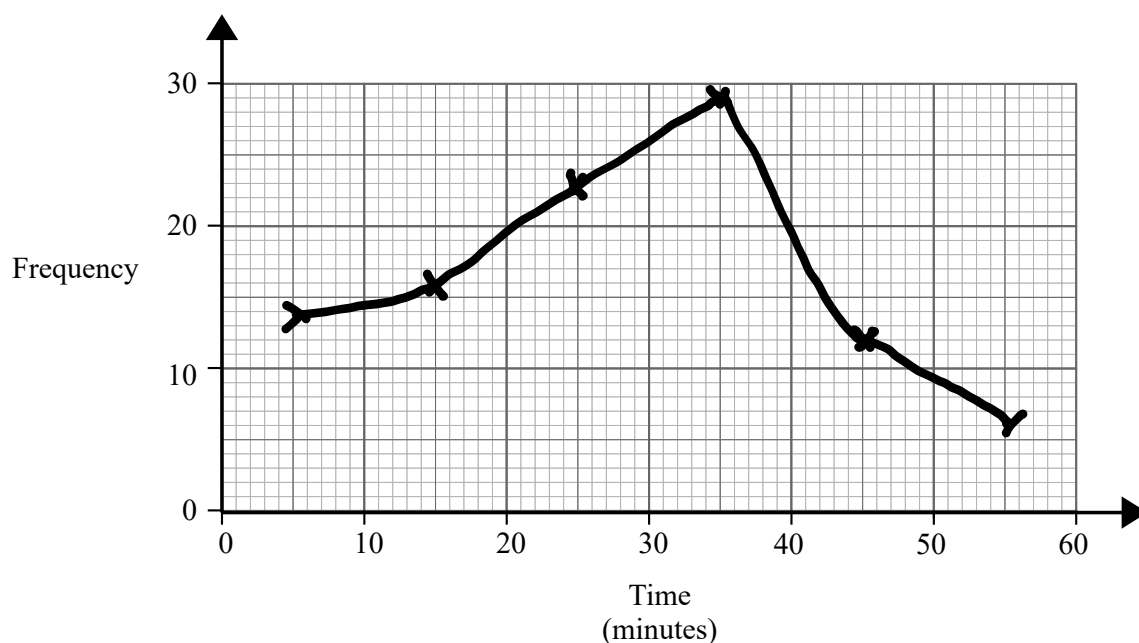


- 1 The frequency table shows the time taken for 100 people to travel to an event.

| Time (minutes)   | Frequency |
|------------------|-----------|
| $0 < t \leq 10$  | 14        |
| $10 < t \leq 20$ | 16        |
| $20 < t \leq 30$ | 23        |
| $30 < t \leq 40$ | 29        |
| $40 < t \leq 50$ | 12        |
| $50 < t \leq 60$ | 6         |

Draw a frequency polygon to show this information.

