$G = c^2 - 4c$

1 (b) Find the value of G when $c = -5$

substitute $C = -5$ into the equation :

$G = (-5)^2 - 4(-5)$ (1)

$= 25 + 20$

$= 45$ (1)

$G =$ 45

(2)

(Total for Question 1 is 2 marks)

2 The function f is such that $f(x) = (x - 4)^2$ for all values of x.

(a) Find f(1)

$f(x) = (x-4)^2$

$f(1) = (1-4)^2$

$= (-3)^2$

$= 9$

9 (1)

(1)

(b) State the range of the function f.

$f(x) \geq 0$ (1)

(1)

The function g is such that $g(x) = \dfrac{4}{x+3}$ $x \neq -3$

(c) Work out fg(2)

$f(x) = (x-4)^2$

$g(x) = \dfrac{4}{x+3}$

$fg(x) = \left(\dfrac{4}{x+3} - 4\right)^2$

$fg(2) = \left(\dfrac{4}{2+3} - 4\right)^2$ (1)

$= \left(-\dfrac{16}{5}\right)^2 = \dfrac{256}{25}$

$\dfrac{256}{25}$ (1)

(2)

(Total for Question 2 is 4 marks)

3 A is inversely proportional to the square of r

$A = 5$ when $r = 0.3$

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

$A \propto \frac{1}{r^2}$

$A = \frac{k}{r^2}$ (1)

when $A = 5$ and $r = 0.3$

$5 = \frac{k}{0.3^2}$

$k = 5 \times 0.3^2$

$= 0.45$ (1)

$A = \frac{0.45}{r^2}$ (1)

$A = \frac{0.45}{r^2}$

(3)

(b) Find the value of A when $r = 7.5A$

$A = \frac{0.45}{(7.5A)^2}$

$A = \frac{0.45}{56.25A^2}$ (1)

$56.25A^3 = 0.45$

$A^3 = \frac{0.45}{56.25}$

$A^3 = \frac{1}{125}$ (1)

$A = \sqrt[3]{\frac{1}{125}}$

$= \frac{1}{5} = 0.2$ (1)

$A = 0.2$

(3)

(Total for Question 3 is 6 marks)

4 $w = 5y^2 - y^3$

(a) Work out the value of w when $y = -2$

$w = 5(-2)^2 - (-2)^3$ (1)

$= 5(4) - (-8)$

$= 20 + 8$

$= 28$ (1)

$w =$ 28

(2)

(Total for Question 4 is 2 marks)

5 The function f is defined as

$$f: x \mapsto \frac{2x}{x-6} \qquad x \neq 6$$

(a) Find f(10)

$\frac{2(10)}{10-6} = \frac{20}{4} = 5$

5 (1)

(1)

(Total for Question 5 is 1 marks)

6 A particle P moves along a straight line.
The fixed point O lies on this line.

The displacement of P from O at time t seconds, $t \geqslant 1$, is s metres where

$$s = 4t^2 + \frac{125}{t}$$

The velocity of P at time t seconds, $t \geqslant 1$, is v m/s

Work out the distance of P from O at the instant when $v = 0$

$v = \frac{ds}{dt} = 8t - 125t^{-2}$ (1)

when $v = 0$, $8t - \frac{125}{t^2} = 0$ (1)

$8t^3 = 125$

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

$= \frac{5}{2} = 2.5$ (1)

$s = 4(2.5)^2 + \frac{125}{2.5}$ (1)

$= 75$ (1)

75 ..... m

(Total for Question 6 is 5 marks)

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

Find the value of h when $M = 500$

$M \propto h^3$

$M = kh^3$ (1)

$4 = k(0.5)^3$

$k = \frac{4}{0.5^3} = 32$ (1)

$500 = 32h^3$

$h^3 = \frac{500}{32} = 15.625$ (1)

$h = \sqrt[3]{15.625}$

$= 2.5$ (1)

2.5

(Total for Question 7 is 4 marks)

8 $a = \dfrac{14}{3x - 7}$ $x = \dfrac{7}{4y - 3}$

Express a in the form $\dfrac{py + q}{ry + s}$ where p, q, r and s are integers.

Give your answer in its simplest form.

$$a = \frac{14}{3\left(\frac{7}{4y-3}\right) - 7} \quad (1)$$

$$= \frac{14}{\frac{21}{4y-3} - 7}$$

$$= \frac{14(4y-3)}{21 - 7(4y-3)} \quad (1)$$

$$= \frac{56y - 42}{21 - 28y + 21}$$

$$= \frac{56y - 42}{42 - 28y}$$

$$= \frac{14(4y-3)}{14(3-2y)} \quad (1)$$

$a = \dfrac{4y-3}{3-2y}$

(Total for Question 8 is 3 marks)

9 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 $y = 27$

$y = \frac{k}{\sqrt{x}}$, $x = pT^3$

$y = \frac{k}{\sqrt{pT^3}}$

let $\frac{k}{\sqrt{p}} = c$,

$y = \frac{c}{\sqrt{T^3}}$ (1)

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

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

$= 1000$ (1)

$27 = \frac{1000}{\sqrt{T^3}}$ (1)

$T^3 = \frac{1000^2}{27^2}$ $T = \left(\frac{1000^2}{27^2}\right)^{\frac{1}{3}} = \frac{100}{9}$ (1)

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

(Total for Question 9 is 4 marks)

10 A is inversely proportional to C^2

$A = 40$ when $C = 1.5$

Calculate the value of C when $A = 1000$

$$A = \frac{k}{C^2}$$

$$40 = \frac{k}{1.5^2}$$

$$k = 40 \times 1.5^2$$

$$k = 90 \quad (1)$$

$$1000 = \frac{90}{C^2}$$

$$C^2 = \frac{90}{1000}$$

$$C = \sqrt{\frac{9}{100}} = \frac{3}{10} = 0.3 \quad (1)$$

(1)

$C =$ 0.3

(Total for Question 10 is 3 marks)

11 The function f is such that

$$f(x) = \frac{2}{3x - 5} \quad \text{where } x \neq \frac{5}{3}$$

(a) Find $f\left(\frac{1}{3}\right)$

$f(\frac{1}{3}) = \frac{2}{3(\frac{1}{3}) - 5} = \frac{2}{-4} = -0.5$

-0.5 (1)

(1)

(Total for Question 11 is 6 marks)

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

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

$P = \frac{k}{y^2}$ (1)

$a = \frac{k}{4^2}$ (1)

$k = 16a$

$P = \frac{16a}{y^2}$ (1)

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

(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

$y = m\sqrt{x}$

$4a = \frac{16a}{m^2 a}$ (1)

$4am^2 = 16$

$m = \sqrt{\frac{4}{a}}$ (1)

$y = \sqrt{\frac{4x}{a}}$

$P = \frac{16a}{\frac{4x}{a}}$

$= \frac{16a^2}{4x} = \frac{4a^2}{x}$ (1)

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

(3)

(Total for Question 12 is 6 marks)

13 (b) Work out the value of F when $r = 48$

$$F = \frac{576}{48^2}$$

$$= \frac{576}{2304} = 0.25$$ (1)

0.25

(1)

(Total for Question 13 is 1 marks)

14 $P = m^2 - 4c$

(a) Work out the value of P when $m = -5$ and $c = 3$

$P = (-5)^2 - 4(3)$ (1)

$= 25 - 12$

$= 13$ (1)

$P =$ 13

(2)

(Total for Question 14 is 2 marks)