



Please write clearly in block capitals.

Centre number

Candidate number

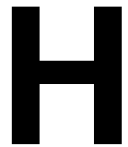
Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS



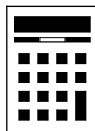
Higher Tier Paper 3 Calculator

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

For Examiner's Use	
Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24–25	
26–27	
TOTAL	

Advice

In all calculations, show clearly how you work out your answer.



JUN2283003H01

Answer **all** questions in the spaces provided.

1 Circle the smallest number.

[1 mark]

4.31

 $4.\dot{3}$ $4.3\bar{3}$

4.301

4.33



2 Work out

$$\begin{pmatrix} -4 \\ 8 \end{pmatrix} - \begin{pmatrix} 3 \\ -2 \end{pmatrix} = \begin{pmatrix} -7 \\ 10 \end{pmatrix}$$

Circle your answer.

[1 mark]

$$\begin{pmatrix} -7 \\ 10 \end{pmatrix}$$



$$\begin{pmatrix} -7 \\ 6 \end{pmatrix}$$

$$\begin{pmatrix} -1 \\ 10 \end{pmatrix}$$

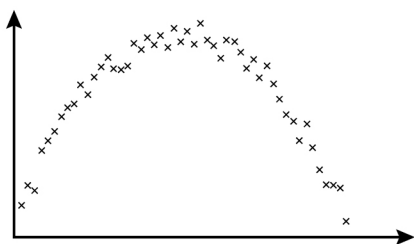
$$\begin{pmatrix} -1 \\ 6 \end{pmatrix}$$



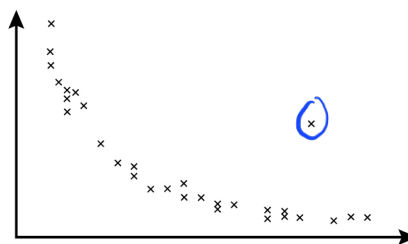
Do not write outside the box

3 Here are four scatter graphs.

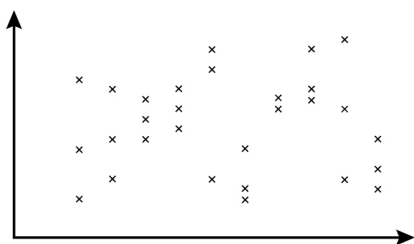
Graph A



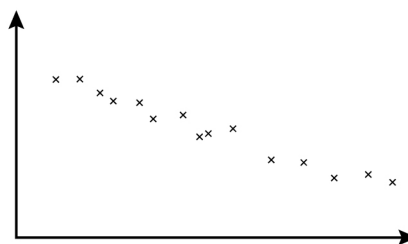
Graph B



Graph C



Graph D



3 (a) For which graph is a straight line of best fit appropriate?
Circle your answer.

[1 mark]

A

B

C

D

⚠

3 (b) Which graph has **one** outlier?
Circle your answer.

[1 mark]

A

B

⚠

C

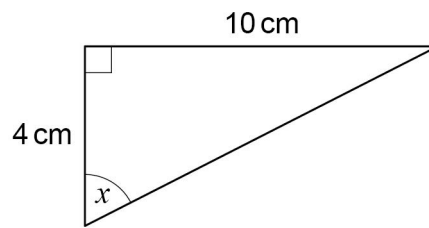
D

4

Turn over ►



- 4 Use trigonometry to work out the size of angle x .



Not drawn
accurately

$$\tan x^\circ = \frac{10}{4}$$

$$x^\circ = \tan^{-1} 2.5$$

$$= 68.1^\circ$$

[3 marks]

$$x = 68.1^\circ$$



5

Laura works in a shop.

The table shows the number of hours she works on two weekends.

