Answer ALL TWENTY ONE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Simplify $g^6 \times g^4$

$6+4$

g^{10}

(1)

(b) Simplify $k^{10} \div k^3$

$10-3$

k^7

(1)

(c) Simplify $(3cd^4)^2$

$3^2 = 9$ / $c^{1 \times 2}$ / $d^{4 \times 2}$

$9c^2d^8$

(2)

(d) Solve the inequality $4x + 7 > 2$

$4x > -5$

$x > -\dfrac{5}{4}$

$x > -1.25$

(2)

(Total for Question 1 is 6 marks)

2 The table shows information about the lengths of time, in minutes, 120 customers spent in a supermarket.

Length of time (L minutes)	Frequency
$20 < L \leqslant 30$	6
$30 < L \leqslant 40$	26
$40 < L \leqslant 50$	31
$50 < L \leqslant 60$	40
$60 < L \leqslant 70$	17

$\times 25 \quad = 150$
$\times 35 \quad = 910$
$\times 45 \quad = 1395$
$\times 55 \quad = 2200$
$\times 65 \quad = 1105$
$\overline{\quad\quad\quad 5760}$

(a) Write down the modal class.

$50 < L \leqslant 60$

....

(1)

(b) Work out an estimate for the mean length of time spent by the 120 customers in the supermarket.

$$\frac{5760}{120}$$

48

....minutes

(4)

(Total for Question 2 is 5 marks)

3
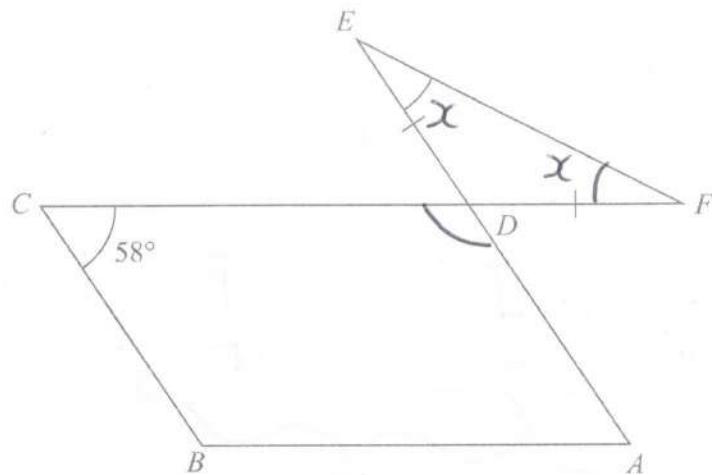
Diagram **NOT** accurately drawn

The diagram shows a parallelogram *ABCD* and an isosceles triangle *DEF* in which *DE = DF*

CDF and *ADE* are straight lines.
Angle *BCD* = 58°

Work out the size of angle *DEF*.
Give a reason for each stage of your working.

∠CDA = 122 (co-interior angles sum to 180)

∠EDF = 122 (opposite angles are equal)

∠DEF = $\dfrac{180-122}{2}$ (base angles of an isosceles triangle are equal)

= 29

29 °

(Total for Question 3 is 5 marks)

4   Andreas, Isla and Paulo share some money in the ratios 3 : 2 : 5

The **total** amount of money that Isla and Paulo receive is £76 more than the amount of money that Andreas receives.

Andreas buys a video game for £48.50 with some of his share of the money.

Work out how much money Andreas has left from his share of the money when he has bought the video game.

$$A \qquad\qquad I \qquad\qquad P$$

$$3 \qquad\qquad 2 \qquad\qquad 5$$

$$= \frac{3}{10} \qquad\qquad\qquad \frac{7}{10}$$
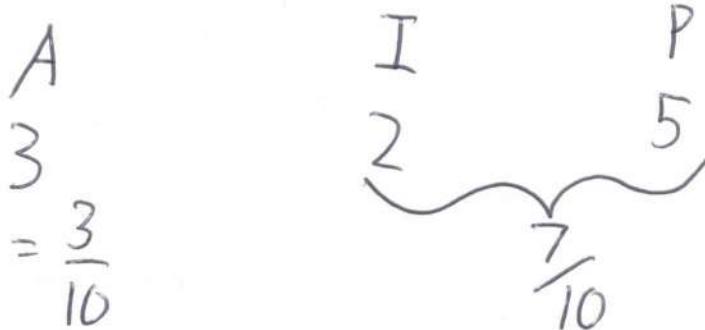
$$\text{Difference} = \frac{4}{10} = 76$$

$$\text{So} \quad \frac{1}{10} = 19$$

$$A = \frac{3}{10} = 3 \times 19 = 57$$

$$57 - 48.50$$

£ 8.50

(Total for Question 4 is 4 marks)

