1. The weight of a piece of wire is directly proportional to its length.

A piece of wire is 25 cm long and has a weight of 6 grams.
Another piece of the same wire is 30 cm long.

Calculate the weight of the 30 cm piece of wire.

$W = kl$

$6 = k(25)$

$k = \frac{6}{25}$

$w = \frac{6}{25}(1)$

$= \frac{6}{25}(30)$

$= \frac{180}{25}$

7.2 ..... grams

(Total 2 marks)

2. A ball falls vertically after being dropped.
The ball falls a distance d metres in a time of t seconds.
d is directly proportional to the square of t.

The ball falls 20 metres in a time of 2 seconds.

(a) Find a formula for d in terms of t.

$d = kt^2$

$20 = k(2)^2$

$20 = 4k$

$k = 5$

$d =$ $5t^2$

(3)

(b) Calculate the distance the ball falls in 3 seconds.

$d = 5(3)^2$

45 ..... m

(1)

(c) Calculate the time the ball takes to fall 605 m.

$605 = 5t^2$

$121 = t^2$

11 ..... seconds

(3)

(Total 7 marks)

3. The time, T seconds, it takes a water heater to boil some water is directly proportional to the mass of water, m kg, in the water heater.

When $m = 250$, $T = 600$

$T = km$

$600 = k(250)$

$k = \frac{600}{250} = \frac{12}{5} = 2.4$

(a) Find T when $m = 400$

$T = 2.4(m)$

$= 2.4(400)$

$= 960$

$T =$ 960

(3)

The time, T seconds, it takes a water heater to boil a constant mass of water is inversely proportional to the power, P watts, of the water heater.

When $P = 1400$, $T = 360$

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

$360 = \frac{k}{1400}$

$k = 504000$

(b) Find the value of T when $P = 900$

$T = \frac{504000}{900}$

$= 560$

$T =$ 560

(3)

(Total 6 marks)

4. D is proportional to S^2.

$D = 900$ when $S = 20$

Calculate the value of D when $S = 25$

$D = kS^2$

$900 = k(20)^2$

$\frac{900}{400} = k$

$k = 2.25$

$D = 2.25S^2$

$D = 2.25(25)^2$

$= 1406.25$

$D =$ 1406.25

(Total 4 marks)

5. In a spring, the tension (T newtons) is directly proportional to its extension (x cm).

When the tension is 150 newtons, the extension is 6 cm.

(a) Find a formula for T in terms of x.

$T = kx$

$150 = k(6)$

$k = 25$

$T = 25x$

$T =$ 25x

(3)

(b) Calculate the tension, in newtons, when the extension is 15 cm.

$T = 25x$

$= 25(15)$

$= 375$

375 newtons

(1)

(c) Calculate the extension, in cm, when the tension is 600 newtons.

$T = 25x$

$600 = 25x$

$\frac{600}{25} = x$

$x = 24$

24 cm

(1)

(Total 5 marks)

6. d is directly proportional to the square of t.

$d = 80$ when $t = 4$

(a) Express d in terms of t.

$d = kt^2$

$80 = k(4)^2$

$80 = 16k$

$k = 5$

$d = 5t^2$

$d = 5t^2$

(3)

(b) Work out the value of d when $t = 7$

$d = 5t^2$

$= 5(7)^2$

$= 245$

$d = 245$

(1)

(c) Work out the positive value of t when $d = 45$

$d = 5t^2$

$45 = 5t^2$

$9 = t^2$

$t = 3$

$t = 3$

(2)

(Total 6 marks)

7. The distance, D, travelled by a particle is directly proportional to the square of the time, t, taken.

When $t = 40$, $D = 30$

(a) Find a formula for D in terms of t.

$D = kt^2$

$30 = k(40)^2$

$30 = k(1600)$

$k = \frac{3}{160}$

$D = \frac{3}{160}t^2$

(b) Calculate the value of D when $t = 64$

$D = \frac{3}{160}t^2$

$= \frac{3}{160}(64)^2$

$= 76.8$

76.8

(1)

(c) Calculate the value of t when $D = 12$
Give your answer correct to 3 significant figures.

$D = \frac{3}{160}t^2$

$12 = \frac{3}{160}t^2$

$640 = t^2$

$t = 25.3$ (3sf)

25.3

(2)

(Total 6 marks)

8. M is directly proportional to L^3.

When $L = 2$, $M = 160$

Find the value of M when $L = 3$

$M = kL^3$

$160 = k(2)^3$

$160 = 8k$

$k = 20$

$M = 20L^3$

$= 20(3)^3$

$= 540$

540

.....