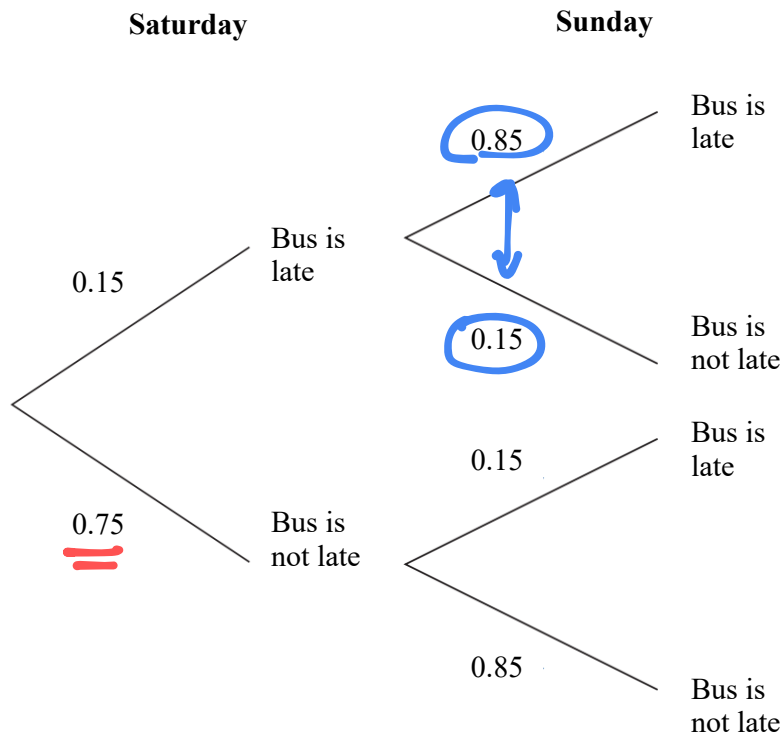


(Total for Question 1 is 2 marks)

We plot mid-point for frequency polygon. Then join them with straight line.

- 2 Bradley gets the bus on Saturday and Sunday.  
The probability that Bradley's bus will be late on any day is 0.15

Bradley draws this probability tree diagram.  
The diagram is not correct.



Write down two things that are wrong with the probability tree diagram.

1 ① The prob. the bus is not late on Saturday should be 0.85.

2 ② The prob. of the bus being late on Sunday should be 0.15.

(Total for Question 2 is 2 marks)

$$P(\text{Bus late}) + P(\text{Bus not late}) = 1$$

- 3 Matt wants to invest £8000 for three years. He can choose between Bank A and Bank B.

**Bank A**

1.2% compound interest  
per annum

**Bank B**

2% compound interest in  
the first year  
1% compound interest  
for each extra year

Which bank will give Matt the most interest after three years.  
You must show your working.

