**1.** *Atlas* is a crane that can unload a cargo ship in 10 h by itself. *Zeus* is a crane that can unload the same cargo ship in 14 h by itself. If *Atlas* starts unloading a ship at noon and *Zeus* joins in at 2 PM, at what time will they have the ship unloaded?

\# of hrs Atlas worked → t   Zeus → t − 2

1 hour Atlas → $\frac{1}{10}$
$\frac{t}{10}$

1 hour Zeus → $\frac{1}{14}$
$\frac{t-2}{14}$

whole job → 1

$\frac{t}{10} + \frac{t-2}{14} = 1$   LCM: 70

$7t + 5t - 10 = 70$
$12t - 10 = 70$
$12t = 80$
$t = \frac{20}{3} = 6\frac{2}{3}$ → **6:40 pm**

**2.** Pam jogged up a hill at 6 km/h, then ran back down at 10 km/h. If the total trip was 1 h 20 min, how far did she run?

1 h 20 min = 4/3 hr

6 km/hr (up), 10 km/hr (down)

$D = RT$ ↓ $T = \frac{D}{R}$

$\frac{D_1}{R_1} + \frac{D_2}{R_2} = T$

$30\left[\frac{D}{6} + \frac{D}{10} = \frac{4}{3}\right]$

$5D + 3D = 40$
$8D = 40$
$D = 5$ ← one way

**Total trip is 10 km.**

<u>**Concentration**</u>: Amount of ***solute*** divided by total amount of solution. So, a 5% concentration means for every 100 mL of solution there is 5 mL of solute (what is being dissolved). A **<u>pure solution</u>** of anything has 100% concentration.

**3.** Nurses often use boric acid as an antiseptic to prevent infection on cuts. Nurse Norma wants to make 800 mL of a 7% solution of boric acid by mixing 4% and 12% solutions. How much of each should she use?

| | mL of solution | x % boric acid | = mL of boric acid |
|---|---|---|---|
| 4% Solution | x | 4% | .04x |
| 12% Solution | 800 − x | 12% | 0.12(800 − x) |
| Final Mixture | 800 | 7% | 0.07(800) |

$0.04x + 0.12(800 - x) = 0.07(800)$
$4x + 12(800 - x) = 7(800)$
$4x + 9600 - 12x = 5600$
$-8x = -4000$
$x = 500$

**4% → 500 mL**
**12% → 300 mL**

**4.** *Apollo* is an industrial-strength pump that can empty a swimming pool in 7 h less than the smaller *Mite* pump. Used together, they can empty a particular pool in 12 h. How long would it take *Apollo* to empty the pool by itself?

t = # of hrs for larger pump to empty pool

t+7 = # of hrs for smaller pump

1 hour → $\frac{1}{t}$ or $\frac{1}{t+7}$

12 hours → $\frac{12}{t}$ or $\frac{12}{t+7}$

entire job → 1

$$\frac{12}{t} + \frac{12}{t+7} = 1$$

$$12(t+7) + 12(t) = t(t+7)$$

$$t^2 - 17t - 84 = 0$$

$$(t+4)(t-21) = 0$$

~~4~~ 21

CHECK: $\frac{12}{21} + \frac{12}{28} = \frac{4}{7} + \frac{3}{7} = 1$ ✓

The larger pump can empty the pool in ~~one~~ 21 hour.

**5.** An airplane is making a 2000 km trip with the goal of averaging 720 km/h for the trip. Unfortunately, for the first half of the trip it was only able to average 600 km/h. What must be its average speed for the second half of the trip to reach its goal?

| | Distance (km) | Rate (kn/h) | Time (h) |
|---|---|---|---|
| First Half | 1000 | 600 | $\frac{1000}{600} = \frac{5}{3}$ |
| Second Half | 1000 | r | $\frac{1000}{r}$ |
| Entire Trip | 2000 | 720 | $\frac{2000}{720} = \frac{25}{9}$ |

Time for first half + Time for second half = Time for entire trip

$$\frac{5}{3} + \frac{1000}{r} = \frac{25}{9}$$

LCD: 9r

$$\frac{5 \cdot 9r}{3} + \frac{1000 \cdot 9r}{r} = \frac{25 \cdot 9r}{9}$$

$$15r + 9000 = 25r$$

$$r = 900$$

The ground speed of the second half must be 900 km/hr.