14 T is directly proportional to the cube of r $T \propto r^3$

$T = 21.76$ when $r = 4$

(a) Find a formula for T in terms of r

$T \propto r^3$

$T = k \times r^3$

$21.76 = k \times (4)^3$

$\frac{21.76}{(4)^3} = k$

$0.34 = k$

$T = 0.34 \times r^3$

(3)

(b) Work out the value of T when $r = 6$

$T = 0.34 \times (6)^3 = 73.44$

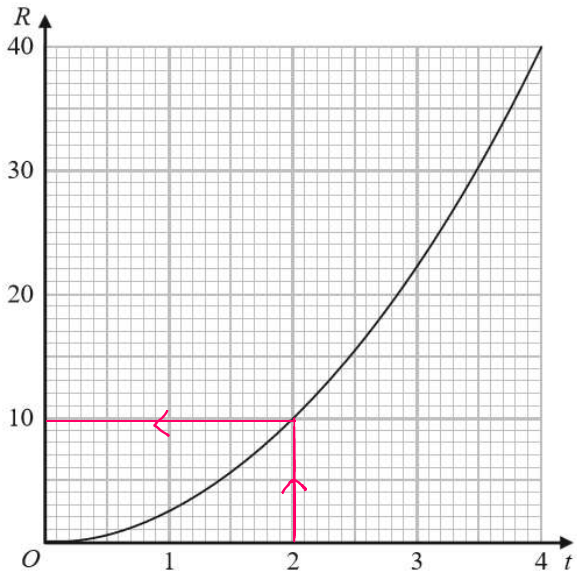
(1)

(Total for Question 14 is 4 marks)

16 R is proportional to t^2

$R \propto t^2$

The graph shows the relationship between R and t for $0 \leqslant t \leqslant 4$



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

when $t = 2$

$R = 10$

$R \propto t^2$

$R = k \times t^2$

$10 = k \times (2)^2$

$\frac{10}{(2)^2} = k$

$2.5 = k$

$R = 2.5 \times t^2$

(3)

Given also that $R = \frac{8}{5x}$

(b) show that t is inversely proportional to $\sqrt{x}$ for $t > 0$

$R = 2.5 \times t^2$ $\quad R = \frac{8}{5x}$

$2.5 \times t^2 = \frac{8}{5x}$

$5x \times 2.5 \times t^2 = 8$

$12.5 \times x \times t^2 = 8$

$x \times t^2 = \frac{8}{12.5}$

$x \times t^2 = \frac{16}{25}$

(2)

(Total for Question 16 is 5 marks)

$t^2 = \frac{16}{25x}$

$t^2 = \frac{16}{25} \times \frac{1}{x}$

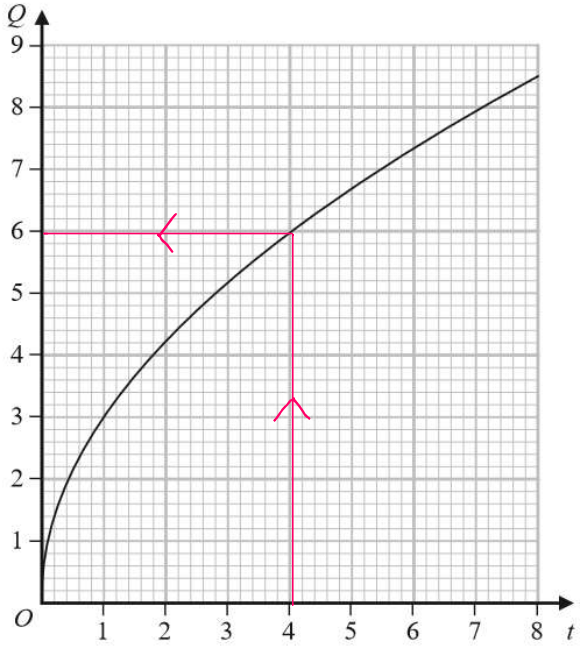
$t = \sqrt{\frac{16}{25} \times \frac{1}{x}}$

$t = \frac{4}{5} \times \frac{1}{\sqrt{x}}$ $\quad t = \frac{0.8}{\sqrt{x}}$

$Q \propto \sqrt{t}$

16 Q is directly proportional to $\sqrt{t}$

The graph shows the relationship between Q and t for $0 < t < 8$



(a) Find a formula for Q in terms of t

$t = 4 \quad Q = 6$

$Q \propto \sqrt{t}$

$Q = k \times \sqrt{t}$

$6 = k \times \sqrt{(4)}$

$\frac{6}{\sqrt{(4)}} = k \qquad k = 3$

$Q = 3 \times \sqrt{t}$

.....

