
 - b. Machine Descriptor
 - c. Check Character
 - d. Product Sequence Number
2. A debris barrier kit is required for use in applications which create airborne debris. Which of the following work tools may create airborne debris?
 - a. Mulching head
 - b. Brush cutter
 - c. Hammer
 - d. All of the above
3. What is the declared dynamic operator sound pressure level for the 246D Skid Loader?
 - a. 81 dB(A)
 - b. 83 dB(A)
 - c. 85 dB(A)
 - d. 101 dB(A)
4. Using the general purpose bucket (p. 69), what is the bucket height for dump clearance at 40 ° dump angle with a 1,704 lb load?
 - a. 93 in.
 - b. 95 in.
 - c. 96 in.
 - d. 98 in.

5. When working on side hills or slopes, which of the following criteria is important to take into consideration?
 - a. Travel Speed
 - b. Direction of Travel
 - c. Surface Material
 - d. All of the above
6. Using the industrial grapple bucket (p. 98), what is the maximum reach height at 40° dump angle?
 - a. 24 in.
 - b. 38 in.
 - c. 39 in.
 - d. 95 in.
7. What is the attachment shown on illustration 76 on page 108?
 - a. General purpose bucket
 - b. Multi-purpose bucket
 - c. Pallet fork
 - d. Grapple bucket
8. You have purchased a 49 inch bale spear to move round bales into your feedlot. What is the tool limit? (p. 124)
 - a. 155 lbs
 - b. 2,000 lbs
 - c. 276 lbs
 - d. 3,000 lbs
9. You have purchased a 49 inch bale spear to move round bales into your feedlot. What is the tipping load for the 246D Skid Loader? (p. 124)
 - a. 3,259 lbs
 - b. 3,264 lbs
 - c. 3,403 lbs
 - d. 3,413 lbs
10. Which of the following items must be completed during your daily inspection of the 246D Skid Loader?
 - a. Check all oil and coolant levels
 - b. Remove any trash build up and debris
 - c. Grease all of the fittings
 - d. All of the above

11. Using illustration 97 shown on page 161, what button do you need to push to turn on the rear working lights?
- a. 16
 - b. 17
 - c. 18
 - d. 19
12. Viewing the fuel gauge on illustration 97 indicates the machine has...?
- a. A full tank
 - b. $\frac{3}{4}$ full tank
 - c. $\frac{1}{2}$ full tank
 - d. $\frac{1}{4}$ full tank
13. Looking at the basic control configuration on illustration 97, item number 24 is...?
- a. Thermostat
 - b. Anti-theft security keys
 - c. Turn signal
 - d. Engine speed control knob
14. Which of the following features are included in the CAT 246D Skid Loader?
- a. Bluetooth microphone
 - b. Backup camera
 - c. Anti-theft security system
 - d. All of the above
15. By moving the right hand joystick forward, which of the following items will happen?
- a. The machine moves forward
 - b. The bucket arm goes down
 - c. The bucket tilts up
 - d. The bucket tilts down

