

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname StemUp Model Solution

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier

Paper 2 Calculator

Friday 10 November 2023

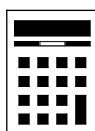
Morning

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.

Advice

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

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	
TOTAL	



N 0 V 2 3 8 3 0 0 2 H 0 1

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

Do not write
outside the
box

1 Expand $5x(x^2 + 3)$

[1 mark]

$$5x \times x^2 + 5x \times 3$$

Answer $5x^3 + 15x$

2 (a) Write 1.52 as an improper fraction in its simplest form.

[1 mark]

$$1.52 = \frac{152}{100} = \frac{38}{25}$$

Answer $\frac{38}{25}$

2 (b) Work out 60 as a percentage of 20

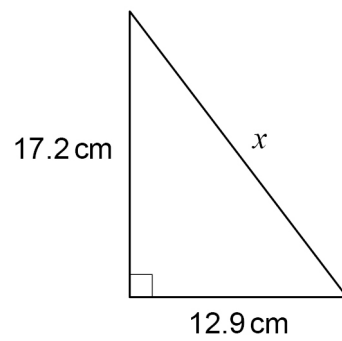
[1 mark]

$$60 \div 20 \times 100 = 300$$

Answer 300 %



3

Use Pythagoras' theorem to work out the value of x .**[3 marks]**Not drawn
accurately

$$x^2 = 12.9^2 + 17.2^2$$

$$x^2 = 166.41 + 295.84$$

$$x^2 = 462.25$$

$$x = \sqrt{462.25}$$

$$x = 21.5$$

$$x = \underline{\quad 21.5 \quad} \text{ cm}$$

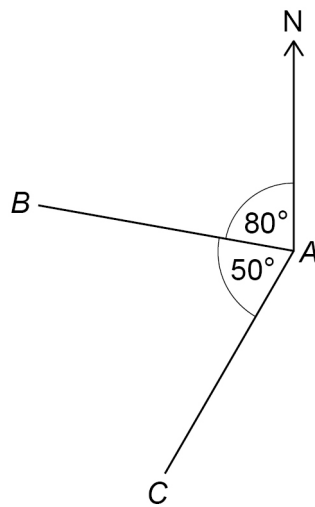
Turn over for the next question

Turn over ►



4

A , B and C are three points.



Not drawn
accurately

Work out the bearing of C from A .

[1 mark]

$$360 - 80 - 50 = 230$$

Answer 230 °



5

Three shops sell the same type and size of lip balm stick.

Shop A



£2.39 each

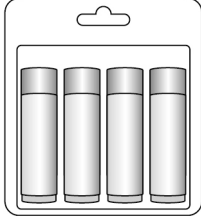
Shop B



£3.08 each

Buy one,
get one half price

Shop C



Pack of 4

Was £11.40

Now $\frac{1}{6}$ off

Which shop is the best value for 8 sticks and what is the total cost in that shop?

Show working to support your answer.

[5 marks]

$$\text{Shop A: } 8 \times £2.39 = £19.12$$

$$\text{Shop B: } 2 \text{ sticks} = 3.08 + 3.08 \div 2 = 3.08 + 1.54 = £4.62$$

$$8 \text{ sticks} = 4 \times 4.62 = £18.48$$

$$\text{Shop C: } 1/6 \text{ off: } 11.40 \div 6 = £1.90$$

$$1 \text{ pack of 4} = 11.40 - 1.90 = £9.50$$

$$8 \text{ sticks} = 2 \times 9.50 = £19.00$$

$$£18.48 < £19.00 < £19.12$$

so Shop B is the best value

Shop B Total cost £ 18.48

Turn over ►



6 Round 1 of voting for Head Student is taking place in a school.

6 (a) To reach round 2, a student must receive **at least** $\frac{4}{15}$ of the votes.

What is the largest possible number of students that can reach round 2?

Circle your answer.

[1 mark]

15

11

3

4

6 (b) There are 900 votes in round 1

Sean receives 180 votes.

Amy draws a pie chart to represent the results.

Here is her method to work out the angle needed for Sean.

$$180 \div 900 \times 100 = 20$$

The angle should be 20°

Is Amy's method correct?

Tick a box.

Yes

☐

No

☒

Give a reason for your answer.

[1 mark]

No. Her method gives the percentage (20%), not the angle.

