

Write your name here

Surname

Other Names

# Mathematics

**Practice Set A**

**Paper 3 (Calculator)**

**Higher Tier**

Time: 1 hour 30 minutes

**You must have:** Ruler graduated in centimetres and millimetres, protractor, pair of compasses, pen, HB pencil, eraser.

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– there may be more space than you need.
- **Calculators may be used.**
- Diagrams are **NOT** accurately drawn, unless otherwise indicated.
- You must **show all your working out.**



## Information

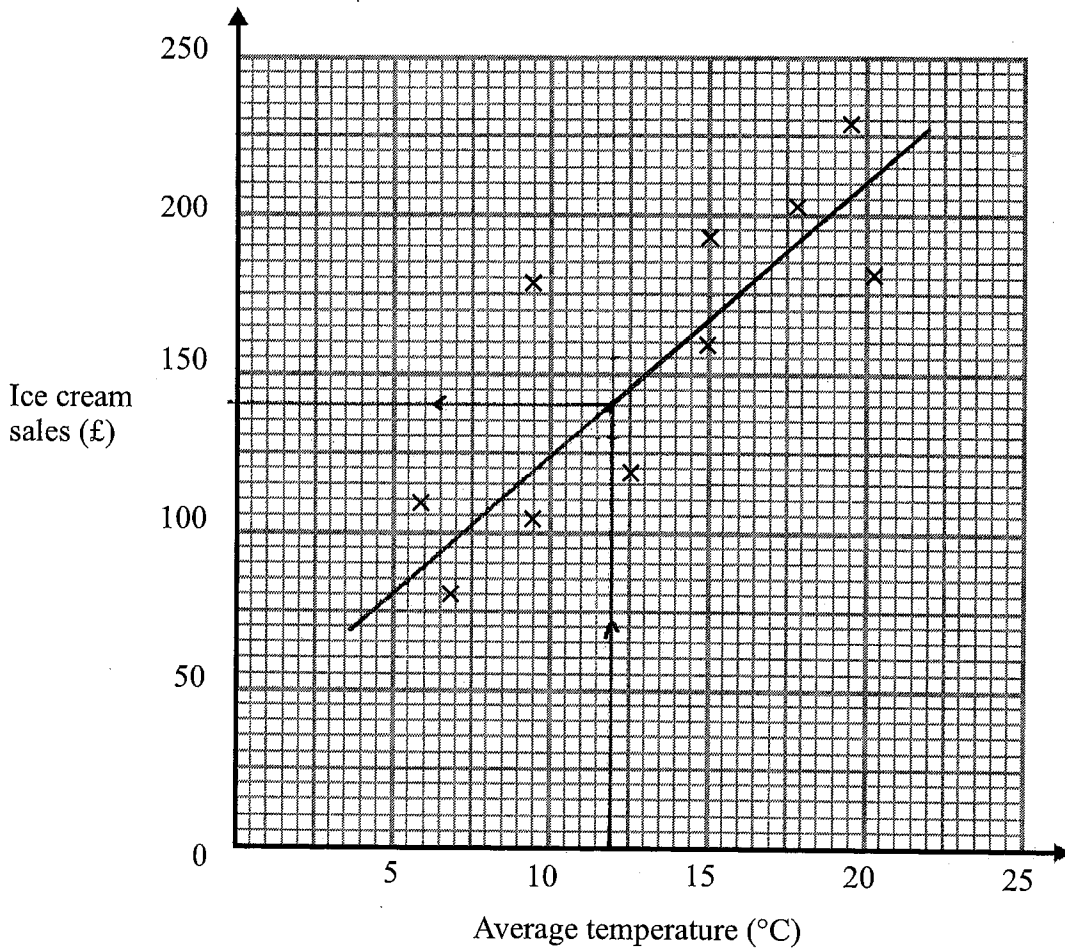
- The total mark for this paper is 80
- The marks for **each** question are shown in brackets  
– use this as a guide as to how much time to spend on each question.

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

- 1 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°. Estimate the ice cream sales on the 11th day.

£140 (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°. Comment on the reliability of this prediction.

