Problems

8. An industrious student decided that she wanted to prove certain laws about gases and the relationships among pressure, volume, and temperature. In Sarah's science laboratory, she collected the following data.

Temperature (kelvins)	Volume (liters)	Pressure (atmospheres)
100	1000	1.0
100	500	2.0
100	250	4.0
100	125	8.0
200	2000	1.0
200	1000	2.0
200	500	4.0
300	750	4.0
600	1500	4.0

a. Show by using a graph, an equation, or a written statement that the volume is directly proportional to the temperature if the pressure is held constant.
b. Use these data to show Boyle's law, which states that at a constant temperature the pressure and volume vary inversely.

Problems

9. The brightness of a lightbulb can be measured by a light meter in a unit named lumens. Jeremy decided to investigate how the brightness of a certain lightbulb changes with the distance from the lightbulb. Jeremy recorded the following data.

Distance from bulb (feet)	Brightness (lumens)
1	1600
2	400
3	178
4	100
5	64
10	16
20	4

a. Express any trends or patterns in words.
b. Display the data in graphical form.
c. Express any trends or patterns in an equation with words.
d. Express any trends or patterns in an equation with symbols.

Examples

23. Two balls are released simultaneously from the same height, 10 meters above the ground. The first ball is released at rest and the second ball is released with a horizontal velocity of 15 m/s. Which ball reaches the ground first? Why?

24. A girl grabs a bucket of water and swings it around her in a horizontal circle, at a constant speed of 2 m/s at an arm's length of 0.7 meters. What is the centripetal acceleration of the bucket of water?

25. The space shuttle orbits the Earth in a near-circular orbit at a constant speed approximately 100 miles above the Earth's surface. If we assume that the centripetal acceleration is equal to the acceleration due to gravity at sea level (9.8 m/s^2) and the orbital radius is equal to the radius of the Earth (6380 km):

    a. What is the average speed of the space shuttle?
    b. How long does the space shuttle take to make one orbit around the Earth?

Problems

6. Margie (45 kg) and Bill (65 kg), both with brand new roller blades, are at rest facing each other in the parking lot. They push off each other and move in opposite directions, Margie moving at a constant speed of 14 ft/s. At what speed is Bill moving? (*Hint:* Recall from Newton's third law that Margie and Bill experience equal and opposite forces.)

7. Tracy (50 kg) and Tom (75 kg) are standing at rest in the center of the roller rink, facing each other, free to move. Tracy pushes off Tom with her hands and remains in contact

with Tom's hands, applying a constant force for 0.75 seconds. Tracy moves 0.5 meters during this time. When she stops pushing off Tom, she moves at a constant speed.

    a. What is Tracy's constant acceleration during her time of contact with Tom?
    b. What is Tracy's final speed after this contact?
    c. What force was applied to Tracy during this time? What is its origin?
    d. What happened to Tom? If Tom moved, describe his motion, force, acceleration, and Tom's final velocity.

Examples

11. Calculate the speed and period of a ball tied to a string of length 0.3 meters making 2.5 revolutions every second.

12. Calculate the average speed of the Moon in kilometers per second around the Earth. The Moon has a period of revolution of 27.3 days and an average distance from the Earth of 3.84×10^8 meters.

14. Calculate the centripetal force exerted on the Earth by the Sun. Assume that the period of revolution for the Earth is 365.25 days and the average distance is 1.5×10^8 km.