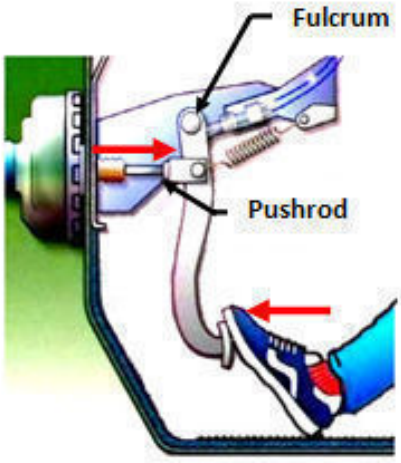
POE 1.1 Selected Review **Name _____**

1.1 Levers

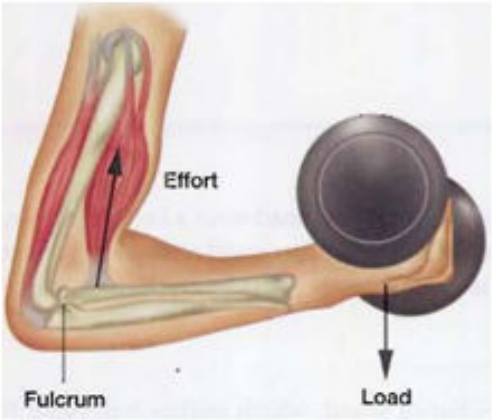


The diagram to the left illustrates a person applying force to a brake pedal assembly. The resistance force is exerted on the lever by the push rod. The person's foot acts as the effort force when braking.

12) What type of lever is illustrated by brake pedal assembly.

13) The effort force applied to the brake pedal is 11 Newtons. The resistance force exerted by the pushrod is 25.3 Newtons. The distance from the fulcrum to the brake pedal is 38.1 cm. If the system is in static equilibrium, calculate the distance from the fulcrum to the resistance force.

Equation(s)	Substitution / Calculations	Solution with units



The diagram to the left illustrates a person curling a dumbbell. The dumbbell acts as the load or resistance force. The bicep acts as the effort force on the forearm.

14) What type of lever is illustrated by a person curling a dumbbell.

12) What is the mechanical advantage of curling the weight if the distance from the elbow to the bicep tendon is 1.3 inch, and the distance from the elbow to the center of gravity of the weight is 16 .1 inches?

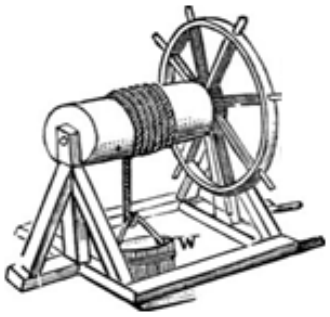
Equation(s)	Substitution / Calculations	Solution with units

1.1 Wheel & Axle

3) In a wheel and axle system, if a wheel is 8 inches in diameter and the axle is 4 inches in diameter, and the wheel completes 6 revolutions, how many revolutions does the axle complete?

A) 3 revolutions
B) 6 revolutions
C) 9 revolutions
D) 12 revolutions

4) Looking at the diagram to the side, a wheel and axle is being used to haul water from a well. If the radius of the wheel is 18 inches, and the diameter of the axle is one foot. What is the ideal mechanical advantage of the system.



Equation(s)	Substitution / Calculations	Solution with units

5) The lug wrench shown in the diagram to the side illustrates a wheel and axle. One of the sockets is placed on the lug nut, the axle. The arms perpendicular to the lug socket act as the wheel. What is the actual mechanical advantage of the lug wrench if an effort force of 102 lbs is applied at the end of one of the arms in order to overcome 1005 lbs at the lug nut?

Equation(s)	Substitution / Calculations	Solution with units

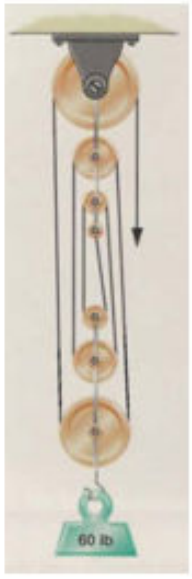
1.1 Pulleys

5) What is the **ideal** effort force required to lift the 60. lb. weight in the given diagram .