Bank A

$$8000 \times 1.012^3$$
$$= 8291.47$$

Bank B

$$8000 \times 1.02 \times 1.01^2$$
$$= 8324.02$$

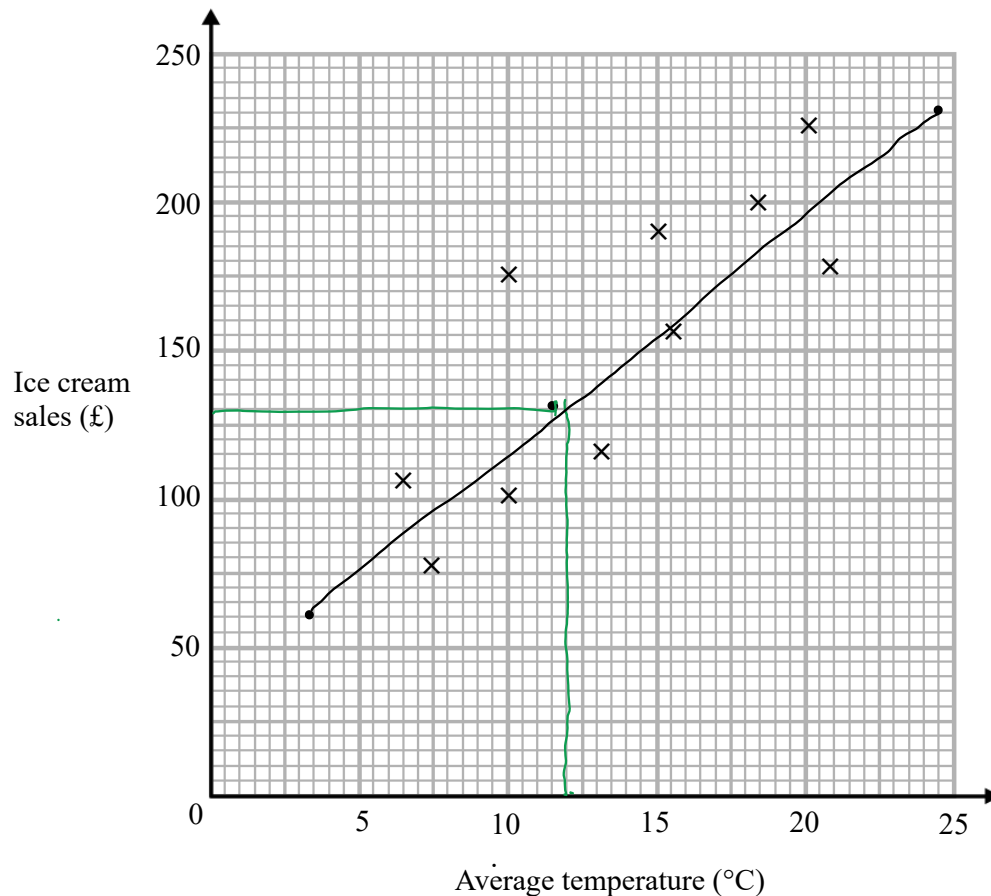
Bank B

(Total for Question 3 is 4 marks)

$$1.2\% \text{ interest} = 100\% + 1.2\% = 101.2\%$$
$$= 1.012$$

- 4 The average daytime temperature for 10 days is recorded.  
A shop also records its ice cream sales for each of the 10 days.

The scatter graph shows this information.



- (a) What type of correlation does the scatter graph show?

Positive

(1)

- (b) On the 11<sup>th</sup> day the temperature was 12°C.  
Estimate the ice cream sales on the 11th day.

£ 130

(2)

- (c) The shop's manager wants to use the scatter graph to predict the ice cream sales for a day with an average temperature of 2°C. Comment on the reliability of this prediction.

It would not be reliable. 2°C is outside the range of data.

(1)

(Total for Question 4 is 4 marks)

5

Find 5% of  $3.8 \times 10^{105}$ 

Give your answer in standard form

$$5\% \text{ of } 3.8$$

$$0.05 \times 3.8 = 0.19$$

$$0.19 \times 10^{105}$$

$$= 1.9 \times 10^{104}$$

$$1.9 \times 10^{104}$$

(Total for Question 5 is 3 marks)

6

Verity buys 12 bottles of apple juice for a total cost of £15  
 Verity sells all 12 bottles at £1.75 each bottle.

Work out Verity's percentage profit.

$$\begin{array}{l} \% \text{ increase} \\ \text{or} \\ \text{decrease} \end{array} = \frac{\text{change}}{\text{original}} \times 100$$

$$12 \times 1.75 = 21$$

$$\frac{21 - 15}{15} \times 100 = \underline{\underline{40}}$$

$$40\%$$

(Total for Question 6 is 3 marks)

7

$$y^2 \times y^a = y^7$$

(a) Find the value of  $a$ .

$$2 + a = 7 \quad a = 7 - 2 = \underline{\underline{5}}$$

5

(1)

$$(y^4)^b = y^{12}$$

(b) Find the value of  $b$ .

$$4b = 12$$

$$b = \frac{12}{4}, \quad b = 3$$

3

(1)

(Total for Question 7 is 2 marks)

8

Change a speed of 81 kilometres per hour to a speed in metres per second

$$81 \frac{\text{km}}{\text{h}} = \frac{81000 \text{ m}}{60 \text{ min}} = 1350 \frac{\text{m}}{\text{min}}$$