	Saturday	Sunday
Weekend 1	3	2
Weekend 2	$5\frac{1}{2}$	$3\frac{1}{2}$

Work out the percentage increase in her **total** hours from Weekend 1 to Weekend 2**[3 marks]**

$$\text{Weekend 1 : } 3 + 2 = 5 \text{ hours } \textcircled{1}$$

$$\text{Weekend 2 : } 5.5 + 3.5 = 9 \text{ hours}$$

$$9 \text{ hours} - 5 \text{ hours} = 4 \text{ hours}$$

$$\% \text{ increase} = \frac{4}{5} \times 100\% = 80\% \textcircled{1}$$

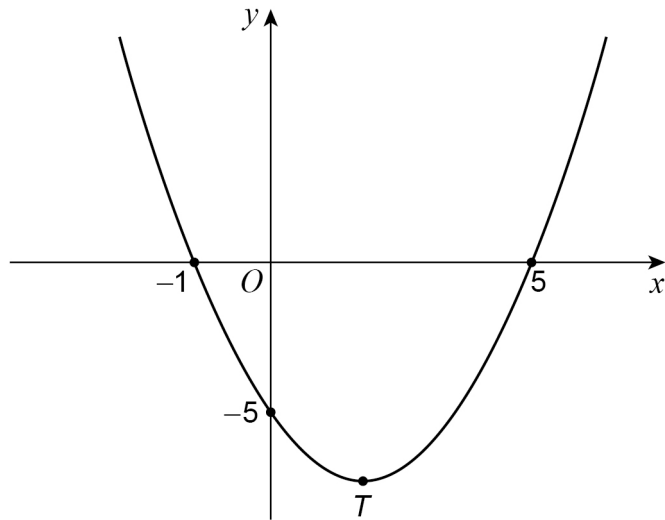
Answer 80 $\textcircled{1}$ %

Turn over for the next question

Turn over ►



- 6 Here is a sketch of the curve $y = x^2 - 4x - 5$



- 6 (a) Write down the **two** roots of $x^2 - 4x - 5 = 0$

[1 mark]

Answer -1 and 5 ⁽¹⁾

- 6 (b) Work out the coordinates of T , the turning point of the curve.

[2 marks]

$$y = (x-2)^2 - 4 - 5$$

$$y = (x-2)^2 - 9$$

Answer (2 , -9) ⁽²⁾



7

A is an **arithmetic** progression.

Here are the first four terms.

13 16 19 22

G is a **geometric** progression.

Here are the first four terms.

2 4 8 16

 n th term of A = 8th term of G
Work out the value of n .**[4 marks]**

$$A : a = 13, d = 3 \quad (1)$$

$$G : a = 2, r = 2$$

$$G : T_8 = 2 \times 2^7 = 256 \quad (1)$$

$$256 = 13 + (n-1)3 \quad (1)$$

$$243 = (n-1)3$$

$$n-1 = 81$$

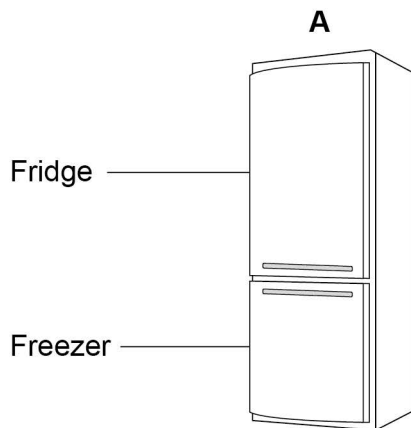
$$n = 82 \quad (1)$$

$$n = \underline{\quad 82 \quad}$$

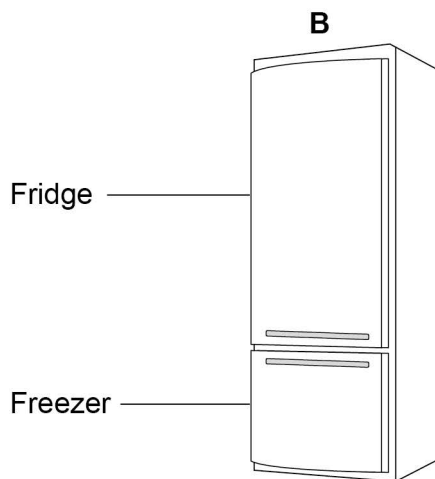


8

Information about two fridge-freezers, A and B, is shown.

**Total** capacity is 330 litres

fridge capacity : freezer capacity = 3 : 2

**Fridge** capacity is 294 litres

fridge capacity : freezer capacity = 7 : 3



Grace buys one of these fridge-freezers.