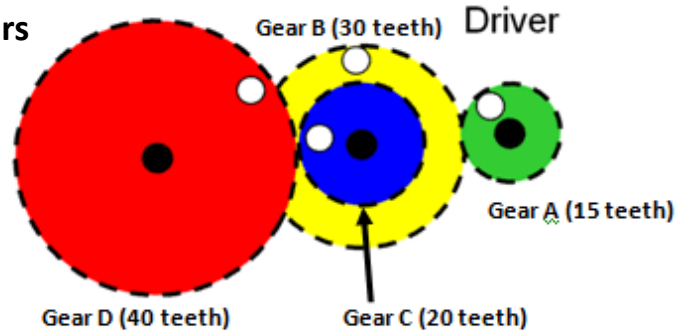
Equation(s)	Substitution / Calculations	Solution with units

6) If the actual effort force was 13.4 lbs, what is the efficiency of the pulley?

Equation(s)	Substitution / Calculations	Solution with units



1.1 Gears



7) What type of gear train is shown to the left?

8) Gear A is the driver gear (input gear). Calculate the gear ratio of Gear A and Gear B.

Equation(s)	Substitution / Calculations	Solution with units

9) Calculate the gear ratio of Gear C and Gear D.

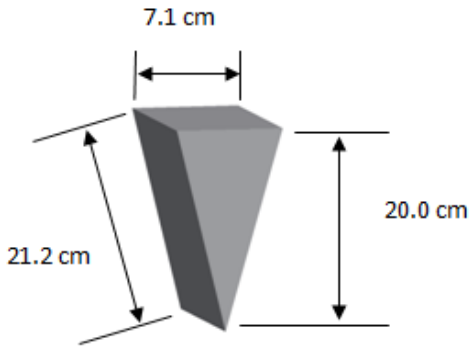
Equation(s)	Substitution / Calculations	Solution with units

10) Calculate the total gear ratio of the gear train.

Equation(s)	Substitution / Calculations	Solution with units

1.1 Inclined Plane/Wedge

In the wedge of the right, there is a down force applied to the wedge of 47 N (newtons). As a result, the slanted faces of the wedge exert an 81 N (newton) force on the material being split. Calculate the effeciency of the wedge pictured to the right.

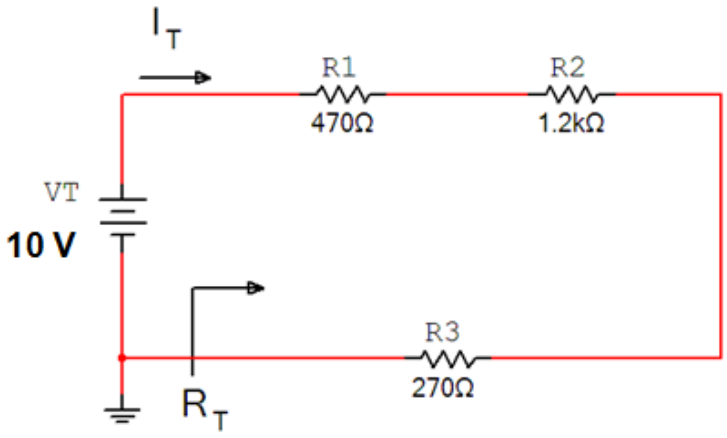


Equation(s)	Substitution / Calculations	Solution with units

POE 1.2 Selected Review **Name _____**

1.1 Series Circuits

4. Using the laws of circuit theory, solve for R_T, I_T, I_{R1}, I_{R2}, I_{R3}, V_{R1}, V_{R2}, and V_{R3}. Be sure to put your answer in proper engineering notation and use the correct units



R_T=_____

I_T=_____

I_{R1}=_____

I_{R2}=_____

I_{R3}=_____

V_{R1}=_____

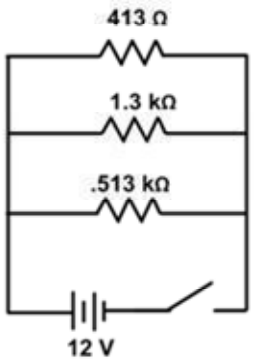
V_{R2}=_____

V_{R3}=_____

KIRCHHOFF=_____

1.2 Parallel Circuits

5) Calculate the total resistance of the given parallel circuit. Then, calculate the total current.

