Physics, Foundation Programme – Problem Solving Exercises 4

Solving Equations II

1. A plane flew 1600 kilometers in 4 hours while flying with the wind. Against the wind, it took the plane 5 hours to travel 1600 kilometers. Find the rate of the plane in calm air and the rate of the wind.

   A: v_plane=360 km/h, v_wind=40 km/h

2. One acetic acid solution is 70% water, and another is 30% water. How many liters of each solution should be mixed to produce 20 liters of a solution that is 40% water?
   A: 5 L of solution with 70% water and 15 L of solution with 30% water

3. A fuel storage tank has one supply pump and two identical outlet pumps. With one outlet pump running, the supply pump can increase the fuel level in the storage tank by 8,750 liters in 30 minutes. With both outlet pumps running, the supply pump can increase the fuel level in the storage tank by 11,250 liters in 45 minutes. Find the pumping rate, in liters per hour, for each of the pumps.

   A: Supply pump: 20,000 L/h, one outlet pump 2,500 L/h

4. Solve each equation and check the solution:

   a) $x^2 + 4x - 96 = 0$ A: 8, -12

   b) $x^2 - 10x + 25 = 0$ A: 5

   c) $x^2 + 27x + 126 = 0$ a: -6, -21

   d) $10x^2 + 9x - 9 = 0$ a: $\dfrac{3}{5}, -\dfrac{3}{2}$

   e) $64x^2 - 16x - 3 = 0$ a: $\dfrac{3}{8}, -\dfrac{1}{8}$

   f) $(4y - 3)^2 - (6y + 4)^2 = 29$ a: $-\dfrac{3}{5}, -3$

   g) $\dfrac{1}{x + 4} - \dfrac{4}{x - 4} + \dfrac{x^2 - 20}{x^2 - 16} = 0$ a: 8, -5

   h) * $\dfrac{5 - 3x}{3 - 5x} + \dfrac{3 - 5x}{5 - 3x} = \dfrac{5}{2}$ a: $7, \dfrac{1}{7}$

5. How long does it take to a projectile shot straight up at a speed of v_o=800 m/s to achieve I) height of 14 km, II) 40 km, and the highest point. The height of the projectile above the ground is given by $h = -5t^2 + 800t$, where h is the height in meters and t is time in seconds. The speed of the projectile in meters per seconds is given by $v = 800 - 10t$, where v>0 means rising projectile and v<0 correspond to the falling projectile.

   A: I) 20s (rise), 140s (fall); II) never; III) 80 s

6. A veterinarian wishes to use 110 meter of chain-link fencing to enclose a rectangular region and subdivide the region into two smaller rectangular regions, as shown in the following figure. If the total enclosed area is 500 meter square, find the dimensions of the enclosed region.
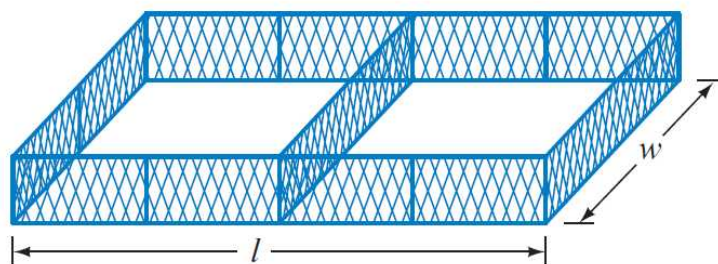
   a: two solutions: l=30m x w=(16 and 2/3) m; l=25 m x w=20 m

7. The hang time is the amount of time a basketball player is in the air when making a jump toward the the basket. An equation that approximate the height h, in meters, of a basketball player during a jump is given by $h = -5t^2 + 8.1t$, where t is time in seconds. Use the equation to determine the basketball player hang time during this particular jump.

   a: t=1.62 s