2° is outside of the range of data -  
the prediction will not be reliable (1)

(Total for Question 1 is 4 marks)

2 Solve

$$8t - 19 = 5t - 11$$

$$-5t \quad -5t$$

$$3t - 19 = -11$$

$$+19 \quad +19$$

$$3t = 8$$

$$t = \frac{8}{3}$$

$$t = \frac{8}{3}$$

(Total for Question 2 is 2 marks)

3 Bob is going to make some orange paint.

He needs to mix red paint, yellow paint and white paint in the ratio 7 : 6 : 2

Bob wants to make 750 ml of orange paint.

$$7 + 6 + 2 = 15$$

Bob has

400 ml of red paint

300 ml of yellow paint

200 ml of white paint

Does Bob have enough red paint, yellow paint and white paint to make the orange paint?  
You must show all your working.

$$750 \div 15 = 50$$

$$7 \times 50 = 350 \text{ ml of red paint} \quad \checkmark$$

$$6 \times 50 = 300 \text{ ml of yellow paint} \quad \checkmark$$

$$2 \times 50 = 100 \text{ ml of white paint} \quad \checkmark$$

Bob has the paint he needs

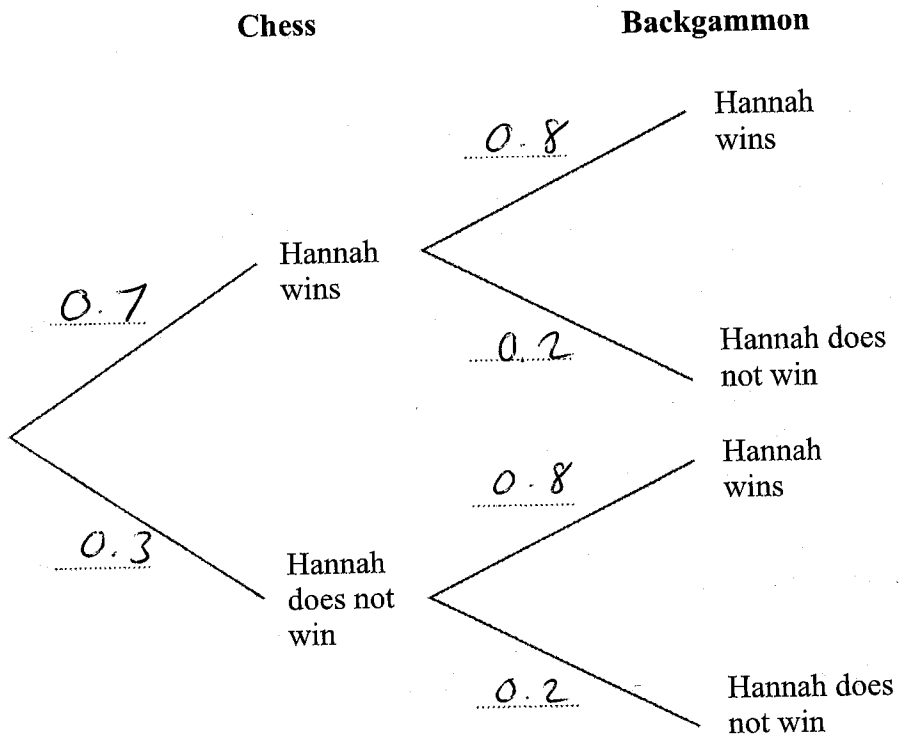
(Total for Question 3 is 4 marks)

4 Hannah is going to play one game of chess and one game of backgammon.

The probability she will win the game of chess is 0.7

The probability she will win the game of backgammon is 0.8

(a) Complete the probability tree diagram.



(2)

(b) Work out the probability that Hannah will win both games.