(3)

Q is increased by 20%

$Q \times 1.2$

(b) Find the percentage increase in t

$Q = 3 \times \sqrt{t}$

$\frac{Q}{3} = \sqrt{t}$

$\left(\frac{Q}{3}\right)^2 = t$

when $Q = 6 \quad t = 4$

$\left(\frac{6 \times 1.2}{3}\right)^2 = t$

$t = 5.76$

..... %

(2)

% change $\frac{5.76 - 4}{4} \times 100 = 44\%$

(Total for Question 16 is 5 marks)

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

17 M varies directly as the cube of h
$M = 4$ when $h = 0.5$

Find the value of h when $M = 500$

$m \propto h^3$

$m = k \times h^3$

$4 = k \times (0.5)^3$

$\frac{4}{(0.5)^3} = k$

$32 = k$

$m = 32 \times h^3$

$500 = 32 \times h^3$

$\frac{500}{32} = h^3$

$\frac{125}{8} = h^3$

(Total for Question 17 is 4 marks)

$\sqrt[3]{\frac{125}{8}} = h$

$h = \frac{5}{2}$

17 Q is directly proportional to the square root of d

$Q = 4.5$ when $d = 324$

Find a formula for Q in terms of d

$Q \propto \sqrt{d}$

$Q = k \times \sqrt{d}$

$4.5 = k \times \sqrt{(324)}$

$\frac{4.5}{\sqrt{(324)}} = k$

$0.25 = k$

$Q = 0.25 \times \sqrt{d}$

(Total for Question 17 is 3 marks)

17 y is directly proportional to the cube of x
$y = 20h$ when $x = h \quad (h \neq 0)$

(a) Find a formula for y in terms of x and h

$y \propto x^3$

$y = k \times x^3$

$20h = k \times (h)^3$

$\frac{20h}{h^3} = k$

$\frac{20}{h^2} = k$

$y = \frac{20}{h^2} \times x^3$

$y =$ .....

(3)

(b) Find x in terms of h when $y = 67.5h$
Give your answer in its simplest form.

$y = \frac{20}{h^2} \times x^3$

$67.5h = \frac{20}{h^2} \times x^3$

$\frac{67.5h}{20/h^2} = x^3$

$\frac{67.5h^3}{20} = x^3$

$\frac{27h^3}{8} = x^3$

$\sqrt[3]{\frac{27h^3}{8}} = x$

$x =$ .....

(2)

(Total for Question 17 is 5 marks)

$x = \frac{3}{2}h$

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

19 P is inversely proportional to y^2
When $y = 4$, $P = a$

(a) Find a formula for P in terms of y and a

$P \propto \frac{1}{y^2}$

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

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

$16a = k$

$P = \frac{16a}{y^2}$

(3)

Given also that y is directly proportional to $\sqrt{x}$
and when $x = a$, $P = 4a$

(b) find a formula for P in terms of x and a

$P = \frac{16a}{y^2}$

$4a = \frac{16a}{y^2}$

$4a \times y^2 = 16a$

$y^2 = \frac{16a}{4a}$

$y^2 = 4 \quad y = \pm\sqrt{2}$

$y \propto \sqrt{x}$ then $y = k \times \sqrt{x}$

$P = \frac{16a}{y^2}$

$P = \frac{16a}{(k\sqrt{x})^2}$

$P = \frac{16a}{k^2 x}$

if $x = a$

$P = \frac{16}{k^2 a}$

$P = \frac{16}{k^2}$

$4a = \frac{16}{k^2}$

$4a \times k^2 = 16$

$k^2 = \frac{16}{4a}$

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

$P = \frac{16a}{k^2 x} = \frac{16a}{\frac{4}{a} x}$

$P = \frac{4a^2}{x}$

(3)

(Total for Question 19 is 6 marks)

20 T is inversely proportional to m^2 $T \propto \frac{1}{m^2}$

$T = 30$ when $m = 0.5$

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

$T = \frac{k}{m^2}$

$30 = \frac{k}{(0.5)^2}$

$30 \times (0.5)^2 = k$

$7.5 = k$

$T = \frac{7.5}{m^2}$

.....

(3)

(b) Work out the value of T when $m = 0.1$

$T = \frac{7.5}{(0.1)^2}$

$T = 750$

.....

(1)

(Total for Question 20 is 4 marks)

20 y is inversely proportional to $\sqrt{x}$
x is directly proportional to T^3

Given that $y = 8$ when $T = 25$

find the exact value of T when $y = 27$

$y \propto \frac{1}{\sqrt{x}}$

$x \propto T^3$

$y = \frac{k_1}{\sqrt{x}}$ $\quad x = k_2 \times T^3$

$y = \frac{k_1}{\sqrt{k_2 \times T^3}}$

k_1 & k_2 can be replaced with 1 constant

$y = \frac{c}{\sqrt{T^3}}$

$8 = \frac{c}{\sqrt{25^3}}$

$8 \times \sqrt{25^3} = c$

$1000 = c$

$y = \frac{1000}{\sqrt{T^3}}$

$27 = \frac{1000}{\sqrt{T^3}}$

$27 \times \sqrt{T^3} = 1000$

$\sqrt{T^3} = \frac{1000}{27}$

$T =$ .....

(Total for Question 20 is 4 marks)

$T^3 = \left(\frac{1000}{27}\right)^2$

$T = \sqrt[3]{\left(\frac{1000}{27}\right)^2}$

$T = \frac{100}{9}$