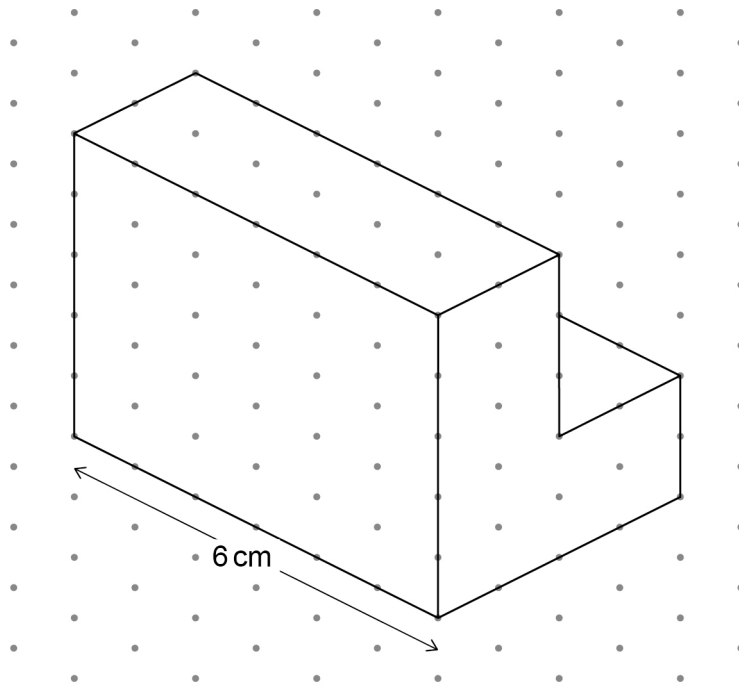
She should multiply by 360, not 100:

$$180 \div 900 \times 360 = 72^\circ$$



7

Here is a prism drawn on an isometric grid.



Work out the volume of the prism.

[3 marks]*Split the L-shaped cross-section into two rectangles:*

$$\text{Area} = 2 \times 5 + 2 \times 2$$

$$= 10 + 4 = 14 \text{ cm}^2$$

Volume = area of cross-section $\times$ length

$$= 14 \times 6$$

$$= 84$$

Answer 84 cm³

Turn over ►



8

Tasha drove 198 miles.

Her average speed for the first 3 hours was 45 miles per hour.

Her average speed for the rest of the journey was 31.5 miles per hour.

Work out her average speed for the whole journey.

[4 marks]

$$\text{First 3 hours: distance} = 3 \times 45 = 135 \text{ miles}$$

$$\text{Rest of journey: } 198 - 135 = 63 \text{ miles}$$

$$\text{Time} = 63 \div 31.5 = 2 \text{ hours}$$

$$\text{Total time} = 3 + 2 = 5 \text{ hours}$$

$$\text{Average speed} = \text{total distance} \div \text{total time}$$

$$= 198 \div 5$$

$$= 39.6$$

Answer 39.6 miles per hour

9

Here is the term-to-term rule for a sequence.

Double the previous term and add 3

The first three terms of the sequence are $a + 1$ $2a + 5$ $4a + 13$

Show that the sum of the first **four** terms is a multiple of 3

[3 marks]

$$4\text{th term} = 2(4a + 13) + 3 = 8a + 29$$

$$\text{Sum} = (a + 1) + (2a + 5) + (4a + 13) + (8a + 29)$$

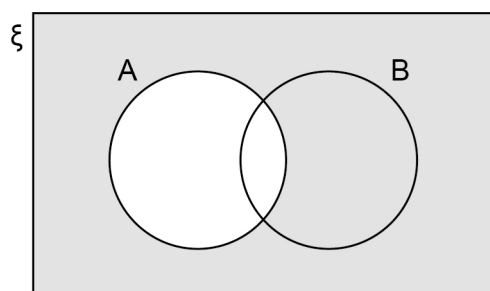
$$= 15a + 48$$

$$= 3(5a + 16)$$

3 is a factor ($15 = 3 \times 5$ and $48 = 3 \times 16$),

so the sum is a multiple of 3

10



Which of these represents the shaded region?

Circle your answer.

[1 mark]

B

 $A' \cup B$ $A' \cap B$
☒ A'

Turn over ►



11

A fair coin is thrown a number of times.

The probability that **every** throw results in Heads is $\frac{1}{64}$

How many times is the coin thrown?

[1 mark]

$$2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6 = 64$$

Answer 6

12

Here is some information about the members of a basketball club.

	Number of members	Mean height of members
Junior	30	1.6 m
Senior	20	2.05 m

Work out the mean height of all 50 members of the club.

Give your answer as a decimal.