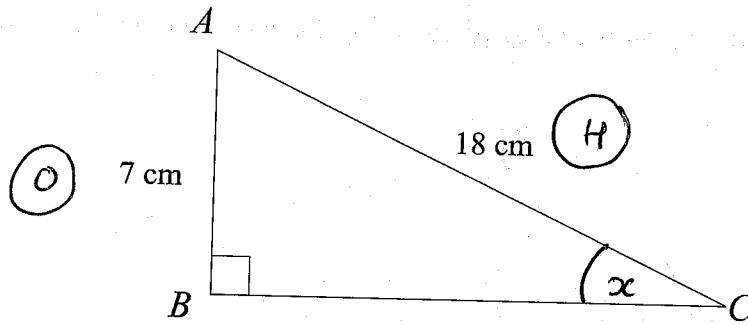
$$0.7 \times 0.8$$

0.56

(2)

(Total for Question 4 is 4 marks)

5



Calculate the size of angle  $ACB$ .

$$\sin x = \frac{0}{4}$$

$$\sin x = \frac{7}{18}$$

$$x = \sin^{-1}\left(\frac{7}{18}\right)$$

$$= 22.885 \dots$$

22.9°

(Total for Question 5 is 2 marks)

6 (a) Factorise fully  $18a^2b + 12ab^2$

$$\underline{6ab(3a + 2b)}$$

(2)

(b) Expand and Simplify  $5(2y - 5) - 3(2y - 1)$

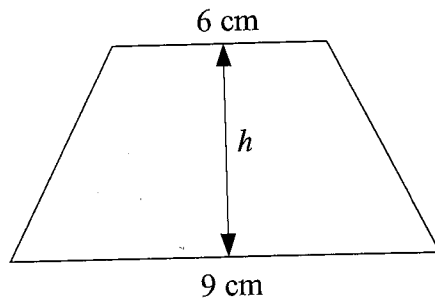
$$10y - 25 - 6y + 3$$

$$\underline{4y - 22}$$

(2)

(Total for Question 6 is 4 marks)

- 7 The diagram shows a trapezium with an area of  $45 \text{ cm}^2$  and a perpendicular height  $h \text{ cm}$ .



Find the value of  $h$ .

$$\frac{1}{2}(6 + 9) \times h = 45$$

$$7.5h = 45$$

$$h = \frac{45}{7.5}$$

$$= 6$$

$$h = \underline{\quad 6 \quad}$$

(Total for Question 7 is 2 marks)

- 8 (a) Write  $7.329 \times 10^6$  as an ordinary number.

$$\underline{7\,329\,000} \quad (1)$$

- (b) Write 0.0508 in standard form.

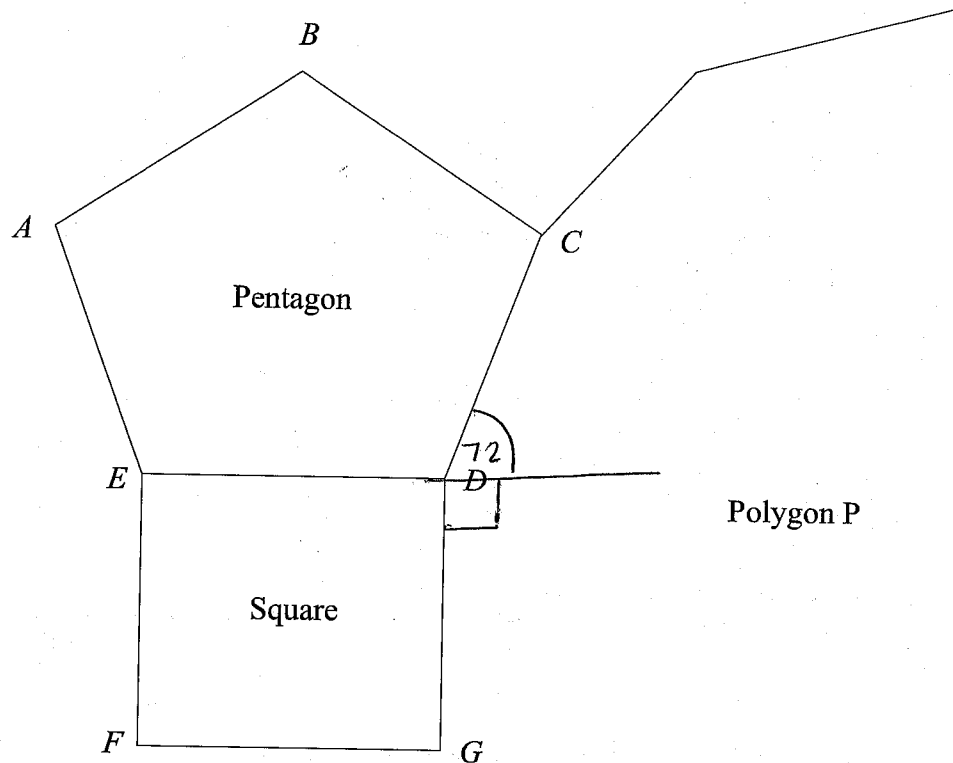
$$\underline{5.08 \times 10^{-2}} \quad (1)$$