She buys the one with the greater **freezer** capacity.

Which one does she buy?

You **must** show your working.

[4 marks]

$$A: \frac{2}{3+2} \times 330 = \frac{2}{5} \times 330 = 132 \quad (1)$$

$$B: \frac{294}{7} \times 3 = 126 \quad (1)$$

Grace buys A. (1)

Answer A

Turn over for the next question



9

Tom and Adil are the two runners in a 200-metre race.

Tom completes the race in 24 seconds.

Adil completes the race at an average speed of 28.8 kilometres per hour.

Who wins the race?

You **must** show your working.

[3 marks]

speed in m/s :

$$\text{Tom} = \frac{200 \text{ m}}{24 \text{ s}} = 8.33 \text{ ms}^{-1} \quad (1)$$

$$\text{Adil} = \frac{28.8 \text{ km}}{1 \text{ hour}} \times \frac{1000 \text{ m}}{1 \text{ km}} \times \frac{1 \text{ hour}}{3600 \text{ s}}$$

$$= 8 \text{ ms}^{-1} \quad (1)$$

Tom wins.

(1)

Answer Tom



10 The mass of a baby is 3.6 kilograms to 1 decimal place.

What is the error interval for the mass in kilograms?

Tick **one** box.

[1 mark]

$3.5 \leq \text{mass} \leq 3.6$

$3.55 \leq \text{mass} \leq 3.65$

$3.5 \leq \text{mass} < 3.6$

$3.55 \leq \text{mass} < 3.65$



11 A quadrilateral has angles 70° , 110° , 130° and 50°

Circle the possible type of quadrilateral.

[1 mark]

kite

parallelogram

rhombus

trapezium



Turn over for the next question

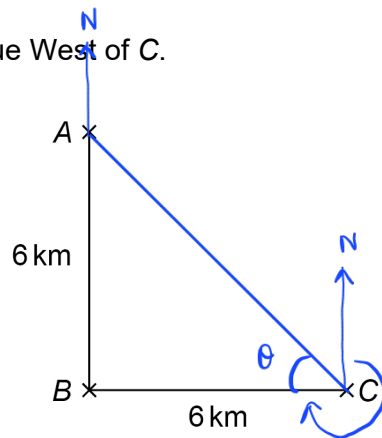


12 (a) B is

6 km due South of A

and

6 km due West of C.

Not drawn
accurately

Work out the bearing of A from C.

[2 marks]

$$\tan \theta = \frac{6}{6} = 1$$

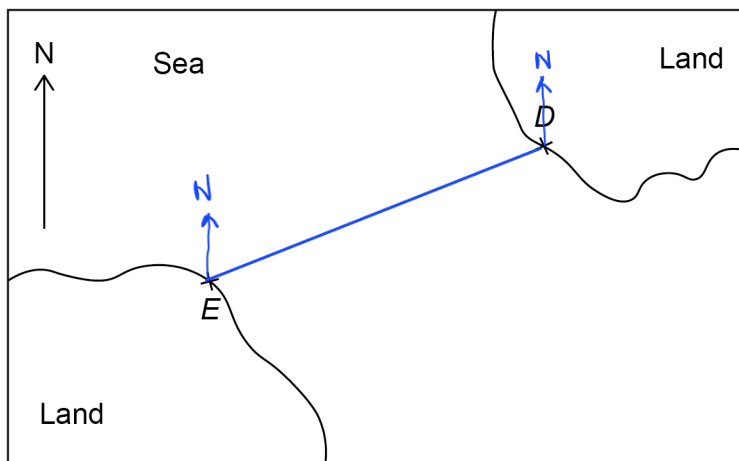
$$\theta = \tan^{-1} 1 = 45^\circ \text{ (1)}$$

$$\text{Bearing} = 180^\circ + 90^\circ + 45^\circ = 315^\circ \text{ (1)}$$

Answer 315 °

Do not write outside the box

12 (b) Here is a scale drawing.



A ship is going to sail from D to E .

Mia works out that the ship needs to sail on a bearing of 068°

Why must Mia be wrong?

[1 mark]

068° is bearing of D from E. (1)

13 Simplify $\sqrt{5}a + \sqrt{5}a$

Circle your answer.

