

Section 2.2 – Mathematical Models

Problem Set 2

Write a mathematical formula to describe the following situations.

1. The pressure of a gas is three times its volume.
2. The number of days Steve works is one third the number of days that Alice works.
3. The number of colors needed to produce one picture is five more than the number it takes to produce a second.
4. The cost of one version of a product is five more than twice the cost to produce a higher end version.
5. The time required to bake a cake is five minutes less than the time required to make a second cake.

Find the following values.

6. **F-Stop** In a lens the F-stop is equal to the focal length, L , divided by the diameter of the lens, d :

$$F = \frac{L}{D}$$

What is the F-stop of a lens whose focal length is 180mm and that is 45mm wide?

7. The **acceleration, a** , of a moving object is equal to the change in its velocity, v , divided by the time the object is accelerating, t , i.e.

$$a = \frac{v}{t}$$

What's the acceleration of an object that takes 5 seconds to increase its velocity by 25 meters per second?

8. **Boyle's Law** describes the relationship between the volume and pressure of a gas. In English, it says that the product of these two parameters will always be a constant, i.e. $PV = k$ where P is the pressure of the gas and V is its volume. What's the constant value for a pressure of 3.8 atmospheres whose volume is 3.1 cubic centimeters?
9. **Simple interest** is a situation where interest is applied to an investment once. If P dollars are invested at r interest, the value of the investment, V , after the interest is earned will be $V = P + Pr$. What will be the final value of an investment of \$8,000 that's invested at 3%?
10. The **P/E or Price-to-Earnings Ratio** is used to evaluate the value of a stock by comparing its price to the earnings of the company. If R represents the ratio, P represents the cost per share of the company's stock and E represents the company's annual earnings per share then the relationship is

$$R = \frac{P}{E}$$

If a company's stock is worth \$82.55 per share and its earnings per share is \$54.22 then what's its P/E ratio?

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Problem Set 3

Write a mathematical formula to describe the following situations.

1. The temperature of one gas is 25° more than the temperature of a second gas.
2. John has four more than three times the number of quarters that Mark has.
3. The number of windows on the first floor of a building is twelve more than the windows on the second floor.
4. The cost of one painting is \$5,000 less than the cost of a second painting.
5. The cost to build a house in one number is \$10,000 more than half the cost to build in another neighborhood.

Find the following values.

6. The **combined gas law** says that if V is the volume of a gas, P is the pressure of the gas and T is the temperature of the gas then

$$\frac{PV}{T} = k$$

Where k is a constant. If the pressure of a gas is 3.1 atmospheres, its volume is 25 cubic centimeters and its temperature is 200°F then what is the gas's constant?

7. The **average** of two numbers, a and b , is equal to the sum of the numbers divided by 2:

$$\text{avg.} = \frac{a+b}{2}$$

What's the average of 10 and 27?

8. If the **acceleration** of a car is a , it accelerates at that rate for t seconds and its initial velocity is v_0 then its final velocity, v , will be $v = v_0 + at$. If a car's initial velocity is 25mph and it accelerates at a rate of 2.5 for 3 seconds, what will its final velocity be?
9. **Compound Interest** Suppose you put money in a savings account and every month you get interest on it. Instead of taking the interest out and spending it, you leave the interest in the account each month. This means that, at the end of month two, you'll get interest not just on the original amount you put in but also on the interest that you left in on month one. At the end of month three, you'll get interest on the principle, the interest from month one and the interest from month two, etc. Over time, this "compounding" can add up to some serious money. The formula for calculating the amount in your account is

$$A = P \left(1 + \frac{r}{n} \right)^{nt}$$

where r is the annual interest rate, n is the number of times the interest is compounded every year, t is the number of years you let the investment go, P is the principle (just like in question two) and A is the amount in the account after t years. If you invest \$2,500 in an account at 4.5% annual interest compounded every month, i.e. 12 times per year, and let it sit for five years, how much money will be in the account?

10. If S_1 is the distance from an object to a lens and S_2 is the distance from the lens to the projected image of the object on the other side of the lens then the lens's **focal length**, f , is given by