- (c) Calculate  $(5.51 \times 10^4) \div (5.8 \times 10^{-3})$   
Give your answer in standard form.

$$9\,500\,000$$

$$\underline{9.5 \times 10^6} \quad (2)$$

(Total for Question 8 is 4 marks)



The diagram shows a regular pentagon, ABCDE, and a square, EDFG.

The lines CD and DG are both sides of another regular polygon, P.

How many sides does polygon P have?

You must show how you got your answer.

$$\text{Exterior angle of pentagon} = \frac{360}{5} = 72$$

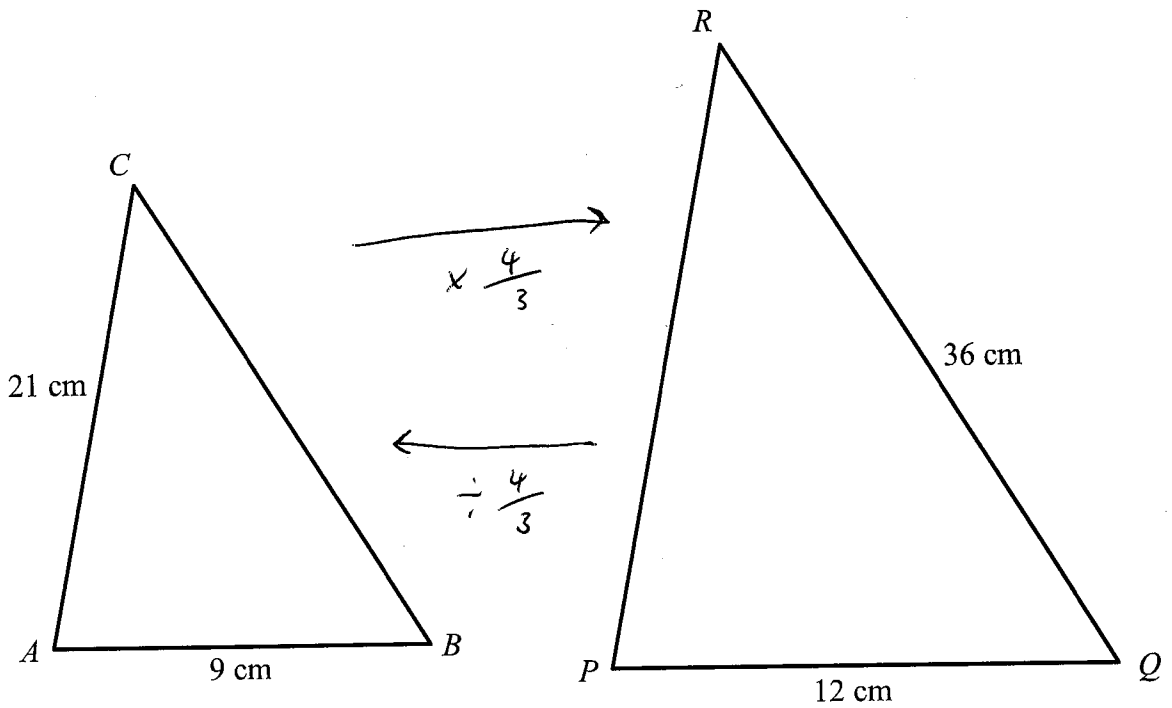
$$\begin{aligned} \text{Interior angle of } P &= 90 + 72 \\ &= 162 \end{aligned}$$

$$\begin{aligned} \text{Exterior angle of } P &= 180 - 162 \\ &= 18^\circ \end{aligned}$$

$$\frac{360}{18} = 20$$

.....20

(Total for Question 9 is 4 marks)



The two triangles  $ABC$  and  $PQR$  are mathematically similar.

