DIRECT AND INVERSE PROPORTION

[ESTIMATED TIME: 70 minutes]

1. **[8 marks]**

A ball is dropped from a tower.
After t seconds, the ball has fallen a distance x metres.

x is directly proportional to t^2.

When $t = 2$, $x = 19.6$

(a) Find an equation connecting x and t.

....
(3)

(b) Find the value of x when $t = 3$

$x =$ ....
(2)

(c) Find how long the ball takes to fall 10 m.

.... seconds
(3)

2. **[4 marks]**

The amount of petrol a car uses is directly proportional to the distance it travels.
A car uses 3 litres of petrol when it travels 50 km.

(a) Work out the amount of petrol the car uses when it travels 125 km.

.... litres

(2)

(b) Work out the distance the car travels when it uses 5.7 litres of petrol.

.... km

(2)

3. **[4 marks]**

M is directly proportional to p^3
$M = 128$ when $p = 8$

(a) Find a formula for M in terms of p.

....

(3)

(b) Find the value of M when $p = 5$

....

(1)

4. [5 marks]

A particle moves from rest.
The speed of the particle is v m/s when it has moved a distance of x metres.

v is proportional to $\sqrt{x}$

When $v = 8$, $x = 25$

(a) Express v in terms of x.

....
(3)

(b) Find the speed of the object when it has moved a distance of 56.25 metres.

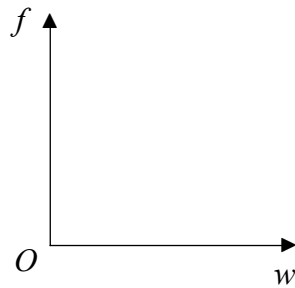............................. m/s
(2)

5. [6 marks]

The frequency, *f* kilohertz, of a radio wave is inversely proportional to its wavelength, *w* metres.

When $w = 200$, $f = 1500$

(a) (i) Express *f* in terms of *w*.

$f =$ ....

(ii) On the axes, sketch the graph of *f* against *w*.

(4)

(b) The wavelength of a radio wave is 1250 m.
Calculate its frequency.

.... kilohertz

(2)

6.   **[6 marks]**

The light intensity, E, at a surface is inversely proportional to the square of the distance, r, of the surface from the light source.

$E = 4$ when $r = 50$

(a) Express E in terms of r.

$$E = \text{.....................}$$
(3)

(b) Calculate the value of E when $r = 20$

$$E = \text{.....................}$$
(1)

(c) Calculate the value of r when $E = 1600$

$$r = \text{.....................}$$
(2)

7. [5 marks]

V is inversely proportional to the square of *t*

$V = 28$ when $t = 2.5$

(a) Express *V* in terms of *t*

....

(3)

(b) Work out the value of *V* when $t = 6.25$

$V = $ ....

(2)

8. **[5 marks]**

P is inversely proportional to *V*.
P = 18 when *V* = 24

(a) Express *P* in terms of *V*.

....
(3)

(b) Find the positive value of *V* when *P* = 3*V*

V = ...
(2)

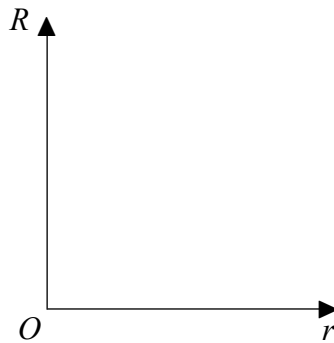An electrician has wires of the same length made from the same material.
The electrical resistance, R ohms, of a wire is inversely proportional to the square of its radius, r mm.
When $r = 2$, $R = 0.9$

(a) (i) Express R in terms of r.

$R =$ ....

(ii) On the axes, sketch the graph of R against r.

(4)

One of the electrician's wires has a radius of 3 mm.

(b) Calculate the electrical resistance of this wire.

.... ohms
(1)

P is directly proportional to q^3

$P = 270$ when $q = 7.5$

(a) Find a formula for P in terms of q

....

(3)

(b) Work out the positive value of q when $P = q$

$q =$ ....

(2)

11.   **[6 marks]**

The distance, *d* kilometres, of the horizon from a person is directly proportional to the square root of the person's height, *h* metres, above sea level.
When $h = 225$, $d = 54$

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

$d =$ ....
(3)

(b) Calculate the distance of the horizon from a person whose height above sea level is 64 metres.

.... kilometres
(1)

(c) Calculate the height above sea level of a person, when the distance of the horizon is 61.2 kilometres.

.... metres
(2)

A wind turbine generates a power of P kilowatts when the wind speed is w m/s.

P is proportional to w^3.

$P = 300$ when $w = 12$

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

....
(3)

(b) Calculate the value of P when $w = 7.5$
   Give your answer correct to 3 significant figures.

$P =$ ....
(2)

(c) When the wind speed is x m/s, the wind turbine generates twice as much power as it does when the wind speed is 10 m/s.
   Calculate the value of x.
   Give your answer correct to 3 significant figures.

$x =$ ....
(4)

A, *r* and *T* are three variables.

A is proportional to T^2
A is also proportional to r^3

$T = 47$ when $r = 0.25$

Find *r* when $T = 365$
Give your answer correct to 3 significant figures.