5 Himari's annual salary is 3 130 000 Japanese Yen (JPY).
She gets a salary increase of 4%

(a) Work out Himari's salary after this increase.

$$3130000 \times 1.04$$

3 255 200 .... JPY

(3)

Kaito bought a car.
The value of the car when Kaito bought it was 750 000 JPY.
At the end of each year, the value of his car had depreciated by 15%

(b) Work out the value of Kaito's car at the end of 3 years.
Give your answer correct to the nearest JPY.

$$750\,000 \times 0.85^3$$

$$= 460593.75$$

460594 .... JPY

(3)

(Total for Question 5 is 6 marks)

6 The line **L** is shown on the grid.
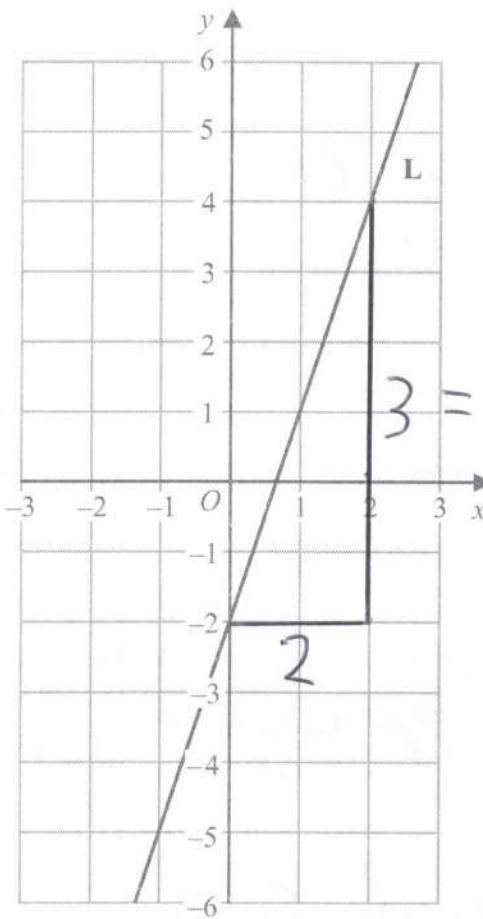
$3 = \frac{6}{2}$, $m = 3$

$c = -2$

Find an equation for **L**.

$y = 3x - 2$

7 The diagram shows a right-angled triangle.

O 3.4 cm

Diagram **NOT** accurately drawn

$x°$

4.7 cm

A
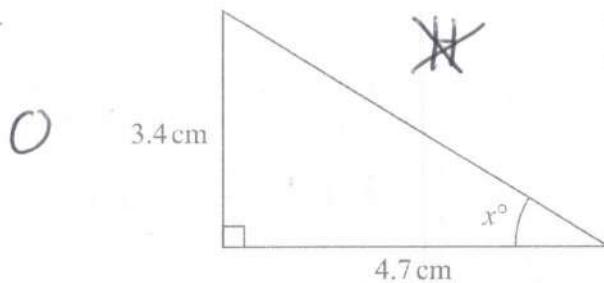
Calculate the value of x.
Give your answer correct to one decimal place.

$\overset{O}{\underline{T}} A$

$$x = \tan^{-1}\left(\frac{3.4}{4.7}\right)$$

$$= 35.882...$$

35.9

$x =$ ....

(Total for Question 7 is 3 marks)
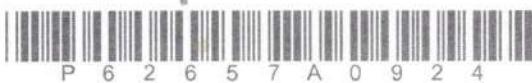
8 The diagram shows an isosceles triangle.