Angle  $A =$  angle  $P$

Angle  $B =$  angle  $Q$

$AB = 9$  cm

$AC = 21$  cm

$PQ = 12$  cm

$QR = 36$  cm

$$\text{Scale factor} = \frac{12}{9} = \frac{4}{3}$$

- (a) Calculate the length of  $PR$ .

$$21 \times \frac{4}{3}$$

..... 28 ..... cm  
(2)

- (b) Calculate the length of  $BC$ .

$$36 \div \frac{4}{3}$$

..... 27 ..... cm  
(2)

(Total for Question 10 is 4 marks)



11 A population of bacteria is increasing by 12% each hour.

Find the percentage increase in the population every 3 hours.

$$100 \times 1.12^3 = 140.4928$$

Increase of 40.4928%

.....40.5%.....

(Total for Question 11 is 2 marks)

12 Light A flashes every 5 seconds.  
Light B flashes every 6 seconds.  
Light C flashes every 7 seconds.

All three lights flash at the same time.

How many times in one hour will the three lamps flash at the same time?

$$\begin{aligned} \text{LCM} &= 5 \times 6 \times 7 \\ &= 210 \end{aligned}$$

They flash at the same time every 210 seconds

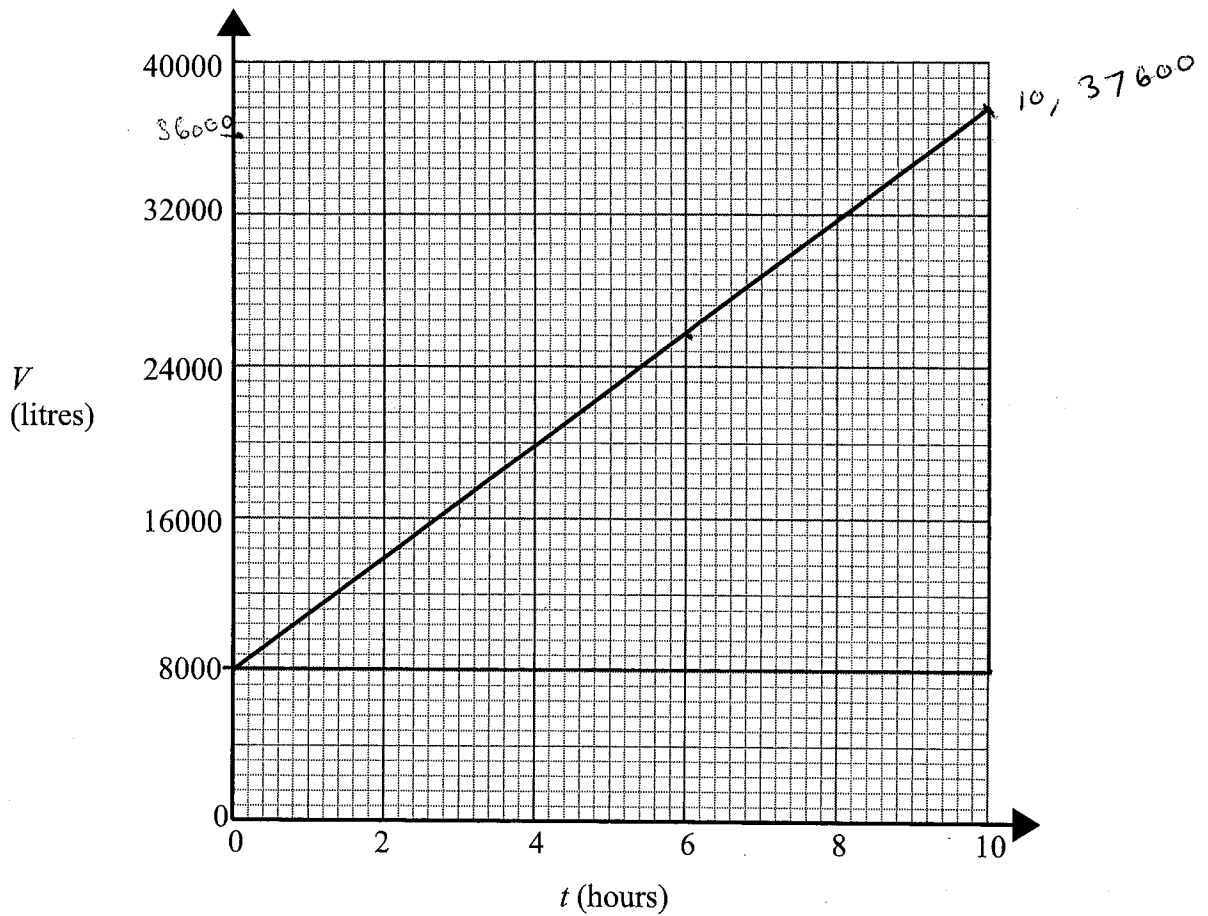
In one hour there are  $60 \times 60 = 3600$  seconds