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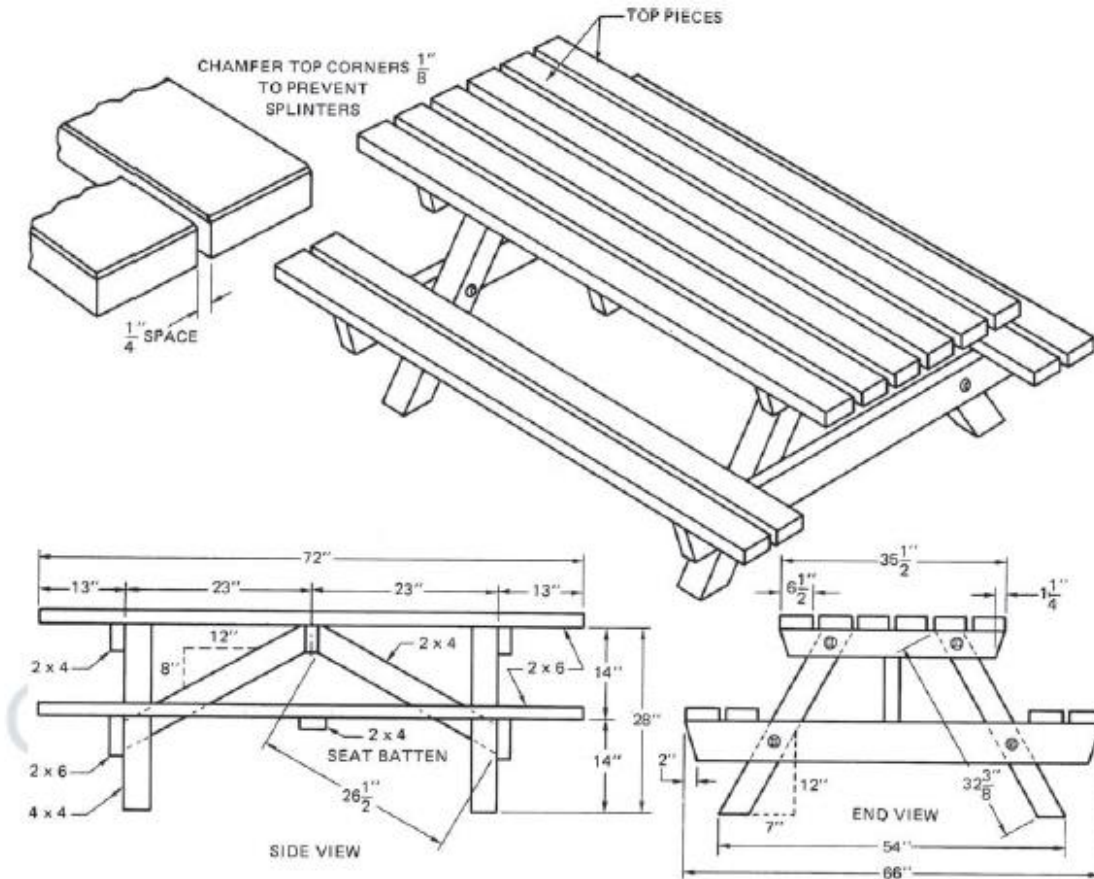
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 - d. 4500 Ohms

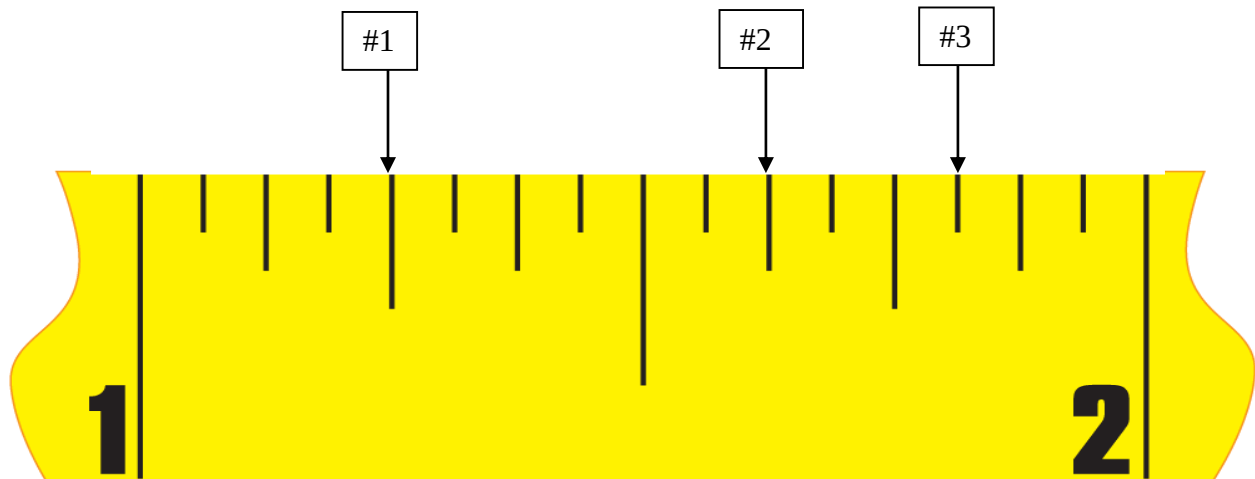
Iowa State FFA Agricultural Mechanics Career Development Event 2016