Diagram **NOT** accurately drawn

8.5 cm

8.5 cm

h

4

8 cm
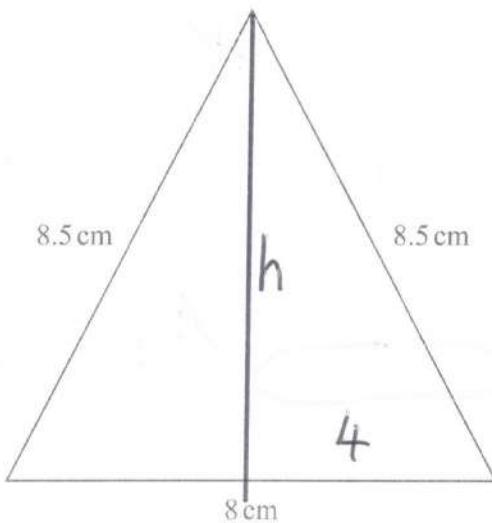
Work out the area of the triangle.

$$h = \sqrt{8.5^2 - 4^2} = 7.5$$

$$A = \frac{1}{2} \times b \times h$$

$$= \frac{1}{2} \times 8 \times 7.5$$

30

..................................cm²

(Total for Question 8 is 4 marks)

9 The diagram shows a solid cylinder with radius 3 m.

3 m
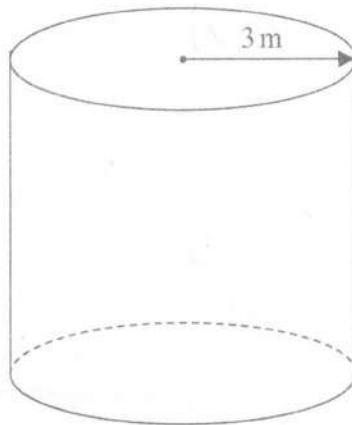
Diagram **NOT**
accurately drawn

The volume of the cylinder is $72\pi \, \text{m}^3$

Calculate the **total** surface area of the cylinder.
Give your answer correct to 3 significant figures.

$$72\pi = \pi \times 3^2 \times h$$
$$h = 8$$

$$SA = \boxed{} + 2 \times 0$$

$$= (2 \times \pi \times 3 \times 8) + (2 \times \pi \times 3^2)$$

$$= 66\pi$$

$$= 207.34...$$

207 m²

(Total for Question 9 is 5 marks)

P 6 2 6 5 7 A 0 1 1 2 4

10 The table shows information about the number of minutes each of 120 buses was late last Monday.

Number of minutes late (L)	Frequency
$0 < L \leqslant 10$	10
$10 < L \leqslant 20$	16
$20 < L \leqslant 30$	44
$30 < L \leqslant 40$	29
$40 < L \leqslant 50$	15
$50 < L \leqslant 60$	6

(a) Complete the cumulative frequency table below.

Number of minutes late (L)	Cumulative frequency
$0 < L \leqslant 10$	10
$0 < L \leqslant 20$	26
$0 < L \leqslant 30$	70
$0 < L \leqslant 40$	99
$0 < L \leqslant 50$	114
$0 < L \leqslant 60$	120

(1)

(b) On the grid, draw a cumulative frequency graph for your table.