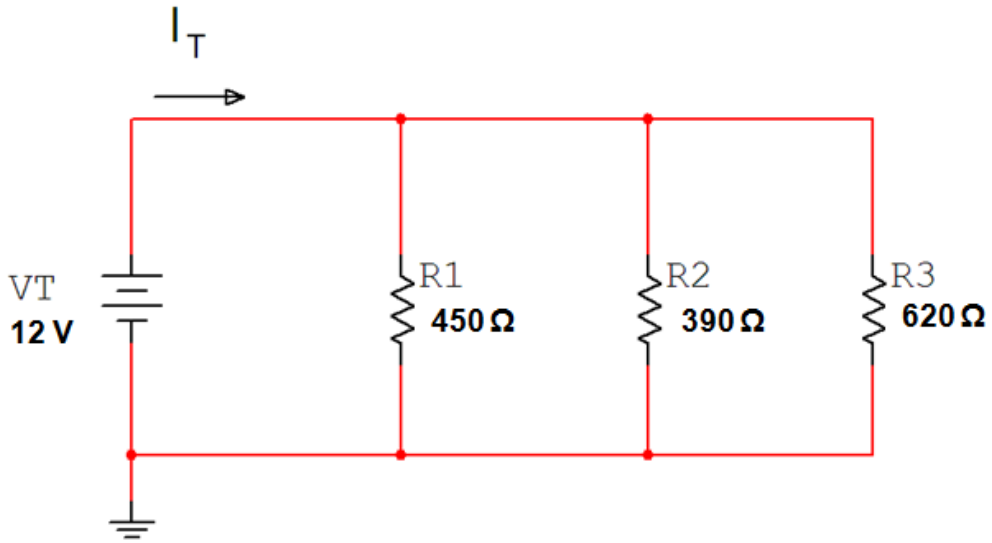


6) If the 413 Ohm resistor was removed and what would happen to each of the following? (Increase, Decrease, Stay the same, not enough info)

Total Voltage _____ Total Current _____ Total Resistance _____

Voltage Drop at .513 Ohm resistor _____ Current at 1.3 Ohm resistor _____

5) Using the laws of circuit theory, solve for R_T, I_T, I_{R1}, I_{R2}, I_{R3} V_{R1}, V_{R2}, and V_{R3}. Be sure to put your answer in proper engineering notation and use the correct units.



R_T=_____

V_T = _____

I_T=_____

V_{R1}=_____

V_{R2}=_____

V_{R3}=_____

I_{R1}=_____

I_{R2}=_____

I_{R3}=_____

1.2 Energy Sources

Which of the following can be best described as a renewable resource.

A) Geothermal

C) Biomass

B) Solar

D) hydroelectricity

Which of the following is **NOT** a nonrenewable energy resource?

A) uranium

C) Hydrogen

B) natural gas

D) coal

1.2 Energy, Work, Power

4) The electric winch is powered by an 18 V battery. The winch lifts the weight shown a total of 13 meters and draws a total of 20 Amps. The weight is 210 Newtons. It takes a total of 17 seconds. Find the efficiency of the electric winch as a percentage and round to the nearest tenth.

$$Efficiency = \frac{output}{input}$$

Equation(s)	Substitution / Calculations	Solution with units

POE 1.3 Selected Review **Name _____**

1.3 Intro to Thermodynamics

Write the laws of the three laws of thermodynamics

Zeroth Law of thermodynamics: _____

First law of thermodynamics: _____

Second law of thermodynamics: _____

Complete the following table:

Scale	Freezing point of water	Boiling point of water	Absolute zero
Celsius			
Kelvin			
Fahrenheit			
Rankin			

Is the following radiation, convection, or conduction?

