

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 = k l  

$$W = k l$$
  
 $6 = k(25)$   
 $\kappa = \frac{6}{25}$   
 $\kappa = \frac{180}{25}$   
 $K = \frac{180}{25}$   
(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.

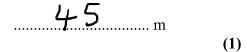
Find a formula for *d* in terms of *t*. (a)

$$d = kt^{2}$$
  
20 = k(2)^{2}  
20 = 4k  
k = 5  

$$d = ...5t^{2}$$

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

$$d = 5(3)^2$$



(3)

(3)

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

$$605 = 5t^{2}$$
  
 $121 = t^{2}$ 

......l..l. seconds (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.

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 $P = 1400$ , $T = 360$	$T = \frac{k}{p}$
(b) Find the value of $T$ when $P = 900$	P
$T = \frac{504000}{900}$	$360 = \frac{k}{1400}$ k = 504000
- 560	T=
	(3) (Total 6 marks)

4. *D* is proportional to  $S^2$ .

$$D = 900$$
 when  $S = 20$ 

Calculate the value of *D* when S = 25

 $D= 2.25 S^2$  $D= 2.25(25)^2$ 

- 1406.25

$$D = k S^{2}$$

$$900 = k (20)^{2}$$

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

$$k = 2.25$$

$$D = 1406.25$$
 (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.

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

375 newtons

(1)

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

$$T = 25x$$

$$600 = 25x$$

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

$$2 = 24$$



 $d = 5t^2$ 

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

$$d = 80$$
 when  $t = 4$ 

(a) Express d in terms of t.

$$d = k t^{2}$$
  
80 = k (4)<sup>2</sup>  
80 = 16k  
k = 5

$$d = 5t^2$$

(3)

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

$$d = 5t^{2}$$
  
= 5(7)<sup>2</sup>  
= 245

$$d = ....245$$
 (1)

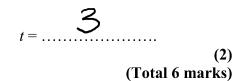
(c) Work out the positive value of t when d = 45

$$d = 5t^{2}$$

$$45 = 5t^{2}$$

$$9 = t^{2}$$

$$t = 3$$





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

When t = 40, D = 30

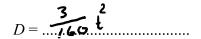
(a) Find a formula for *D* in terms of *t*.

$$D = kt^{2}$$
  

$$30 = k(40)^{2}$$
  

$$30 = k(1600)$$
  

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



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

$$D = \frac{3}{160} t^{2}$$
$$= \frac{3}{160} (64)^{2}$$
$$= 76.8$$

(1)

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

$$D = \frac{3}{10} t^{2}$$

$$12 = \frac{3}{10} t^{2}$$

$$640 = t^{2}$$

$$t = 25.3 (35t)$$

$$25.3$$
(Total 6 marks)
(2)

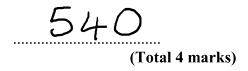


8. *M* is directly proportional to  $L^3$ .

When L = 2, M = 160

Find the value of M when L = 3

when 
$$L = 3$$
  
 $M = K L^{3}$   
 $160 = K (2)^{3}$   
 $160 = 8K$   
 $K = 20$   
 $M = 20L^{3}$   
 $= 20(3)^{3}$   
 $= 540$ 



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

Calculate the value of p when m = 12

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

$$k = 432$$

$$P = \frac{432}{M}$$

$$= \frac{432}{12}$$
(Total 2 marks)

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



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

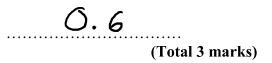
Calculate the value of *r* when t = 4.

$$\Gamma = \frac{k}{E}$$

$$12 = \frac{k}{6 \cdot 2}$$

$$k = 2 \cdot 4$$

$$r = \frac{2.4}{5}$$
  
 $r = \frac{2.4}{5} = 0.6$ 



**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,

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

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

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

$$k = 1440$$

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

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

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

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

$$1 \cdot 6 = \frac{1440}{x^{2}}$$

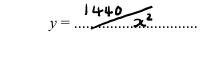
$$2^{2} = \frac{1440}{1\cdot 6} = 900$$

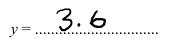
- **13.** *P* is inversely proportional to  $d^2$ .
  - $P = 10\ 000$  when d = 0.4

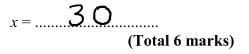
Find the value of *P* when d = 0.8

$$\begin{aligned}
 \rho &= \frac{k}{d^2} & \rho &= \frac{1600}{d^2} \\
 10000 &= \frac{k}{(0.4)} & = \frac{1600}{0.5} \\
 k &= 1600 & 0.5
 \end{aligned}$$

$$P = ...2500$$
 (Total 3 marks)







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- 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.

$$S = \frac{k}{\delta^{1}}$$

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

$$k = 8000$$



(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.

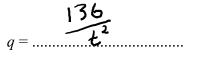
When t = 4, q = 8.5

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

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

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

$$k = 136$$



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

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

5.44

(1) (Total 4 marks)

(3)



**16.** *P* is inversely proportional to *V*.

When V = 8, P = 5

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

$$\begin{aligned}
\rho &= \frac{k}{v} \\
5 &= \frac{k}{8} \\
k &= 40
\end{aligned}$$

$$P &= \frac{40}{v} \\
P &= \frac{40}{v} \\
(3)
\end{aligned}$$

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



- 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.  $F = \frac{k}{3c^2}$   $F = \frac{34}{2^2}$   $F = \frac{34}{2^2}$   $F = \frac{34}{2^2}$  K = 36  $\frac{7}{4}$ (4)

(b) Calculate x when F = 64.

$$F = \frac{36}{x^{2}} \qquad x = \sqrt{\frac{34}{64}}$$

$$64 = \frac{36}{x^{2}} \qquad \frac{2 = \frac{3}{7}}{(2)}$$

$$7^{2} = \frac{36}{64} \qquad (Total 6 marks)$$

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