[1 mark]

$5a$

$5a^2$

$2\sqrt{5}a$ (1)

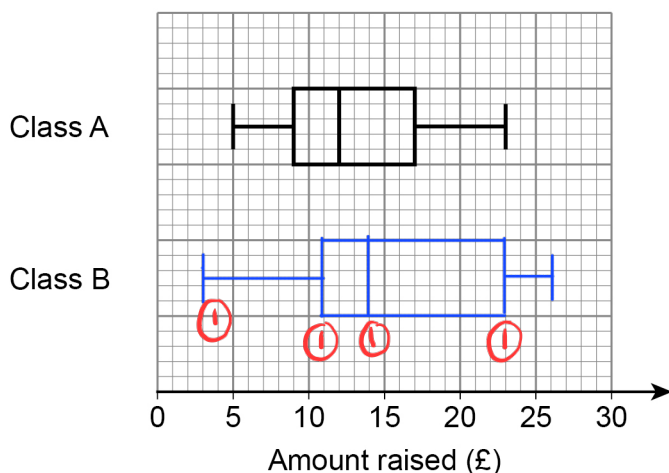
$\sqrt{10}a$

4

Turn over ►



14 Students in two classes, A and B, raised money for charity.
The box plot for class A is shown on the grid.



For class B,

- the lowest amount was £3 and the highest amount was £26
- the lower quartile was £11
- the median was £2 greater than the class A median
- the interquartile range was $1\frac{1}{2}$ times greater than the class A interquartile range.

Draw the box plot for class B on the grid.

[4 marks]

$$\text{Median}_B = 12 + 2 = 14$$

$$\text{IQR}_B = 1.5 \times \text{IQR}_A$$

$$= 1.5 \times (17 - 9) = 12$$

$$\text{Upper quartile}_B = 11 + 12 = 23$$



15

A town has

a population density of 278 people per km²

and

a population of 158 460

$$\text{population density} = \frac{\text{population}}{\text{area}}$$

The population increases to 168 720

Work out the population density after the increase.

[3 marks]

$$\text{Area} = \frac{158\,460}{278} = 570 \quad (1)$$

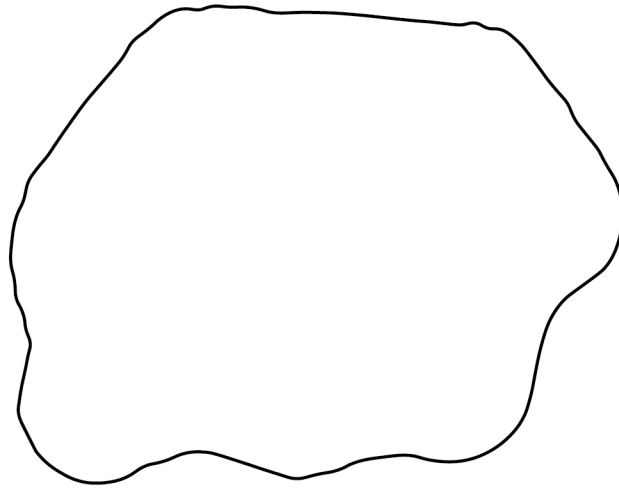
$$\text{population density after increase} = \frac{168\,720}{570} \quad (1)$$

$$= 296 \quad (1)$$

Answer 296 people per km²

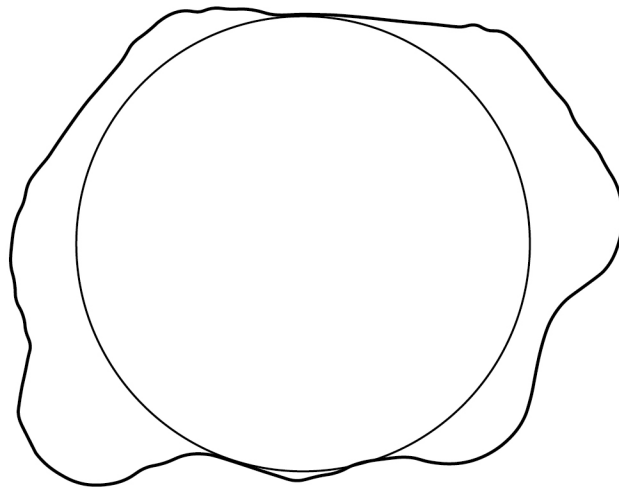
16 Here is a scale drawing of a reservoir.