_____ The heat you feel from a fireplace
_____ warm air rises to the ceiling
_____ water pumped in an auto cooling system
_____ Frying a pancake
_____ particles colliding with other particles
_____ air travels this way
_____ transfer through solid
_____ transfer through space
_____ moves as a wave
_____ moves as a current
_____ sun rays reaching earth
_____ occurs only within fluids
_____ a coil on an electric stove
_____ this type of transfer is affected by color

Covert 58 °F to degrees Kelvin.

Equation(s)	Substitution / Calculations	Solution with units

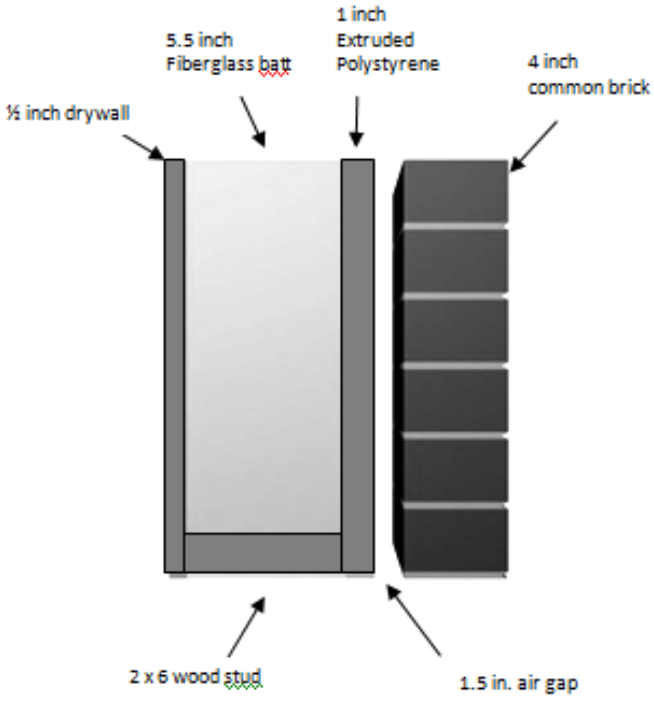
The U-value of a material measures the ability of the material to _____ heat. The _____ the value the better the material will conduct heat.

A) conduct, lower
B) resist, higher
C) conduct, higher
D) resist, lower

The R-Value of a material measures the ability of a material to _____ heat. The _____ the R-value the more resistance to heat the material has.

A) conduct, lower
B) resist, higher
C) conduct, higher
D) resist, lower

Study the diagram and the table below to answer the following questions.



R-Value Chart	
Construction Material	**R-Value**
Drywall 1 inch	0.90
Extruded Polystyrene 1 in.	4.00
2 x 4	4.38
2 x 6	6.88
Brick 4 in. common	0.80
Fiberglass Batt 1 inch.	3.142
1 inch of air space	0.17

1) Total R-value at a point through the fiberglass batt.

Calculations	Solution with units

2) Total R-value at a point through the wood stud.

Calculations	Solution with units

3) Calculate the difference in R-values.

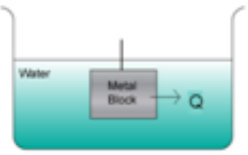
Calculations	Solution with units

1.3 Thermodynamics-Conductivity

4) A side wall in a refrigerated semi-trailer has a R-value of 13.0 $\frac{ft^2 \cdot °F \cdot hr}{Btu}$. The temperature outside the trailer is 84°F, and the inside of the trailer is 45°F. Calculate the energy transfer over 2 hours, through a single side wall on the trailer. The dimensions of the wall are 50 ft. by 13 ft. Ensure to use all correct units.

Equation(s)	Substitution / Calculations	Solution with units

A block of aluminum at 90.0°C is placed in 2.00 liter (2kg) of water at 15.0°C if the final temperature becomes 37.0°C.