$$\frac{1350 \text{ m}}{60 \text{ sec}} = 22.5 \text{ m/s}$$

$$1 \text{ hour} = 60 \text{ mins}$$

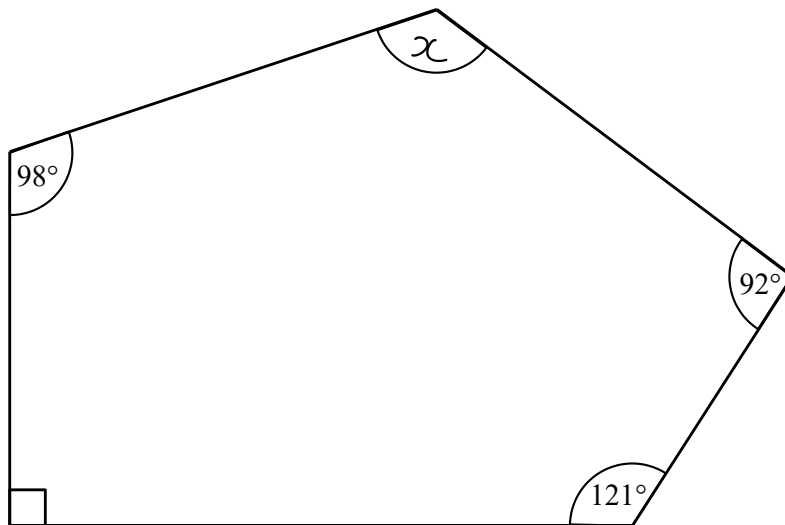
$$1 \text{ min} = 60 \text{ secs}$$

22.5

m/s

(Total for Question 8 is 3 marks)

- 9 The diagram shows a pentagon.



Work out the value of  $x$

$$\text{Angles in Pentagon} = 540^\circ$$

$$x = 540 - (90 + 121 + 92 + 98)$$

$$x = \underline{\underline{139^\circ}}$$

139°

(Total for Question 9 is 3 marks)

$$\begin{aligned} \text{Sum of all} \\ \text{Interior angles in} &= (n-2) \times 180 \\ n\text{-sided polygon} &= (5-2) \times 180 \\ &= 540^\circ \end{aligned}$$

10 The density of orange cordial is 1.21 grams per  $\text{cm}^3$ .

The density of carbonated water is 1.01 grams per  $\text{cm}^3$ .

A drink with a volume of  $280 \text{ cm}^3$  is made by mixing 1 part of orange cordial with 7 parts of carbonated water.

Work out the density of the drink.

$$\underline{C : W} \quad 1 + 7 = 8 \quad \text{parts}$$

$$1 : 7 \quad 280 \div 8 = 35 \text{ cm}^3 = 1 \text{ part}$$

$$35 : 245 \quad (\text{multiply by } 35)$$

$$\text{mass} = \text{density} \times \text{Volume}$$

$$\underline{\text{orange}}: \text{mass} = 1.21 \times 35 = 42.35 \text{ g}$$

$$\underline{\text{water}}: \text{mass} = 1.01 \times 245 = 247.45 \text{ g}$$

$$\text{density} = \frac{\text{total mass}}{\text{total volume}} = \frac{42.35 + 247.45}{280}$$

$$= 1.035$$

$$\underline{1.035} \text{ g/cm}^3$$

(Total for Question 10 is 4 marks)

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{Upper} = \frac{\text{Upper}}{\text{Lower}}$$

$$\text{Lower} = \frac{\text{Lower}}{\text{Upper}}$$



- 11 There are 5 starters, 6 main courses and desserts in a restaurant.

Riley says there are 130 different ways of choosing a starter, a main course and a dessert.

Could Riley be correct?

You must show your working.

$$5 \times 6 \times x = 30x$$

$$30x = 130$$

$$x = \frac{130}{30}$$

$$x = 4.3\bar{3}$$

No, Riley can't be correct.  $x$  must be a whole number.

(Total for Question 11 is 2 marks)

- 12 Holly recorded the heights, in centimetres, of some girls. She used her results to work out the information in this table.

|                     |        |
|---------------------|--------|
| Least height        | 138 cm |
| Interquartile range | 19 cm  |
| Median              | 165 cm |
| Upper quartile      | 172 cm |
| Range               | 44 cm  |