9 {

Cumulative frequency

Number of minutes late
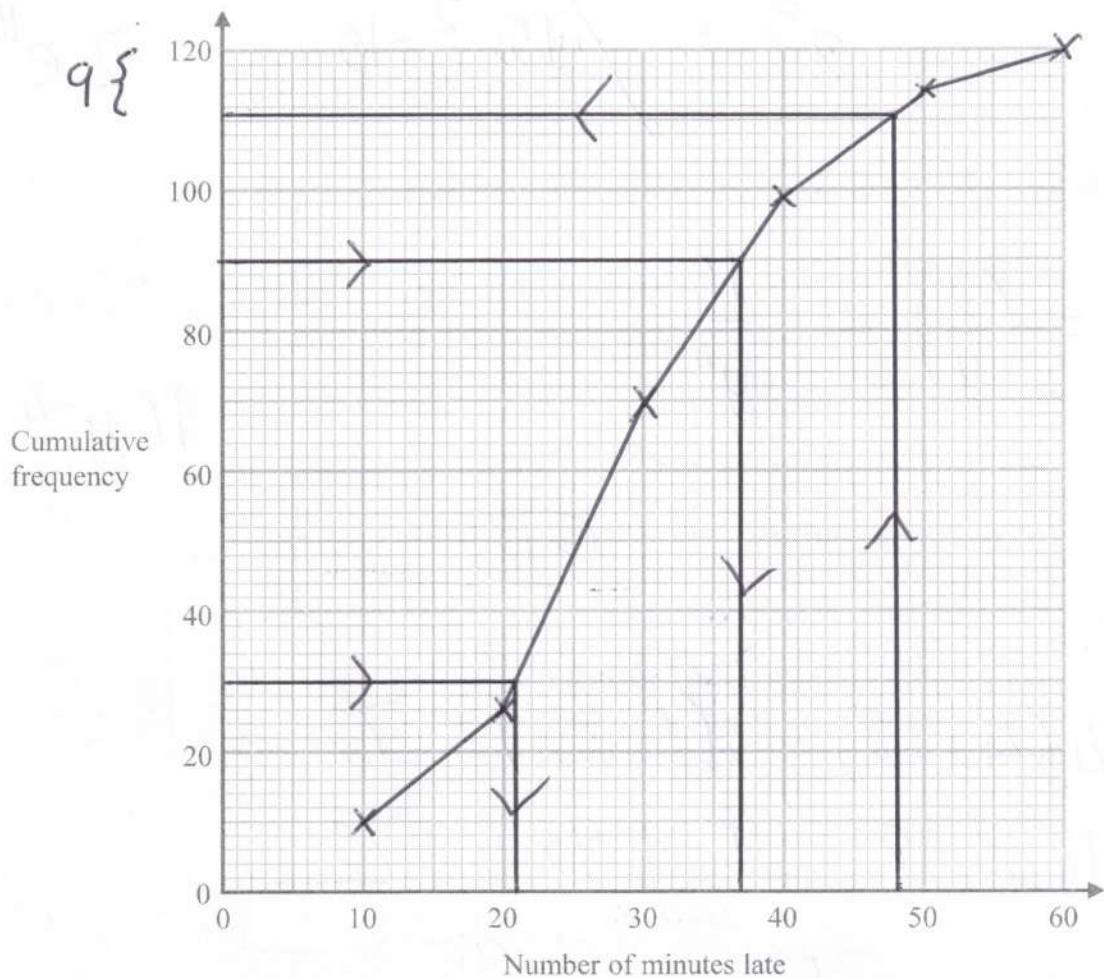
(2)

(c) Use your graph to find an estimate for the interquartile range.

37 − 21

[ms! 14→18]

16 ....minutes

(2)

(d) Use your graph to find an estimate for the number of buses that were more than 48 minutes late last Monday.

9 ....

(2)

(Total for Question 10 is 7 marks)

P 6 2 6 5 7 A 0 1 3 2 4

11 (a) Simplify fully $(8e^{15})^{\frac{2}{3}}$

$8^{\frac{2}{3}} = 4$ / $15 \times \frac{2}{3} = 10$

$4\ e^{10}$

(2)

(b) Express $\left(\dfrac{y}{2}\right)^{-4}$ in the form ay^n where a and n are integers.

$= \left(\dfrac{2}{y}\right)^4 = \dfrac{16}{y^4}$

$16y^{-4}$

(2)

(c) Solve $\dfrac{4x-2}{3} - \dfrac{5-3x}{4} = 6$ $\boxed{\times 12}$

Show clear algebraic working.

$4(4x-2) - 3(5-3x) = 72$

$16x - 8 - 15 + 9x = 72$

$25x = 95$

$x = \dfrac{95}{25} = \dfrac{19}{5}$

$x =$ 3.8

(4)

(Total for Question 11 is 8 marks)

12 Given that $\dfrac{3^y}{9^{3x}} = 81$

find the value of x.
Show clear algebraic working.

$$\frac{3^x}{(3^2)^{3x}} = 3^4$$

$$\frac{3^x}{3^{6x}} = 3^4$$

$$3^{-5x} = 3^4$$

so $-5x = 4$

$$x = -\frac{4}{5}$$

$x = $ ......-0.8

(Total for Question 12 is 3 marks)

13 Use algebra to show that $0.6\dot{8}\dot{1} = \dfrac{15}{22}$

$$x = 0.6\dot{8}\dot{1}$$
$$10x = 6.\dot{8}\dot{1}$$
$$1000x = 681.\dot{8}\dot{1}$$
$$\underline{\quad 990x = 675 \quad}$$

$$x = \frac{675}{990}$$

$$= \frac{15}{22}$$

(Total for Question 13 is 2 marks)