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Environmental/Natural Resource Systems Land Measurement Problem Solving

Please use this image to answer 1-4

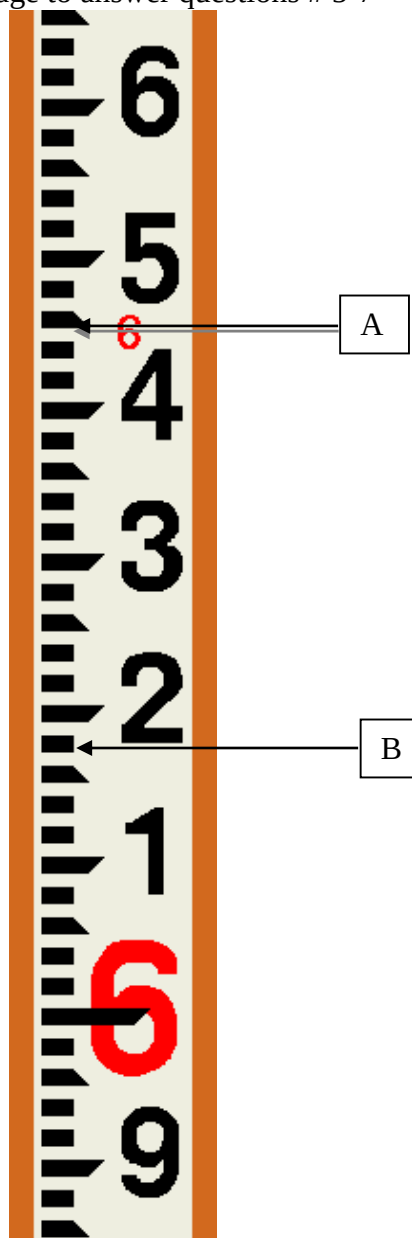


Standard Tape Measure Showing Inch Breakdown

1. 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"
2. What is the measurement of #2 in the image above?
 - a. 5/8"
 - b. 1 10/16"
 - c. **1 5/8"**
 - d. 1 3/4"

3. 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. $1 \frac{9}{16}$ "
4. What is the distance between 1 & 3 on the tape measure?
- a. $\frac{1}{2}$ "
 - b. $\frac{15}{32}$ "
 - c. $\frac{7}{16}$ "
 - d. $\frac{9}{16}$ "**