5) Calculate the energy transferred to the water. Ensure correct units. (Precision to 0.0)

Equation(s)	Substitution / Calculations	Solution with units

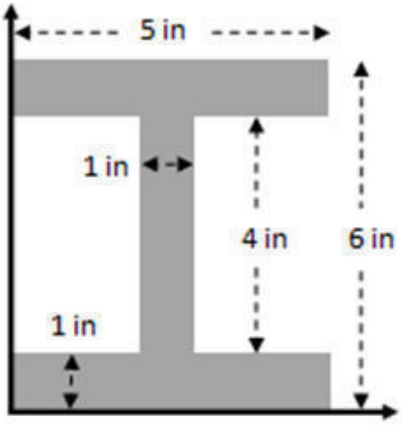
6) Calculate the mass of the aluminum block using the energy found from the previous heat transfer.

Equation(s)	Substitution / Calculations	Solution with units

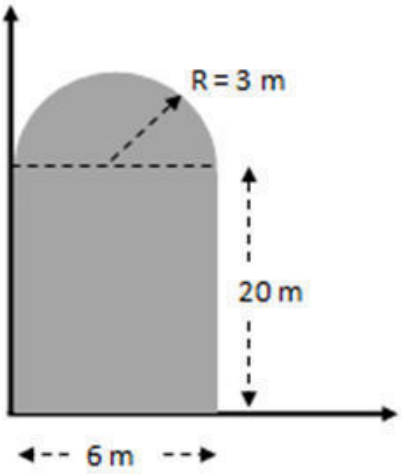
POE Unit 2 Selected Review **Name _____**

2.1 Centroids

2) Calculate the centroid of the composite shape.



3) Calculate the centroid of the composite shape.



2.1 Beam Deflection

$$I_{xx} = \frac{bh^3}{12} \qquad \Delta MAX = \frac{FL^3}{48EI}$$

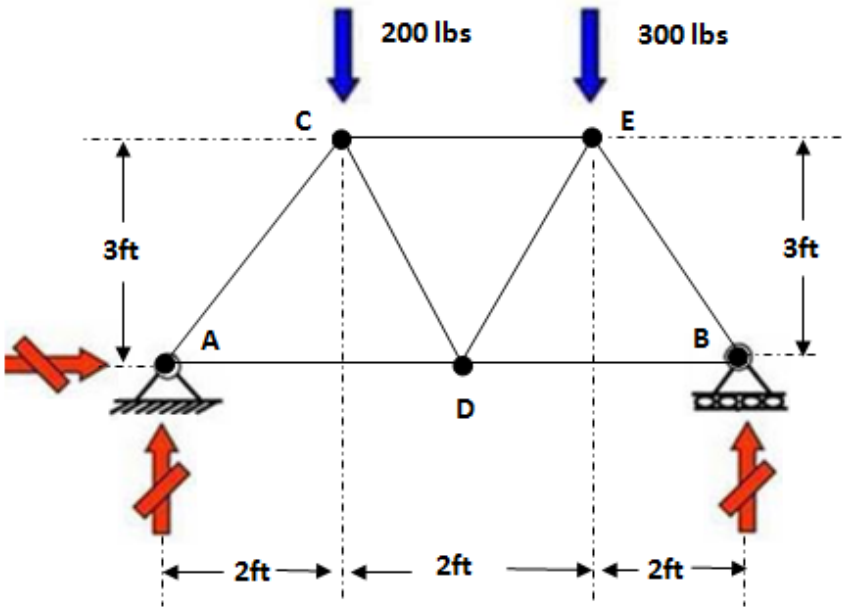
A 2 x 6 beam (actual dimensions of 1.5 in. x 5.5 in.) is supporting a 340 lb load. The beam is oriented in a vertical position as shown above. The span is 84 inches. The beam deflects 0.34 inches.

1) Calculate the moment of inertia of the given beam.

2) Calculate the modulus of elasticity of the beam.

3) How much force would need to be applied in order to deflect the beam exactly 1.00 inch?

Truss Calculations



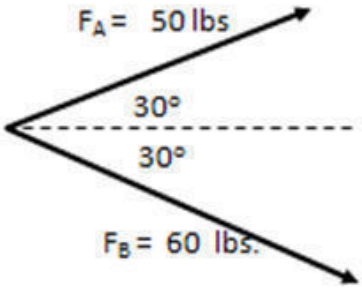
1) Calculate the magnitude of R_{fAY}

2) Draw the free body diagram of joint A

3) Calculate the force in member AC. Determine whether it is in tension or compression.