$$\text{Range} = \text{Max} - \text{min}$$

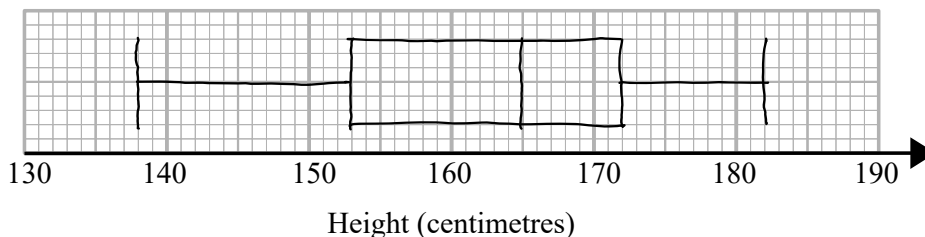
$$44 = \text{Max} - 138$$

$$\text{Max} = 182$$

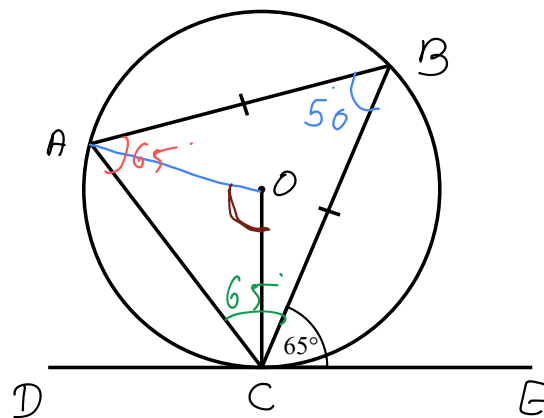
Draw a box plot for the information in the table.

$$\text{IQR} = \text{UQ} - \text{LQ} \quad \text{LQ} = \underline{\underline{153}}$$

$$\text{UQ} = 172 - \text{LQ}$$



(Total for Question 12 is 2 marks)



$A$ ,  $B$  and  $C$  are points on the circumference of a circle, centre  $O$ .  
 $DCE$  is a tangent to the circle.

$$AB = BC$$

$$\text{Angle } BCE = 65^\circ$$

Find the size of angle  $AOC$

You must show all your working.

$$\angle BAC = 65^\circ \text{ (Alternate segment theorem)}$$

$$\angle ACB = 65^\circ \text{ (Angles in a isosceles triangles at the base are same)}$$

$$\angle ABC = 50^\circ \text{ (Angles in a triangle add to } 180^\circ)$$

$$\angle AOC = 100^\circ \text{ (Angles at centre is twice angle at circumference)}$$

100

(Total for Question 13 is 4 marks)

14 Make  $d$  the subject of  $e = \sqrt{\frac{d+e}{de-2f}}$

$$e^2 = \frac{d+e}{de-2f}$$

$$e^2 (de - 2f) = d + e$$

$$de^3 - 2e^2f = d + e$$

$$de^3 = d + e + 2e^2f$$

$$de^3 - d = e + 2e^2f$$

$$d(e^3 - 1) = e + 2e^2f$$

$$d = \frac{e + 2e^2f}{e^3 - 1}$$

(Total for Question 14 is 4 marks)

15 Here are the first five terms of a quadratic sequence.

-3

4

14

27

43

Find an expression, in terms of  $n$ , for the  $n$ th term of this sequence

$$\begin{array}{ccccccccc} -3 & 4 & 14 & 27 & 43 & & & & \\ \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & & & & & \\ 7 & 10 & 13 & 16 & & & & & \\ \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & & & & & & \\ 3 & 3 & 3 & & & & & & \end{array}$$

$$a = \frac{3}{2} = 1.5$$

$$\text{so } 1.5n^2$$

$$\text{original: } -3 \quad 4 \quad 14 \quad 27 \quad 43$$

$$1.5n^2: \quad 1.5 \quad 6 \quad 13.5 \quad 24 \quad 37.5$$

$$\begin{array}{ccccccccc} \text{difference:} & -4.5 & -2 & 0.5 & 3 & 5.5 & & & \\ & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & \underbrace{\quad} & & & & \\ & 2.5 & 2.5 & 2.5 & 2.5 & & & & \end{array}$$

← linear:

$$2.5n - 7$$

$$1.5n^2 + 2.5n - 7$$

(Total for Question 15 is 3 marks)