$$\frac{3600}{210} = 17.14$$

.....18.....  
Either 17 or 18 times

(Total for Question 12 is 3 marks)

- 13 Bernie is filling up a swimming pool.  
The graph shows the volume  $v$  of water in the swimming pool at time  $t$  hours.



Work out the rate of that the water is flowing into the pool.

Give your answer in litres per hour.

$$\frac{37600 - 8000}{10} = 2960 \text{ l/hr}$$

..... 2960 ..... l/hr

(Total for Question 13 is 2 marks)

[2900 - 3000]

14 Cylinder A and cylinder B are mathematically similar.

The surface area of cylinder A is  $50 \text{ cm}^2$  and the ~~length~~ of cylinder B is  $128 \text{ cm}^2$

The volume of cylinder A is  $80 \text{ cm}^3$  surface area

Calculate the volume of cylinder B.

$$\text{Scale factor for area} = \frac{128}{50} = \frac{64}{25}$$

$$\text{scale factor for length} = \frac{8}{5}$$

$$\text{Scale factor for volume} = \frac{512}{125}$$

$$80 \times \frac{512}{125} = 327.68 \text{ cm}^3$$

.....  
327.68 cm<sup>3</sup>

(Total for Question 14 is 3 marks)

- 15 There are 12 people in a room.  
Each person shakes each other person's hand once.

Work out the number handshakes that take place.

$$\frac{12 \times 11}{2} = 66$$

66

(Total for Question 15 is 2 marks)

- 16 By completing the square, find the coordinates of the turning point of the curve with the equation  $y = x^2 - 3x + 1$   
You must show all your working.

$$y = \left(x - \frac{3}{2}\right)^2 - \frac{9}{4} + 1$$

$$y = \left(x - \frac{3}{2}\right)^2 - \frac{5}{4}$$

$\left(\frac{3}{2}, -\frac{5}{4}\right)$

(Total for Question 16 is 3 marks)

17 Here are the first 5 terms of a quadratic sequence.

6                      10                      17                      27                      40

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

$$\begin{array}{r} a+b+c \rightarrow 6 \\ 3a+b \rightarrow 4 \\ 2a \rightarrow 3 \end{array} \quad \begin{array}{r} 10 \\ 7 \\ 3 \end{array} \quad \begin{array}{r} 17 \end{array}$$

$$an^2 + bn + c$$

$$2a = 3$$

$$a = 1.5$$

$$3a + b = 4$$

$$3(1.5) + b = 4$$

$$4.5 + b = 4$$

$$b = -0.5$$

$$a + b + c = 6$$

$$1.5 - 0.5 + c = 6$$

$$1 + c = 6$$

$$c = 5$$

$$\underline{1.5n^2 - 0.5n + 5}$$

(Total for Question 17 is 4 marks)

18 Given that

$$x+9 : 5x-1 = x+7 : 2x-3$$

Find the possible values of  $x$ .