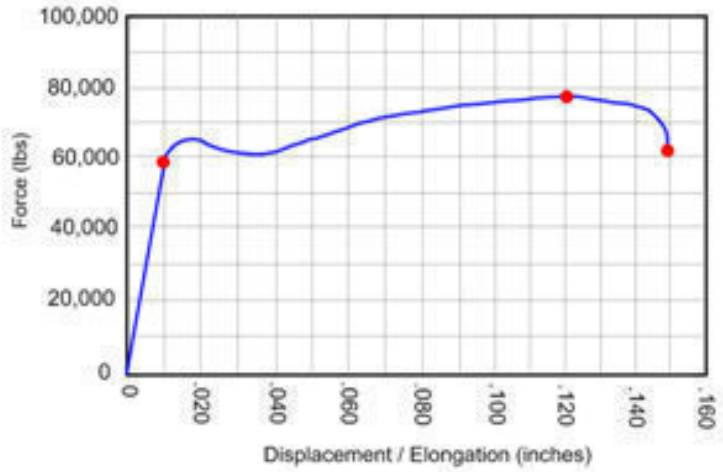
2.1 Force Vectors

8) Using the diagram to the right, calculate the magnitude, direction, and sense of the resultant. (Hint: 1. calculate x and y components of each, 2. sum x and y forces, 3.determine resultant)



2.3 Material Strength Testing

A student was playing with his sweet grappling hook in the woods. He noticed an odd material in on the ground. Using his POE skills he decided to perform a destructive tensile test on a sample of mystery material. The sample of the material he used had a cross-sectional area of .125 in^2 and an original length of .554 inches.



1) Calculate the stress at the point that would correspond to the proportional limit of a stress strain curve.

Equation(s)	Substitution / Calculations	Solution with units

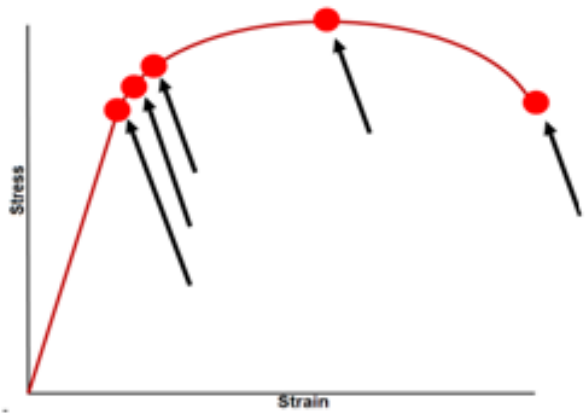
2) Calculate the ultimate stress of the material

Equation(s)	Substitution / Calculations	Solution with units

3) Calculate the modulus of elasticity of the material.

Equation(s)	Substitution / Calculations	Solution with units

4) Using the internet, look up the given modulus of elasticity (often referred to as Young's Modulus) to determine the material. What material does it appear to be?



9) Given the Stress Strain graph to the side identify each point.

Yield point / Elastic limit

Proportional limit

Failure

Ultimate Strength / Ultimate Stress

Offset Yield Strength

10) For sections A, B, and C describe how the physical aspect of the material is changing and how stress and strain are behaving (increasing, decreasing, constant change, etc.).

A: _____

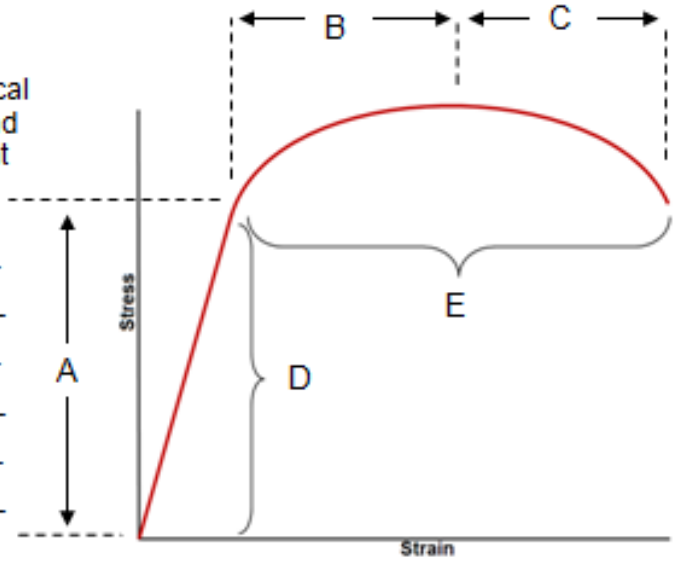
_____

B: _____

_____

C: _____

_____



11) For D, and E name the regions of the graph being illustrated.