Scale: 1 cm represents 500 m



Virat wants to estimate the volume of water in the reservoir.

He draws on the scale drawing a circle with radius 3 cm



- 16 (a) Virat estimates the volume of the reservoir by assuming that
- the reservoir is a cylinder whose cross section is the circle
 - the depth of the reservoir is 17 metres.

Work out Virat's estimate in cubic metres.

[3 marks]

$$\text{Actual radius} = 3 \times 500 = 1500 \text{ m} \quad (1)$$

$$\text{Volume} = \pi \times 1500^2 \times 17 \quad (1)$$

$$= 38\,250\,000 \pi \text{ m}^3$$

$$= 120\,181\,500 \text{ m}^3$$

$$= 1.2 \times 10^8 \text{ m}^3 \quad (1)$$

Answer 1.2×10^8 m³

- 16 (b) In fact,
- the depth of the reservoir is 13.8 metres
 - the reservoir is **not** a cylinder (see diagram).

Which statement about the actual volume of the reservoir is correct?

Tick **one** box.

It is less than Virat's estimate

It is greater than Virat's estimate

(1) It could be less than or greater than Virat's estimate

Give a reason for your answer.

[2 marks]

The area is larger but the depth is smaller

(1)



- 17** In a video game, players make their own character.
They choose one of each from
- 8 faces
 - 4 bodies
 - 5 hairstyles.

- 17 (a)** How many different characters can be made?

[2 marks]

$$8 \times 4 \times 5 = 160$$

① ①

Answer 160

- 17 (b)** Two characters are made at random.

What is the probability that they are exactly the same?

[1 mark]

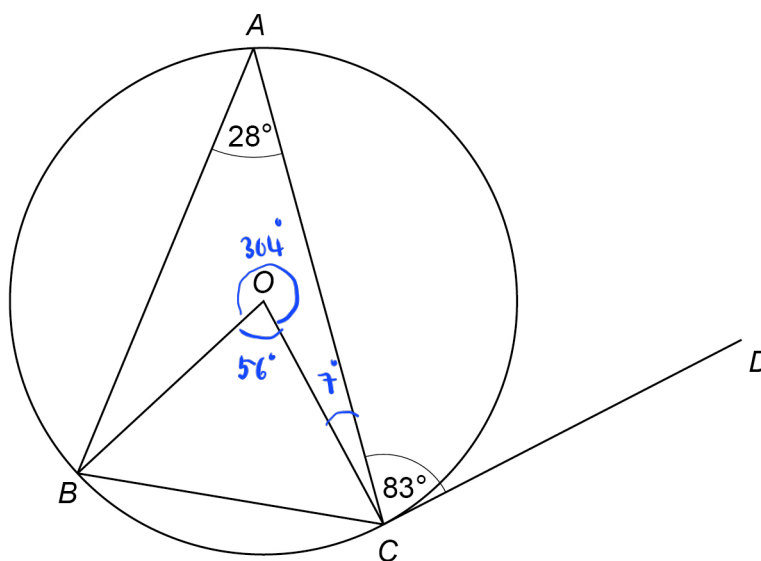
$$\frac{1}{160}$$

①

Answer $\frac{1}{160}$



18 A, B and C are points on a circle, centre O.
DC is a tangent to the circle.



Not drawn accurately

Show that angle ABO : angle ACO = 3 : 1

[5 marks]

