Proportion questions

Direct proportion
1.   If $y \propto x$ and $y = 5$ when $x = 3$:
(a) if x is increased to 12, what is the enlargement factor?
(b) what is y at $x = 12$?

2. If $y \propto x$ and $y = 100$ when $x = 1000$, what will y be when $x = 100$?

3. If $y \propto x$ and $y = -27$ when $x = 9$,
(a) what will y be when $x = 3$?
(b) if the proportionality formula is $y = kx$, what is the value of k? What does k represent if $y = kx$ is drawn on a graph?

4. A car drives 20 miles in 30 minutes. How far will it travel in 36 minutes, assuming the speed is constant?

5. A walker takes 2000 steps to walk 1600 m. On the next day, he walks 5000 steps. How many km is this?

6. The current I through a resistor is proportional to the voltage V across it.
When $V = 2$ volts, $I = 1$ mA (milliAmp).
(a) what is the current if $V = 240$ Volts?
(b) what is the voltage if $I = 0.1$ Amp?
(c) write a formula for V in terms of I, $V = RI$ (what is R?).
(d) write a formula for I in terms of V, $I = SV$ (what is S?)

7. The exchange rate between dollars D and pounds P is such that £54 is worth $75.
Fill in the following table, to 2 decimal place accuracy (use STO and RCL buttons on your calculator).
If we define $D = kP$, what is the value of k?

£	10		37		61.33	
$		20		54		87.50

Which is worth more, £30 or $40?

8. The strength of gravity on a rocky planet is proportional to the radius of the planet. On Earth (radius 6.4 million km) an astronaut weighs 800 N. How much would he weigh on the Moon, radius 1.6 million km?

Inverse proportion
9. $y \propto \dfrac{1}{x}$ and $y = 5$ at $x = 4$.
(a) If x increases to 40, what is the enlargement factor for x?
(b) What is y when $x = 40$?
(c) Write a formula for calculating y from x.

10. The time t taken to complete a journey is inversely proportional to the speed v. The journey takes 24 minutes at 36 miles per hour (mph).   How long will it take at
(a) 12 mph?
(b) 24 mph?
(c) 48 mph?
(d) How long is the journey?

11. In an electrical circuit, the current I through a component is inversely proportional to its resistance R. $I = 0.25$ Amp when $R = 20$ Ohms.
(a) Write a formula defining I in terms of R.
(b) What is I when $R = 10$ Ohms?
(c) What is R if $I = 0.125$ Amp?
Sketch a graph of I against R with points for R = 5, 10, 20, 25 and 30 Ohms.

(d) Ohm's law states that $I = \dfrac{V}{R}$.   What is the voltage V in this circuit?

12. The wavelength L of sound waves is inversely proportional to the frequency f. At middle C (a frequency of 256 Hz) the wavelength is 1.29 m.
(a) Write a formula for calculating frequency from wavelength
(b) Write a formula for calculating wavelength from frequency

Challenge questions (other proportionality rules)
13. The mass of a paving slab is proportional to the square of the length of a side, $M \propto L^2$.   Slabs of side 50 cm have mass 25 kg.   What is the mass of a slab of side 60 cm?

14. The mass of a cannon ball is proportional to the cube of its diameter. A 6 lb cannon ball is 9 cm diameter.   What is the mass of a 12 cm diameter ball?

15. The power that an engine can make is proportional to the piston area.   An engine with pistons 7 cm diameter produces 130 kW.
(a) How much power does an engine make if its pistons are 28 cm diameter?
(b) Write a formula defining power W in terms of piston diameter d.

16. The light intensity I at a distance d from a light source varies inversely as the square of the distance, $I \propto \dfrac{1}{d^2}$.   At a distance of 93 million miles the intensity is 1300 W/m^2.   What will be the intensity at a distance of 350 million miles?

17. The diameter D of a hot air balloon is proportional to the cube root of the weight W it must carry, $D \propto \sqrt[3]{W}$.   A balloon 5.2 m diameter can carry 1 man. How large must a balloon be to carry 12 men?