$$\frac{x+9}{5x-1} = \frac{x+7}{2x-3}$$

$$(x+9)(2x-3) = (x+7)(5x-1)$$

$$2x^2 - 3x + 18x - 27 = 5x^2 - x + 35x - 7$$

$$2x^2 + 15x - 27 = 5x^2 + 34x - 7$$

$$0 = 3x^2 + 19x + 20$$

$$0 = (3x+4)(x+5)$$

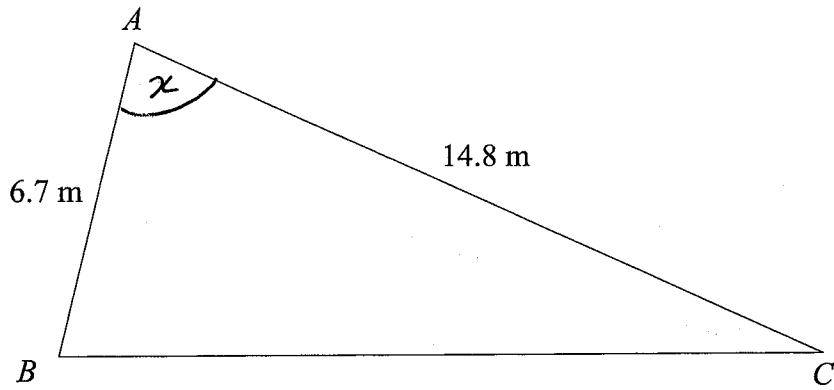
$$x = -\frac{4}{3} \quad x = -5$$

$$x = -\frac{4}{3} \text{ or } -5$$

---

(Total for Question 18 is 4 marks)

19



Angle  $BAC$  is acute and the area of the triangle is  $45 \text{ m}^2$   
 Calculate the perimeter of triangle  $ABC$ .  
 Give your answer to 3 significant figures.

$$\frac{1}{2} ab \sin C = 45$$

$$\frac{1}{2} (6.7)(14.8) \sin x = 45$$

$$49.58 \sin x = 45$$

$$\sin x = \frac{45}{49.58}$$

$$x = \sin^{-1}\left(\frac{45}{49.58}\right)$$

$$= \underline{\underline{65.179^\circ}}$$

$$BC^2 = 6.7^2 + 14.8^2 - 2(6.7)(14.8) \cos(65.179)$$

$$= 180.678$$

$$BC = \sqrt{180.678}$$

$$= 13.4 \text{ m} \quad 3\text{sf}$$

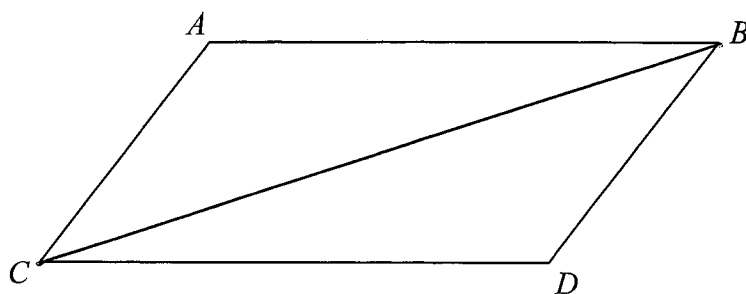
$$\text{perimeter} = 6.7 + 14.8 + 13.4$$

$$= 34.9 \text{ m}$$

.....34.9.....m

(Total for Question 19 is 5 marks)

20  $ABCD$  is a parallelogram



Prove that <sup>tri</sup>angle  $ABC$  ~~is equal to~~ <sup>and tri</sup>angle  $BCD$  are congruent.

$AB = CD$  opposite sides of a parallelogram  
are equal

$AC = BD$       \_\_\_\_\_ " \_\_\_\_\_

$BC$  is common to both triangles

SSS

(Total for Question 20 is 3 marks)



21 (a) Show that the equation  $x^3 + 4x = 1$  has a solution between  $x = 0$  and  $x = 1$ .

$$(0)^3 + 4(0) = 0$$

$$(1)^3 + 4(1) = 5$$

1 is between 0 and 5 (and the function is continuous)  $\therefore$  solution between 0 and 1. (2)

(b) Show that the equation  $x^3 + 4x = 1$  can be rearranged to give:  $x = \frac{1}{4} - \frac{x^3}{4}$

$$x^3 + 4x = 1$$

$$4x = 1 - x^3$$

$$x = \frac{1}{4} - \frac{x^3}{4}$$

(1)