D: _____

E: _____

12) A tesing sample has a diameter of .25" and has a 2500 lb tensile load applied to it. Calculate the amount of stress the sample is under.

Equation(s)	Substitution / Calculations	Solution with units

13) A sample portion of a dogbone had an original length of 1.125". After a load was applied to the sample the final length was 1.197". Calculate the amount of strain endured by the sample.

Equation(s)	Substitution / Calculations	Solution with units

Fluid Power EOC Station

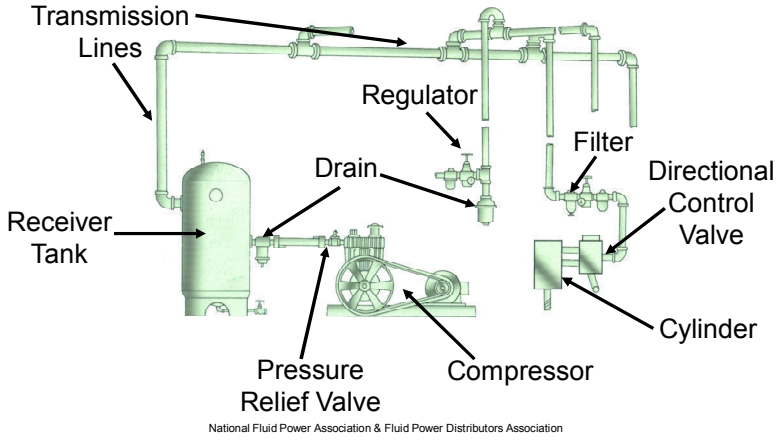
The use of a *gas* flowing under pressure to transmit power from one location to another is _____. The use of a *liquid* flowing under pressure to transmit power from one location to another is _____.

Gauge Pressure + Atmospheric Pressure = _____

Atmospheric pressure equals _____ psi (lb/in^2)

Characteristics of Pneumatics

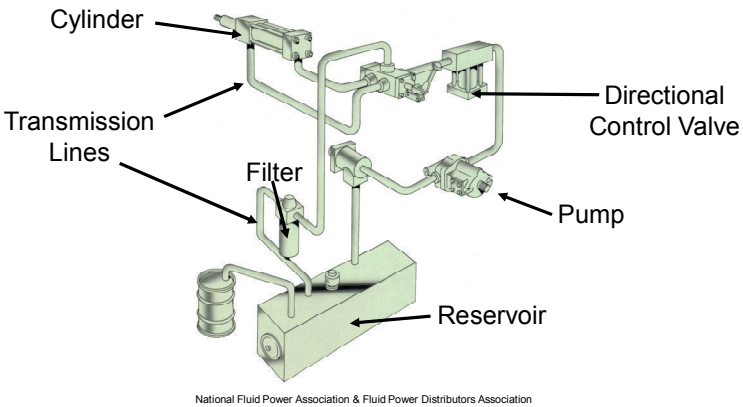
Common Pneumatic System Components



National Fluid Power Association & Fluid Power Distributors Association

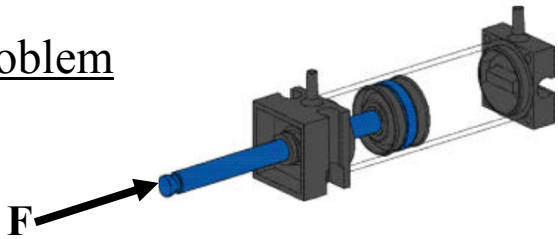
Characteristics of Hydraulics

Common Hydraulic System Components



National Fluid Power Association & Fluid Power Distributors Association

Problem



1. The gauge pressure of a pneumatic cylinder reads 5.0 psi when the volume of the air inside is 3.0 cubic inches (in^3). A force (F) is applied to the cylinder causing the cylinder to compress the air. The gauge now reads 11.0 psi. Atmospheric pressure is 14.7 psi. a) What is the absolute pressure of the air before and after the cylinder is compressed? b) What is the new volume of the air after the cylinder is compressed?