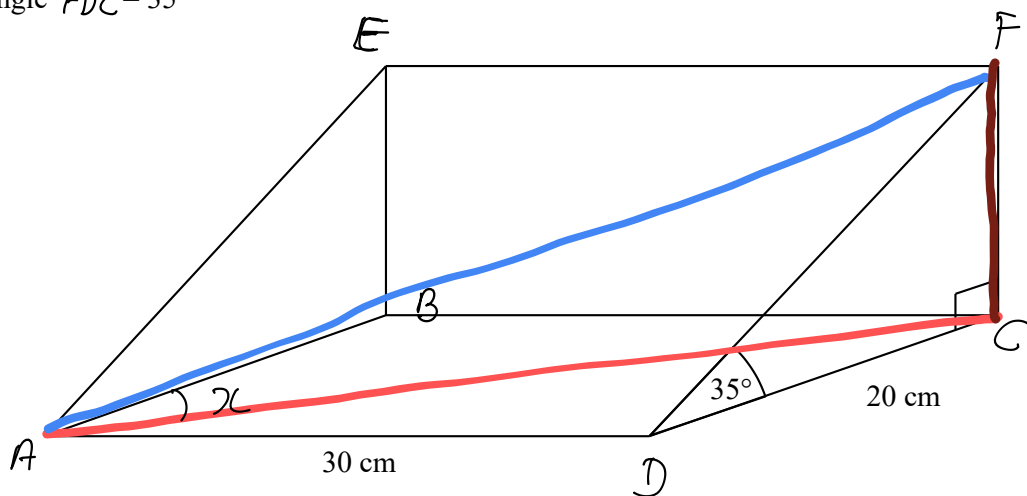
$$n^2: \quad 1 \quad 4 \quad 9 \quad 16 \quad 25$$

- 16 The diagram shows a triangular prism.

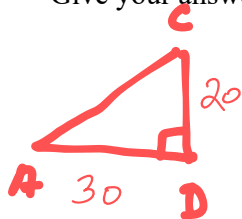
$$CD = 20 \text{ cm}$$

$$AD = 30 \text{ cm}$$

$$\text{Angle } FDC = 35^\circ$$

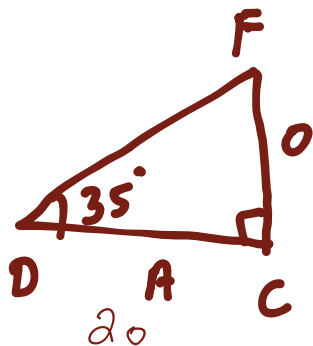


Calculate the size of the angle the line  $AF$  makes with the plane  $ABCD$ .  
Give your answer correct to 3 significant figures.



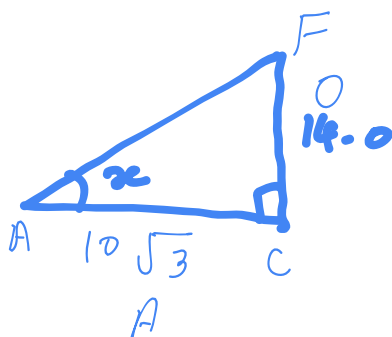
$$AC^2 = 20^2 + 30^2$$

$$AC = \sqrt{400 + 900} = 10\sqrt{13}$$



$$\tan 35 = \frac{CF}{20}$$

$$CF = 20 \times \tan 35 = 14.0$$



$$\tan x = \frac{14.0}{10\sqrt{13}}$$

$$x = \tan^{-1}\left(\frac{14.0}{10\sqrt{13}}\right)$$

$$x = 21.2^\circ$$

**21.2**

(Total for Question 16 is 4 marks)

**SOH**

**CAH**

**TOA**

**Tan =  $\frac{\text{Opp}}{\text{Hyp}}$**

17 Prove algebraically that the sum of the squares of any 2 odd positive integers is always even.

$$\begin{aligned} & 2n+1 \quad \& \quad 2m+1 \\ & (2n+1)^2 + (2m+1)^2 \\ & = 4n^2 + 4n + 1 + 4m^2 + 4m + 1 \\ & = 4n^2 + 4m^2 + 4n + 4m + 2 \\ & = 2(2n^2 + 2m^2 + 2n + 2m + 1) \\ & = 2 \times \text{no.} \end{aligned}$$

↙  
multiple of 2.  $\therefore$  even

(Total for Question 17 is 3 marks)

Any number multiply by 2 gives even number.