Use this image to answer questions # 5-7

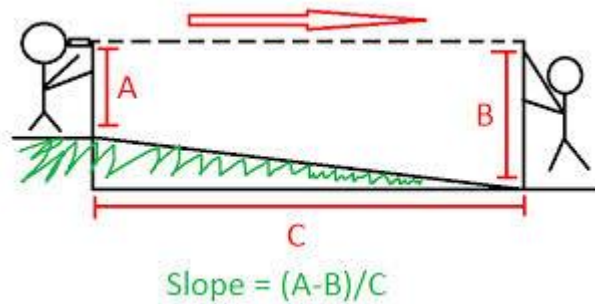


5. Using the surveying rod in the image on the previous page, what is the reading at A?

- a. 1.50
- b. 6.50
- c. 6.05
- d. 6.45**

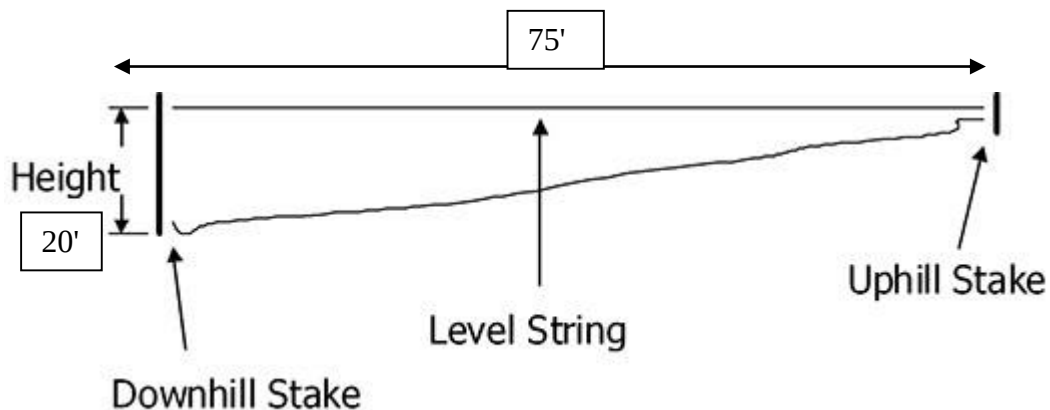
6. Using the surveying rod in the image on the previous page, what is the reading at B?

- a. 1.70
- b. 6.17**
- c. 6.15
- d. 6.50



7. Assuming that you are assisting on a job site and want to prep the job site to lay a level pad of cement in a pig pen. In order to minimize costs you will need to determine if there is any slope over the 6' site. If there is more than a 3% slope you will need to backfill the area that slopes off to ensure that costs remain low. Using the measurements taken at A & 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%**



8. Using the information in the figure on the bottom of the previous page calculate the percent slope for the worksite of your next concrete pad.

- a. 20%
- b. 26%**
- c. 75%
- d. 95%

9. A concrete slab is needed for the wash bay at the hog barn at the Iowa State Fair. The wooden forms to pour the concrete slab have inside dimensions of 12 feet by 36 feet and provide for a uniform slab thickness of 6 inches. What approximate volume of concrete (in cubic yards) is needed to fill the forms?

Hint: 1 cubic yard = 27 cubic feet 1 foot = 12 inches

- a. 1.2 cubic yards
- b. 8 cubic yards**
- c. 96 cubic yards
- d. 69984 cubic yards

10. Approximately how many acres are in a rectangular field measuring 1000 by 375 yards?

Hints: Area of a rectangle is the length times the width

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

- a. 8.61 acres
- b. 17.55 acres
- c. 77.48 acres**
- d. 16,335,000,000 acres

11. You have been asked to place wood shavings in all of the pig pens at the Iowa State Fair. The bags of wood shavings that are available at the local Co-Op if applied properly can cover 25 square feet per bag. The pens that you will be applying the wood shavings to are 6 x 6 square in shape. How many bags of wood shavings will you need for all 250 pens?

- a. 6
- b. 25
- c. 250
- d. 360**

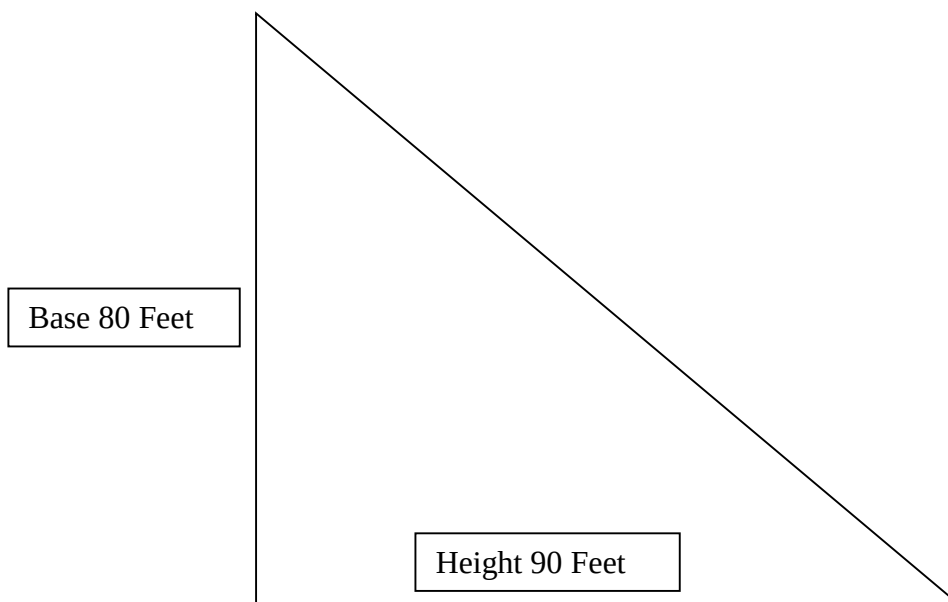
12. The Iowa State Fair wants to pay your FFA chapter for the wood shavings and your time. You charge \$0.10 per square foot for your labor and overhead expenses. The wood shavings are on sale at \$3 per bag. How much does the Iowa State Fair owe your chapter?