(c) Starting with  $x_0 = 0$ , use the iteration formula  $x_{n+1} = \frac{1}{4} - \frac{x_n^3}{4}$  twice to find an estimate for the solution to  $x^3 + 4x = 1$

$$x_1 = \frac{1}{4} - \frac{(0)^3}{4} = \frac{1}{4}$$

$$x_2 = \frac{1}{4} - \frac{\text{Ans}^3}{4} = \frac{63}{256} = 0.24609375$$

$$\begin{array}{r} 63 \\ \hline 256 \end{array}$$

(3)

(Total for Question 21 is 6 marks)

22 50 people were asked which fruits they liked from apples, bananas and oranges.

12 people like all three fruits.

34 people like apples.

7 like apples and bananas but not oranges.

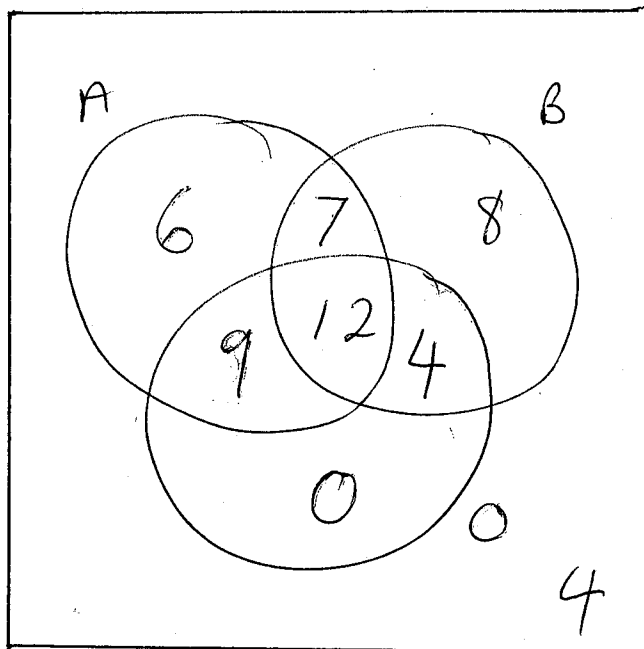
16 like bananas and oranges.

4 of the people do not like any of the fruits.

All 25 people who like oranges like at least one other fruit.

Two of the 50 people are chosen at random.

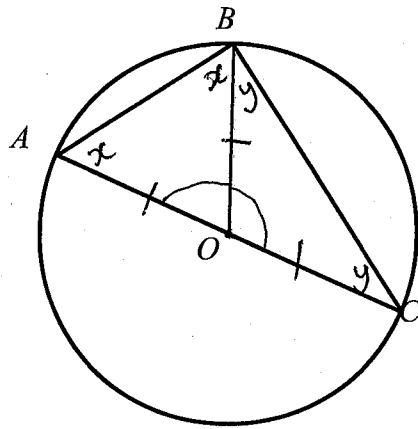
Work out the probability that they both like bananas.



$$\frac{8}{50} \times \frac{7}{49} = \frac{4}{175}$$

$$\frac{4}{175}$$

(Total for Question 22 is 5 marks)



Angles at the base of an isosceles triangle are equal

$A, B$  and  $C$  are points on the circumference of a circle, centre  $O$ .  
 $AOC$  is a diameter of the circle.

Prove that angle  $ABC$  is  $90^\circ$

You must **not** use any circle theorems in your proof.

$$\text{Let } \angle ABO = x \qquad \text{Let } \angle OBC = y$$

$$\underline{\underline{\angle ABC = x + y}}$$

$$\angle AOB = 180 - 2x$$

$$\angle BOC = 180 - 2y$$

$$\angle AOB + \angle BOC = 180$$

Angles on a straight line add to  $180^\circ$

$$180 - 2x + 180 - 2y = 180$$

$$360 - 2x - 2y = 180$$

$$360 = 180 + 2x + 2y$$

$$180 = 2x + 2y$$

$$\underline{\underline{90 = x + y}}$$

$$\angle ABC = x + y \quad \therefore \angle ABC = 90^\circ$$

(Total for Question 23 is 4 marks)