2. A flow meter attached to the main line in a hydraulic system measures the flow rate at 1,400 cu in per minute. The line has an inside diameter of 2 in. What is the flow velocity in the meter?

Statistics

1) Complete the following table. Calculate each student's mean, median, mode and range.

Name	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7
John	79	81	89	81	78	82	84
Mary	63	83	69	82	86	92	92
Jose	68	78	71	81	84	78	79
Martha	88	70	82	64	85	70	87
Jacob	72	62	73	69	73	68	73

2) Calculate the standard deviation for Test 2. Calculate the standard deviation for Test 5. Compare the data of Test 2 and Test 5.

3) A 6-sided die is rolled once. What is the probability of getting number 5?

4) A spinner has 5 different colored areas. What would the probability that the spinner stops on blue or yellow?

5) A 6-sided die is rolled once. What is the probability of getting a two, a six, or a nine?

6) Two 6-sided dice are rolled. What are the odds that one cube will show at least 5 and the other number cube will show a multiple of 3?

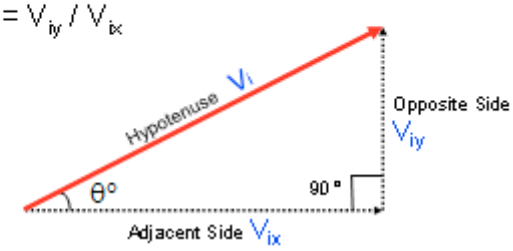
Kinematics

Acceleration due to gravity:
$g = -9.81$ m/sec^2 or -32.15 ft/sec^2

$\sin\theta° = V_{iy} / V_i \longrightarrow V_{iy} = V_i \sin\theta°$

$\cos\theta° = V_{ix} / V_i \longrightarrow V_{ix} = V_i \cos\theta°$

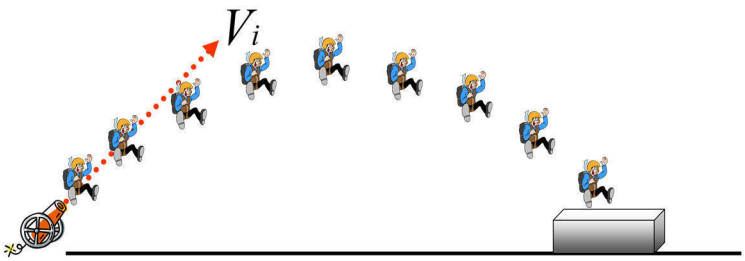
$\tan\theta° = V_{iy} / V_{ix}$



Problems

1. The launch angle $\theta = 30°$. The initial velocity $V_i = 25$ feet per second (ft/sec).

a. What is the initial vertical velocity?
b. What is the initial horizontal velocity?
c. What is the horizontal distance or range between the take-off and landing points?



2. If a golf ball travels 325 ft and had an initial velocity of 36.75 yards/sec, what angle was it hit at?

3.1 RobotC Programming

1. What will this program cause the robot to do?

```
task main()
{
  startMotor (RightMotor, 63);
  wait (2);
  stopMotor (RightMotor);
}
```

   a. the code will turn on the right motor at half speed for 2 seconds and then stop.
   b. the code will turn on the right motor at half speed for 2 milliseconds and then stop.
   c. the code will cause the robot to move forward at half speed for 2 rotations and then stop.
   d. the code will turn on the right motor at full speed in the opposite direction for 2 seconds and then stop.

2. Write a program in ROBOTC that will command your robot to do the following:

The robot will move forward while the touch sensor is not pressed. If an object is detected within 10 cm by the sonar sensor, the robot will stop and turn left before moving again.