- a. \$900.00
- b. \$1080.00
- c. \$1980.00**
- d. \$1991.00

13. The Polk County Fair Board members are really impressed with your work habit and the how the pens look for the Stat Fair. The County Fair Board wants to hire you to apply the same wood chips in their pens at the same application rate. Your chapter is typically busy during the county fair, but is willing to complete the job at a higher rate to entice your members to volunteer. The prices have increased to cover your labor and overhead expenses to \$0.12 per square foot. How many square feet is their show ring? Please see the image below to determine square footage.

Fields with Right Triangles: $\text{Base} \times \text{Height} \div 2 = \text{Area}$

- a. **3,600**
- b. 7,200
- c. 1,704
- d. 1, 352



14. Using the information provided in question # 13, how much will you charge to spread the wood shavings in the show ring?

- a. **\$432**
- b. \$360
- c. \$720
- d. \$864

15. How much will the Polk County Fair board owe your FFA chapter for the wood shavings and labor?

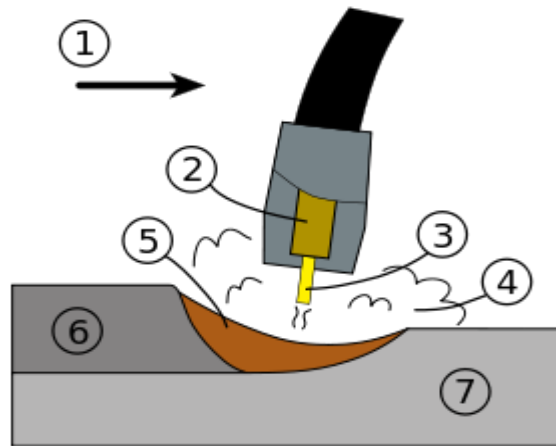
- a. \$288
- b. \$432
- c. **\$864**
- d. \$1296

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Metals & Welding Systems
Gas Metal Arc Welding Problem Solving



Answer questions 1-5 using the diagram above

1. Using the Miller Welding Calculator sheet using 75%Ar25%CO₂ shielding gas and .045" wire and you are planning to weld 3/16 mild steel, what should the machines voltage be set at?
 - a. 19-20 volts
 - b. 18-19 volts**
 - c. 17-18 volts
 - d. 16-17 volts