14 $\mathscr{E}$ = {integers x such that $10 \leqslant x \leqslant 25$}
    $A = \{x : x < 18\}$
    $B = \{x : 13 \leqslant x < 22\}$

(a) Write down n(A)

10, 11 ... 17

8

(1)

(b) List the members of the set $(A \cup B)'$

$(A \cup B)$ = all from
             10 → 21
             inclusive

22, 23, 24, 25

(2)

(c) List the members of the set $A' \cap B$

$A' = 18, 19 .. 25$

$B = 13, 14 .. 21$

$\cap = 18, 19, 20, 21$

(2)

$C \subset A$, $C \subset B$ and n(C) = 5

(d) List the members of the set C

13, 14, 15, 16, 17

(1)

(Total for Question 14 is 6 marks)

15 Make x the subject of $y = \dfrac{5 - 2x}{x + 3}$

$$y(x+3) = 5 - 2x$$

$$yx + 3y = 5 - 2x$$

$$yx + 2x = 5 - 3y$$

$$x(y+2) = 5 - 3y$$

$$x = \frac{5 - 3y}{y + 2}$$

(Total for Question 15 is 4 marks)

16 Solve the simultaneous equations

$$3xy - y^2 = 8$$
$$x - 2y = 1$$

$$x = 1 + 2y$$

Show clear algebraic working.

$$3y(1+2y) - y^2 = 8$$

$$3y + 6y^2 - y^2 = 8$$

$$5y^2 + 3y - 8 = 0$$

$$(5y + 8)(y - 1) = 0$$

$$y = -\frac{8}{5} \qquad\qquad y = 1$$

$$x = 1 + 2\left(-\frac{8}{5}\right) \qquad x = 1 + 2(1)$$

$$\qquad\qquad\qquad\qquad\qquad = 3$$

$$= -\frac{11}{5}$$

$$x = 3, y = 1 \qquad , \quad x = -\frac{11}{5}, y = -\frac{8}{5}$$

17 The diagram shows a rectangle.

$\boxed{\text{So } x > 2}$

$\longleftarrow (2x-4)\,\text{cm} \longrightarrow$

Diagram **NOT** accurately drawn

$(3x + 2)\,\text{cm}$

The area of the rectangle is $A\,\text{cm}^2$

Given that $A < 3x + 27$
find the range of possible values for x.

$$(2x-4)(3x+2) < 3x + 27$$

$$6x^2 - 8 - 8x - 3x - 27 < 0$$

$$6x^2 - 11x - 35 < 0$$

$$(2x-7)(3x+5) < 0$$

$-\dfrac{5}{3}$ $\dfrac{7}{2}$
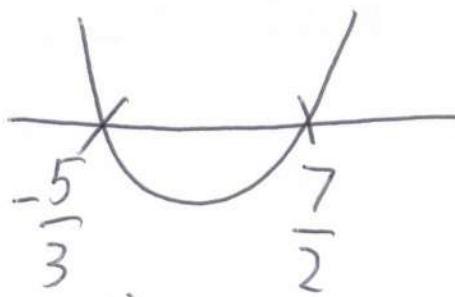
(reject)

$$2 < x < \dfrac{7}{2}$$

(Total for Question 17 is 5 marks)

18 The diagram shows cuboid *ABCDEFGH*.

Diagram **NOT** accurately drawn

4 cm

5 cm
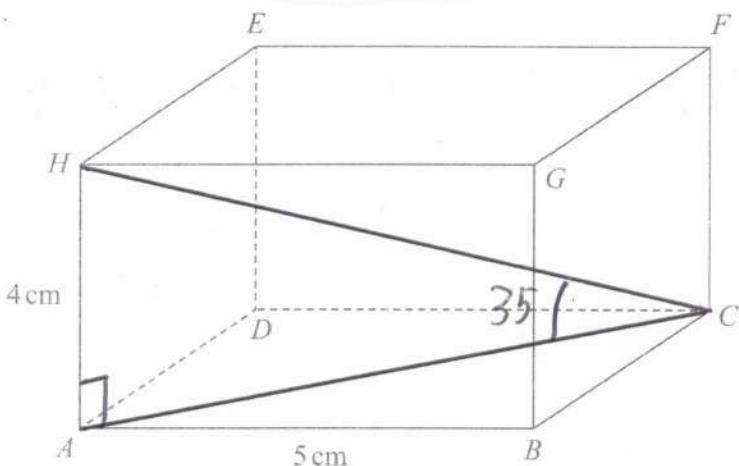
$AB = 5$ cm
$AH = 4$ cm
The size of the angle between *CH* and the plane *ABCD* is 35°

Calculate the volume of the cuboid.
Give your answer correct to 3 significant figures.