$$ACO = 90 - 83 = 7^\circ \quad (1)$$

$$BOC \text{ (small)} = 2 \times 28^\circ = 56^\circ \quad (1)$$

$$BOC \text{ (large)} = 360^\circ - 56^\circ = 304^\circ \quad (1)$$

$$ABO^\circ = 360^\circ - 304^\circ - 7^\circ - 28^\circ$$

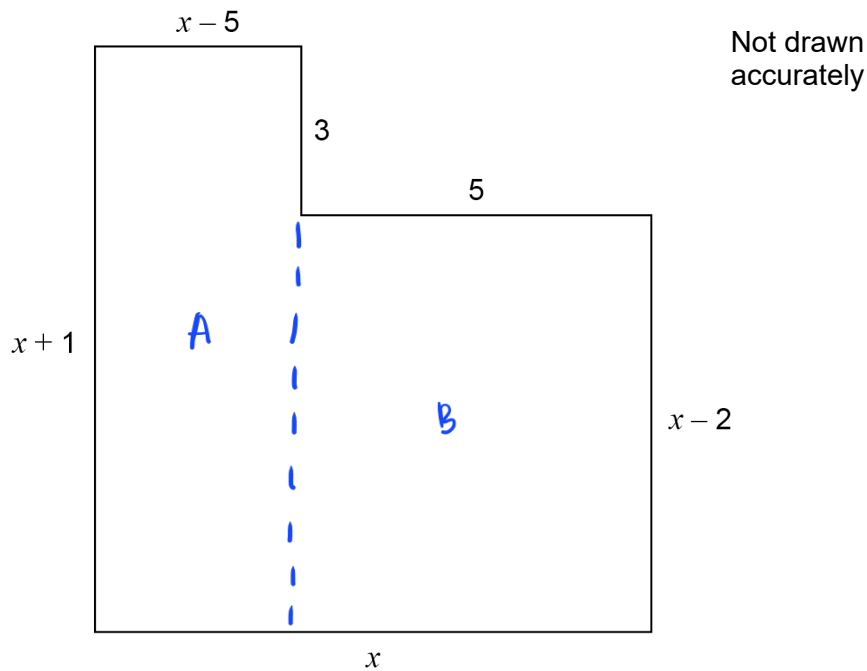
$$= 21^\circ \quad (1)$$

$$ABO : ACO = 21 : 7 \quad \downarrow \div 7$$

$$3 : 1 \quad (1)$$



- 19 Here is the plan of the floor of an L-shaped room.
All lengths are in metres.



- 19 (a) The area of the floor is 75m^2

Show that $x^2 + x - 90 = 0$

[3 marks]

$$\text{Area of A : } (x-5)(x+1) = x^2 - 4x - 5 \quad (1)$$

$$\text{Area of B : } 5(x-2) = 5x - 10$$

$$x^2 - 4x - 5 + 5x - 10 = 75 \quad (1)$$

$$x^2 + x - 15 - 75 = 0 \quad (1)$$

$$x^2 + x - 90 = 0$$



19 (b) By factorising $x^2 + x - 90$ work out the value of x .

You **must** show your working

[2 marks]

$$(x-9)(x+10) \quad (1)$$

$$x = 9 \text{ or } x = -10$$

$x = 9$ only since length can't be negative

$$x = \underline{9} \quad (1)$$

20 £2448 is invested in an account at a rate of compound interest.
One year after the investment there is £2496.96 in the account.

How much is in the account four years after the investment?

[3 marks]

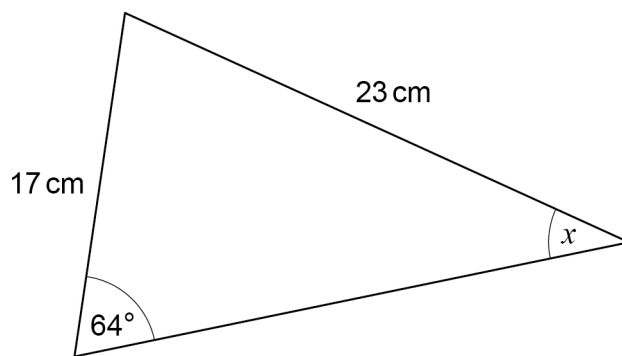
$$\frac{2496.96 - 2448}{2448} = \frac{48.96}{2448} = 0.02 = 2\% \quad (1)$$

$$2448 \times 1.02^4 = 2649.79 \quad (1)$$

Answer £ 2649.79



21

Not drawn
accuratelyUse the sine rule to work out the size of angle x .