(Total 4 marks)

9. p is inversely proportional to m.
$p = 48$ when $m = 9$

Calculate the value of p when $m = 12$

$p = \frac{k}{m}$

$48 = \frac{k}{9}$

$k = 432$

$p = \frac{432}{m}$

$= \frac{432}{12}$

36

.....

(Total 2 marks)

10. r is inversely proportional to t.
$r = 12$ when $t = 0.2$

Calculate the value of r when $t = 4$.

$$r = \frac{k}{t}$$

$$12 = \frac{k}{0.2}$$

$$k = 2.4$$

$$r = \frac{2.4}{t}$$

$$r = \frac{2.4}{4} = 0.6$$

0.6

(Total 3 marks)

11. f is inversely proportional to d.

When $d = 50$, $f = 256$

Find the value of f when $d = 80$

$$f = \frac{k}{d}$$

$$256 = \frac{k}{50}$$

$$k = 12800$$

$$f = \frac{12800}{d}$$

$$f = \frac{12800}{80}$$

$f =$ 160

(Total 3 marks)

12. y is inversely proportional to x^2.

Given that $y = 2.5$ when $x = 24$,

(i) find an expression for y in terms of x

$$y = \frac{k}{x^2}$$

$$2.5 = \frac{k}{(24)^2}$$

$$k = 1440$$

$y =$ $\frac{1440}{x^2}$

(ii) find the value of y when $x = 20$

$$y = \frac{1440}{x^2}$$

$$= \frac{1440}{(20)^2}$$

$y =$ 3.6

(iii) find a value of x when $y = 1.6$

$$y = \frac{1440}{x^2}$$

$$1.6 = \frac{1440}{x^2}$$

$$x^2 = \frac{1440}{1.6} = 900$$

$x =$ 30

(Total 6 marks)

13. P is inversely proportional to d^2.

$P = 10\,000$ when $d = 0.4$

Find the value of P when $d = 0.8$

$$P = \frac{k}{d^2}$$

$$10000 = \frac{k}{(0.4)^2}$$

$$k = 1600$$

$$P = \frac{1600}{d^2}$$

$$= \frac{1600}{0.8^2}$$

$P =$ 2500

(Total 3 marks)

14. The shutter speed, S, of a camera varies inversely as the square of the aperture setting, f.

When $f = 8$, $S = 125$

(a) Find a formula for S in terms of f.

$$S = \frac{k}{f^2}$$

$$125 = \frac{k}{8^2}$$

$$k = 8000$$

$S = \frac{8000}{f^2}$

(3)

(b) Hence, or otherwise, calculate the value of S when $f = 4$

$$S = \frac{8000}{4^2}$$

$$S = 500$$

$S = 500$

(1)

(Total 4 marks)

15. q is inversely proportional to the square of t.

When $t = 4$, $q = 8.5$

(a) Find a formula for q in terms of t.

$$q = \frac{k}{t^2}$$

$$8.5 = \frac{k}{(4)^2}$$

$$k = 136$$

$q =$ $\frac{136}{t^2}$

(3)

(b) Calculate the value of q when $t = 5$

$$q = \frac{136}{5^2}$$

$$= 5.44$$

5.44

(1)

(Total 4 marks)

16. P is inversely proportional to V.

When $V = 8$, $P = 5$

(a) Find a formula for P in terms of V.

$P = \frac{k}{V}$

$5 = \frac{k}{8}$

$k = 40$

$P = \frac{40}{V}$

(3)

(b) Calculate the value of P when $V = 2$

$P = \frac{40}{2}$

20

(1)

(Total 4 marks)

17. The force, F, between two magnets is inversely proportional to the square of the distance, x, between them.

When $x = 3$, $F = 4$.

(a) Calculate F when $x = 2$.

$F = \frac{k}{x^2}$

$4 = \frac{k}{3^2}$

$k = 36$

$F = \frac{36}{x^2}$

$= \frac{36}{2^2}$

9

(4)

(b) Calculate x when $F = 64$.

$F = \frac{36}{x^2}$

$64 = \frac{36}{x^2}$

$x^2 = \frac{36}{64}$

$x = \sqrt{\frac{36}{64}}$

$x = 3/4$

(2)

(Total 6 marks)