T°Ⓐ $AC = \dfrac{4}{\tan 35} = 5.712...$

$BC = \sqrt{5.712^2 - 5^2} = 2.7629...$

$V = 5 \times 4 \times 2.7629$

$= 55.25...$

55.3

.... cm³

(Total for Question 18 is 5 marks)

P 6 2 6 5 7 A 0 2 0 2 4

19 OAB is a triangle.

$$\overrightarrow{OA} = \mathbf{a} \qquad \overrightarrow{OB} = \mathbf{b}$$

The point C lies on OA such that $OC : CA = 1 : 2$
The point D lies on OB such that $OD : DB = 1 : 2$

Using a vector method, prove that $ABDC$ is a trapezium.
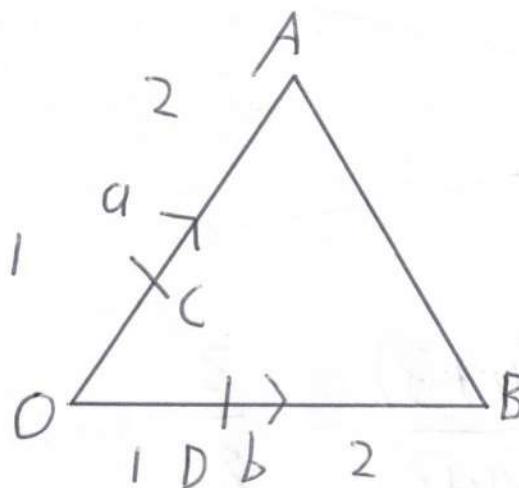
$$AB = -a + b$$

$$CD = -\frac{1}{3}a + \frac{1}{3}b$$

$$= \frac{1}{3}(-a + b)$$

∴ AB and CD are parallel hence $ABDC$ is a trapezium.

(Total for Question 19 is 3 marks)

20 A bag contains X counters.

There are only red counters and blue counters in the bag.

There are 4 more blue counters than red counters in the bag.

Finty takes at random 2 counters from the bag.

The probability that Finty takes 2 blue counters from the bag is $\frac{3}{8}$

Work out the value of X.
Show clear algebraic working.

$$R \qquad\qquad B$$
$$y \qquad\qquad y+4$$

$$P(BB) = \frac{(y+4)}{(2y+4)} \times \frac{(y+3)}{(2y+3)} = \frac{3}{8}$$

$$8(y^2 + 7y + 12) = 3(4y^2 + 14y + 12)$$

$$8y^2 + 56y + 96 = 12y^2 + 42y + 36$$

$$0 = 4y^2 - 14y - 60$$

$$0 = 2y^2 - 7y - 30$$

$$0 = (2y + 5)(y - 6)$$

$$y = -\frac{5}{2}$$
(reject as must be an integer)

so $y = 6$
$(2 \times 6) + 4$
$= 16$

(Total for Question 20 is 5 marks)

21 The function f is such that $f(x) = 5 + 6x - x^2$ for $x \leqslant 3$

(a) Express $5 + 6x - x^2$ in the form $p - (x - q)^2$ where p and q are constants.

$$-1\left[x^2 - 6x\right] + 5$$
$$-1\left[(x-3)^2 - 9\right] + 5$$
$$-1(x-3)^2 + 9 + 5$$

$$14 - (x-3)^2$$

(2)

(b) Using your answer to part (a), find the range of values of x for which $f^{-1}(x)$ is positive.

$$y = 14 - (x-3)^2$$
$$(x-3)^2 = 14 - y$$
$$x - 3 = \sqrt{14 - y}$$
$$x = 3 + \sqrt{14 - y}$$

so $f^{-1}(x) = 3 + \sqrt{14 - x} > 0$

$$\sqrt{14 - x} > -3$$
$$14 - x < 9$$
$$5 < x$$

AND $x \leqslant 14$

$$5 < x \leqslant 14$$

(5)

(Total for Question 21 is 7 marks)

TOTAL FOR PAPER IS 100 MARKS