[3 marks]

$$\frac{\sin x^\circ}{17} = \frac{\sin 64^\circ}{23}$$

$$\sin x^\circ = \frac{\sin 64^\circ}{23} \times 17 \quad (1)$$

$$x^\circ = \sin^{-1} \frac{17 \sin 64^\circ}{23} \quad (1)$$

$$= \sin^{-1} 0.664\dots = 41.3$$

$$x = \underline{41.3} \quad (1)$$

22

$$f(x) = 3x \quad \text{and} \quad g(x) = x^2$$

Circle the expression for $fg(x)$

[1 mark]

$$\textcircled{3x^2} \quad (1)$$

$$9x^2$$

$$3x^3$$

$$9x^4$$



23

Here are two simultaneous equations.

$$y = x^2 + 7x - c$$

and

$$y = 3x + d$$

There is a solution when $x = 5$ Work out the value of $c + d$ **[3 marks]**

$$x^2 + 7x - c = 3x + d \quad (1)$$

$$x^2 + 7x - 3x = c + d \quad (1)$$

$$x^2 + 4x = c + d$$

$$(5)^2 + 4(5) = c + d$$

$$25 + 20 = c + d$$

$$45 = c + d \quad (1)$$

Answer 45

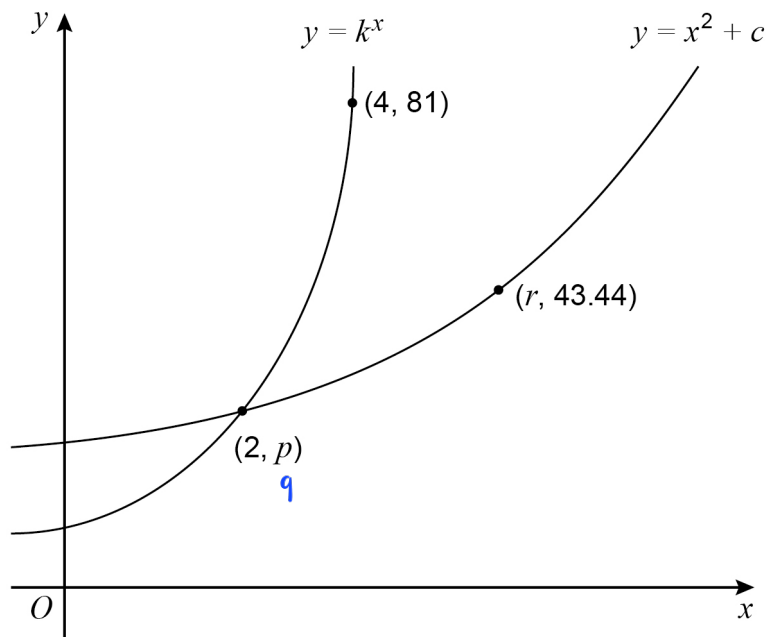
Turn over for the next question

Turn over ►



24

Here is a sketch of the graphs of $y = k^x$ and $y = x^2 + c$
 k and c are positive constants.



Work out the value of r .

[4 marks]