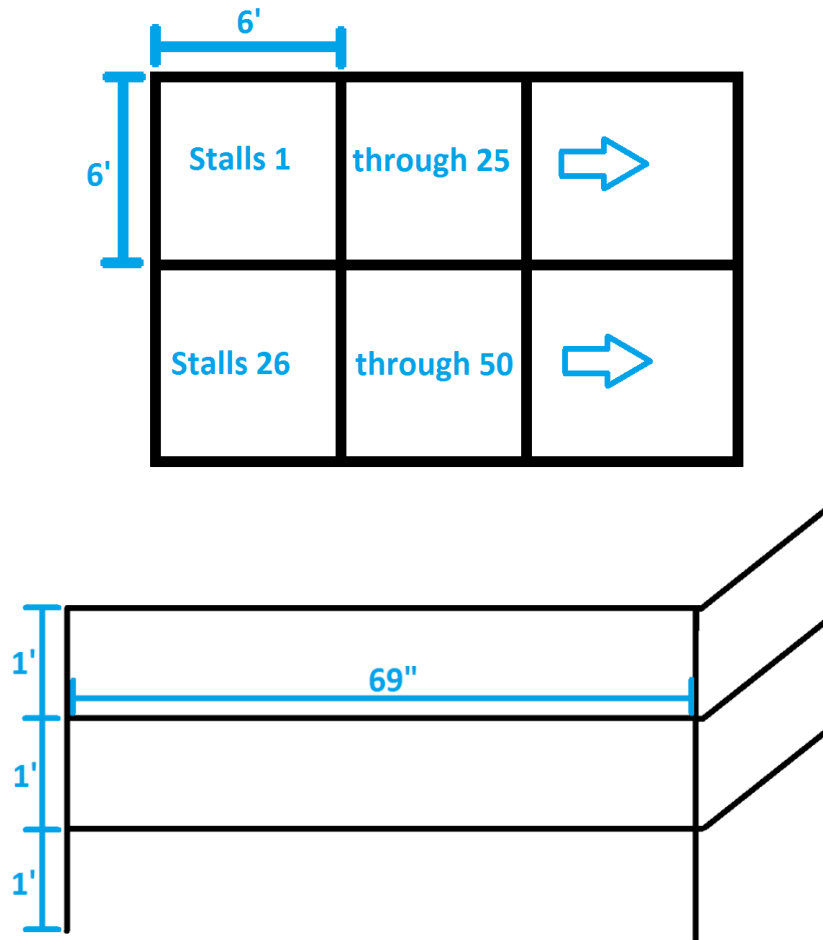
2. Using the Miller Welding Calculator sheet using 75%Ar25%CO₂ shielding gas and .045" wire and you are planning to weld 3/16 mild steel, what should the machines wire feed be set at?
 - a. 320-340 ipm**
 - b. 160-175 ipm
 - c. 120-130 ipm
 - d. 360-380 ipm

3. If you buy flux-cored wire what shielding gas combination will you need to use?
- a. 100% Ar
 - b. 75% Ar 25% CO₂
 - c. Stargon
 - d. **Flux core does not require the use of gas**
4. What can a damage liner cause the machine to do?
- a. Improper grounding
 - b. Excessive wire speed
 - c. **Bird nesting**
 - d. Stream transfer

Items 5-7 will require you to identify items or issues with actual welds provided to you

5. What item needs to be replaced?
- a. Gas Nozzle
 - b. Gas Diffuser
 - c. Gas liner
 - d. Contact Tip
6. Identify the weld joint shown
- a. T-joint
 - b. Lap joint
 - c. Butt joint
 - d. Corner
7. You produced the following weld, identify the major issue associated with this weld
- a. Travel Speed Too Slow
 - b. Wire Speed Too Fast
 - c. Arc length Too Far Away
 - d. No Shielding Gas

You are preparing for the Iowa State Fair and need to build 50 hog stalls. You have a limited amount of space and metal to build all of the hog stalls and come up with the design below. There will be 25 stalls in a straight line and another 25 located directly behind. All stalls are equal in size.



8. What length of 1/8"x 1.5"x 1.5" Square tube will you need to build the legs?
 - a. **36"**
 - b. 72"
 - c. 10'
 - d. 12'
9. What length of 1/8"x 1.5"x 1.5" Square tube will be needed to complete the first stall?
 - a. 70'
 - b. **81'**
 - c. 117'
 - d. 142'