18 The functions  $f$  and  $g$  are such that

$$f(x) = \frac{3}{6x+5} \quad x \neq -\frac{5}{6}$$

$$g(x) = x^2 - 2 \quad x \geq 0$$

Solve  $fg(x) = 1$

$$\frac{3}{6(x^2 - 2) + 5} = 1$$

$$\frac{3}{6x^2 - 12 + 5} = 1$$

$$\frac{3}{6x^2 - 7} = 1$$

$$3 = 6x^2 - 7$$

$$6x^2 = 10$$

$$x^2 = 10/6$$

$$x = \sqrt{\frac{10}{6}}$$

$$x = \frac{\sqrt{10}}{\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}}$$

$$= \frac{\sqrt{60}}{6}$$

$$= \frac{2\sqrt{15}}{2 \times 3} = \frac{\sqrt{15}}{3}$$

$$\frac{\sqrt{15}}{3}$$

(Total for Question 18 is 3 marks)

- 19 (a) Show that the equation  $x^4 - 3x^3 - 7 = 0$  can be written in the form  $x = \sqrt[4]{3x^3 + 7}$

$$x^4 = 3x^3 + 7$$

$$x = \sqrt[4]{3x^3 + 7}$$

(1)

- (b) Starting with  $x_0 = 3$  use the iteration formula  $x_{n+1} = \sqrt[4]{3x_n^3 + 7}$  three times to find an estimate for a solution to  $x^4 - 3x^3 - 7 = 0$

$$x_1 = \sqrt[4]{3(3)^3 + 7} = 3.0628 \leftarrow \text{Ans}$$

$$x_2 = \sqrt[4]{3(\text{Ans})^3 + 7} = 3.10705 \leftarrow \text{Ans}$$

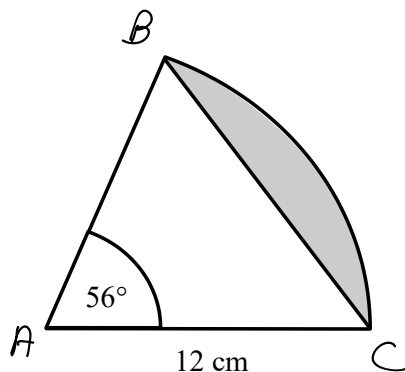
$$x_3 = \sqrt[4]{3(\text{Ans})^3 + 7} = 3.13816$$

3.13816

(3)

(Total for Question 19 is 4 marks)

- 20  $BAC$  is a sector of a circle, centre  $A$ ,  
 $AC$  is 12 cm.



Find the area of the shaded segment.  
 Give your answer to 3 significant figures.

$$\begin{aligned}\text{Area of Sector} &= \frac{56}{360} \times \pi (12)^2 \\ &= 70.371675... \text{ cm}^2\end{aligned}$$

$$\begin{aligned}\text{Area of Triangle} &= \frac{1}{2} ab \sin C \\ &= \frac{1}{2} (12)(12) \sin (56^\circ) \\ &= 59.6907... \text{ cm}^2\end{aligned}$$