$$\text{Using point } (4, 81) : 81 = k^4$$

$$k = 3 \quad (1)$$

$$y = 3^x$$

$$\text{when } x = 2, y = 3^2 = 9 \quad (p = 9)$$

$$\text{Using point } (2, 9) : 9 = 2^2 + c$$

$$c = 5 \quad (1), y = x^2 + 5$$

$$\text{When } y = 43.44, 43.44 = x^2 + 5 \quad (1)$$

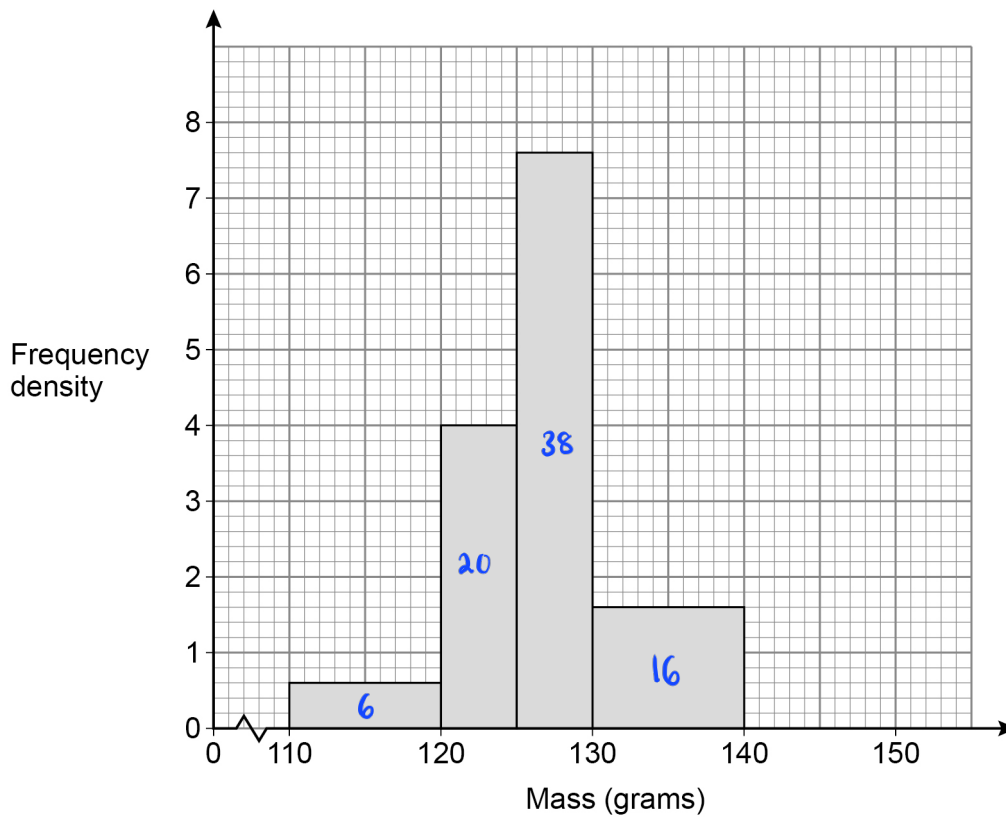
$$x^2 = 38.44$$

$$x = 6.2 \quad \therefore r = 6.2$$

$$r = \underline{\quad 6.2 \quad (1) \quad}$$



25 A company makes tubes of toothpaste.
The masses of 80 tubes are checked.
A histogram is drawn to represent the data.



The company makes 28 000 tubes each day.

Estimate how many tubes each day have a mass **less than** 122 grams.

[4 marks]

$$10 \times 0.6 = 6$$

$$2 \times 4 = 8$$

$$6 + 8 = 14$$

$$\frac{14}{80} \times 28\,000 = 4900$$

Answer

4900



26 Q and R are two numbers.

As a product of prime factors,

$$Q = 2^3 \times 3 \times a^3$$

$$R = 2^4 \times 3^2 \times a^2$$

26 (a) The highest common factor (HCF) of Q and R is 4056

Work out the value of a .

[2 marks]

$$\text{HCF of } Q \text{ and } R = 2^3 \times 3 \times a^2 = 4056$$

$$8 \times 3 \times a^2 = 4056$$

$$24 a^2 = 4056 \quad (1)$$

$$a^2 = 169$$

$$a = 13$$

$$a = \underline{\quad 13 \quad}$$

26 (b) Work out the lowest common multiple (LCM) of Q and R .

[2 marks]

$$\text{LCM of } Q \text{ and } R = 2^4 \times 3^2 \times a^3 \quad (1)$$

$$= 2^4 \times 3^2 \times 13^3$$

$$= 16 \times 9 \times 2197$$

$$= 316\,368 \quad (1)$$

$$\text{Answer } \underline{\quad 316\,368 \quad}$$



27 Expand and simplify fully $(x - 3)(x - 4)(x + 8)$

[3 marks]

$$(x-3)(x-4) = x^2 - 7x + 12 \quad (1)$$

$$(x^2 - 7x + 12)(x + 8) = x^3 + 8x^2 - 7x^2 - 56x + 12x + 96 \quad (1)$$

$$= x^3 + x^2 - 44x + 96 \quad (1)$$

Answer $x^3 + x^2 - 44x + 96$

END OF QUESTIONS



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