10. The current cost for a 6' 1/8"x1.5"x1.5" Square tube is \$0.35 (including tax) per foot, how much should you budget for your first hog stall?
- a. **\$28.35**
 - b. \$30.35
 - c. \$55.96
 - d. \$56.00
11. How much additional square tubing will you need to complete a second stall to your existing one calculated above?
- a. 49' 3"
 - b. 50' 4"
 - c. 55' 5"
 - d. **57' 9"**
12. What is the additional cost to adding the second stall?
- a. \$16.45
 - b. **\$20.21**
 - c. \$19.42
 - d. \$55.32
13. How much metal will you need if you decide to construct stalls 1 through 25 in a straight line?
- a. 502'
 - b. 1,148'
 - c. 1,323'
 - d. **1,467'**
14. What is the total amount of steel you will need to purchase in order to complete all 50 stalls?
- a. 1200'
 - b. **2424' 9"**
 - c. 1895'
 - d. 957' 9"
15. What is going to be the total cost to build all 50 stalls?
- a. **\$848.66**
 - b. \$490.08
 - c. \$780.65
 - d. \$1,023.45

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Machinery Systems Skid Steer Problem Solving

For this problem solving activity, use the Skid Steer Loader (SSL) Operation and Maintenance Manual look up the needed information for a 246D Skid Steer.

1. Reading the CAT product identification number (PIN) the underlined area CAT 0789BG 6SL12345 identifies the...?
 - a. Caterpillar's World Manufacture Code
 - b. **Machine Descriptor**
 - c. Check Character
 - d. Product Sequence Number
2. A debris barrier kit is required for use in applications which create airborne debris. Which of the following work tools may create airborne debris?
 - a. Mulching head
 - b. Brush cutter
 - c. Hammer
 - d. **All of the above**
3. What is the declared dynamic operator sound pressure level for the 246D Skid Loader?
 - a. **81 dB(A)**
 - b. 83 dB(A)
 - c. 85 dB(A)
 - d. 101 dB(A)
4. Using the general purpose bucket (p. 69), what is the bucket height for dump clearance at 40 ° dump angle with a 1,704 lb load?
 - a. 93 in.
 - b. **95 in.**
 - c. 96 in.
 - d. 98 in.

5. When working on side hills or slopes, which of the following criteria is important to take into consideration?
 - a. Travel Speed
 - b. Direction of Travel
 - c. Surface Material
 - d. **All of the above**
6. Using the industrial grapple bucket (p. 98), what is the maximum reach height at 40° dump angle?
 - a. **24 in.**
 - b. 38 in.
 - c. 39 in.
 - d. 95 in.
7. What is the attachment shown on illustration 76 on page 108?
 - a. General purpose bucket
 - b. Multi-purpose bucket
 - c. **Pallet fork**
 - d. Grapple bucket
8. You have purchased a 49 inch bale spear to move round bales into your feedlot. What is the tool limit? (p. 124)
 - a. 155 lbs
 - b. **2,000 lbs**
 - c. 276 lbs
 - d. 3,000 lbs
9. You have purchased a 49 inch bale spear to move round bales into your feedlot. What is the tipping load for the 246D Skid Loader? (p. 124)
 - a. **3,259 lbs**
 - b. 3,264 lbs
 - c. 3,403 lbs
 - d. 3,413 lbs
10. Which of the following items must be completed during your daily inspection of the 246D Skid Loader?
 - a. Check all oil and coolant levels
 - b. Remove any trash build up and debris
 - c. Grease all of the fittings
 - d. **All of the above**

11. Using illustration 97 shown on page 161, what button do you need to push to turn on the rear working lights?
- a. 16
 - b. **17**
 - c. 18
 - d. 19
12. Viewing the fuel gauge on illustration 97 indicates the machine has...?
- a. A full tank
 - b. $\frac{3}{4}$ full tank
 - c. $\frac{1}{2}$ **full tank**
 - d. $\frac{1}{4}$ full tank
13. Looking at the basic control configuration on illustration 97, item number 24 is...?
- a. Thermostat
 - b. Anti-theft security keys
 - c. Turn signal
 - d. **Engine speed control knob**
14. Which of the following features are included in the CAT 246D Skid Loader?
- a. Bluetooth microphone
 - b. Backup camera
 - c. Anti-theft security system
 - d. **All of the above**
15. By moving the right hand joystick forward, which of the following items will happen?
- a. The machine moves forward
 - b. **The bucket arm goes down**
 - c. The bucket tilts up
 - d. The bucket tilts down