$$70.37... - 59.69... = 10.7$$

**10.7**

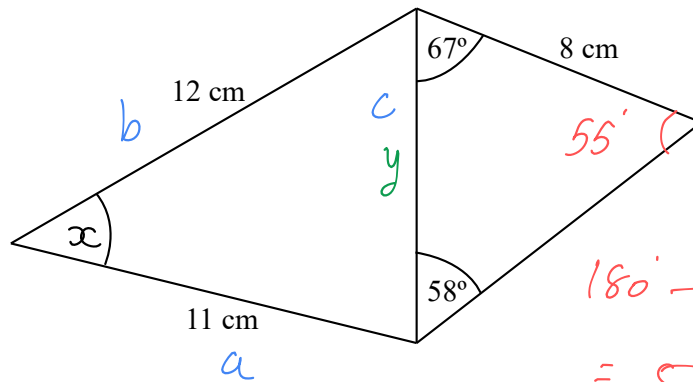
cm<sup>2</sup>

(Total for Question 20 is 3 marks)

$$\text{Area of Sector} = \frac{\theta}{360} \times \pi r^2$$



21



Work out the value of  $x$ .  
Give your answer to 1 decimal place.

$$\frac{y}{\sin 55^\circ} = \frac{8}{\sin 58^\circ}$$

$$y = \frac{8 \times \sin 55^\circ}{\sin 58^\circ}$$

$$y = \underline{7.727 \text{ cm}}$$

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

$$= \frac{11^2 + 12^2 - 7.727^2}{2(11)(12)}$$

$$x = \underline{\underline{39.0^\circ}}$$

**39.0**

(Total for Question 21 is 4 marks)

22

Solve  $\frac{1}{1-2x} + \frac{2}{x+3} = 3$ 

$$\frac{x+3}{(1-2x)(x+3)} + \frac{2(1-2x)}{(1-2x)(x+3)} = 3$$

$$\frac{x+3+2-4x}{(1-2x)(x+3)} = 3$$

$$5-3x = 3(1-2x)(x+3)$$

$$5-3x = 3(x+3-6x-2x^2)$$

$$5-3x = 3x+9-18x-6x^2$$

$$6x^2 + 12x - 4 = 0$$

$$3x^2 + 6x - 2 = 0$$

$$a=3 \quad b=6 \quad c=-2$$

$$x = \frac{-6 \pm \sqrt{(6)^2 - 4(3)(-2)}}{2(3)}$$

$$x = \underline{0.291} \quad \text{or} \quad x = \underline{-2.29}$$

$$x = 0.291 \quad \text{or} \quad -2.29$$

(Total for Question 22 is 5 marks)

- 23 Prove algebraically that the straight line with equation  $3x - 2y + 13 = 0$  is a tangent to the circle with equation  $x^2 + y^2 = 13$

$$3x + 13 = 2y \rightarrow y = \frac{3x + 13}{2} \quad \text{Sub. y in } x^2 + y^2 = 13$$

$$x^2 + \left(\frac{3x + 13}{2}\right)^2 = 13$$

$$x^2 + \frac{9x^2 + 78x + 169}{4} = 13$$

$$4x^2 + 9x^2 + 78x + 169 = 52$$

$$13x^2 + 78x + 117 = 0$$

$$x^2 + 6x + 9 = 0$$

$$(x + 3)(x + 3) = 0$$

$$\underline{\underline{x = -3}}$$

only one point of intersection.

$\therefore$  must be a tangent.

24 The displacement of an object,  $s$ , is given by the formula

$$s = \frac{v^2 - u^2}{2a}$$

where,

$v = 15.49$  correct to 2 decimal places

$u = 4.92$  correct to 3 significant figures

$a = 7.5$  correct to 2 significant figures

By considering bounds, work out the value of  $s$  to a suitable degree of accuracy.  
Show your working clearly and give a reason for your answer.

$$15.485 \leq v < 15.495$$

$$4.915 \leq u < 4.925$$

$$7.45 \leq a < 7.55$$

$$\text{Upper bound } s = \frac{15.495^2 - 4.915^2}{2(7.45)}$$

$$= 14.4924698$$

$$\text{Lower bound } s = \frac{15.485^2 - 4.925^2}{2(7.55)}$$

$$= 14.27348344$$

14 (2 s.f.) where both  
upper & lower bound to 14  
to 2 s.f.

14

(Total for Question 24 is 4 marks)

TOTAL FOR PAPER IS 80 MARKS