[3 marks]

$$\text{Junior total} = 30 \times 1.6 = 48 \text{ m}$$

$$\text{Senior total} = 20 \times 2.05 = 41 \text{ m}$$

$$\text{Total height} = 48 + 41 = 89 \text{ m}$$

$$\text{Mean} = 89 \div 50$$

$$= 1.78$$

Answer 1.78 m



- 13 A straight line passes through (3, 14) and (12, 32)

Work out the equation of the line.

Give your answer in the form $y = mx + c$

[3 marks]

$$m = \frac{32 - 14}{12 - 3} = \frac{18}{9} = 2$$

$$y = 2x + c$$

$$\text{At } (3, 14): 14 = 2 \times 3 + c$$

$$c = 14 - 6 = 8$$

$$y = 2x + 8$$

Answer $y = 2x + 8$

Turn over for the next question

Turn over ►

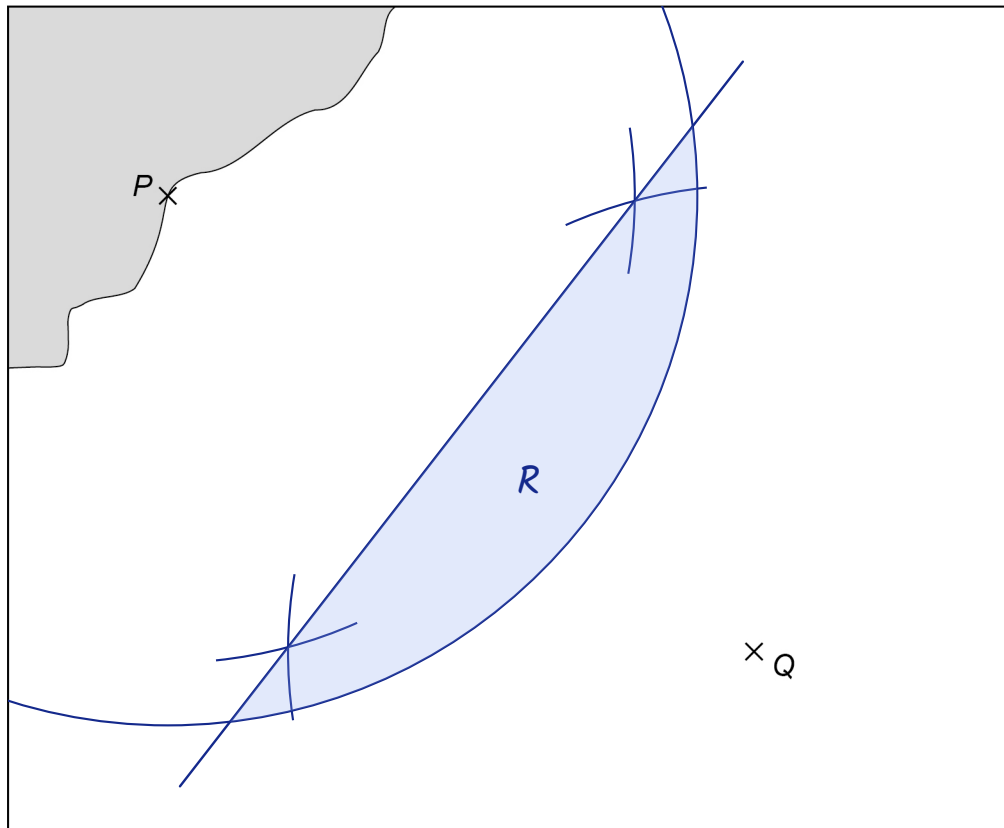


14

Use a ruler and compasses in this question.

The scale diagram shows port P and lighthouse Q .

Scale: 1 cm represents 2 km



A ship is

less than 14 km from P

and

closer to Q than to P .

Label the region, R , where the ship could be.

Show all your construction lines.

[4 marks]



- 15 A bag contains discs.

Trial

A disc is chosen at random from the bag.

The colour of the disc is noted.

The disc is put back into the bag.

The trial is carried out 100 times.

The table shows the relative frequency of a blue disc after every 25 trials.

Total number of trials	25	50	75	100
Relative frequency of a blue disc	0.4	0.36	0.4	0.32

- 15 (a) For the trials from the 26th to the 50th, how many times was a blue disc chosen?

[2 marks]

After 25 trials: $0.4 \times 25 = 10$ blue

After 50 trials: $0.36 \times 50 = 18$ blue

Trials 26 to 50: $18 - 10 = 8$

Answer 8

- 15 (b) There is a total of 1000 discs in the bag.

Work out the **best** estimate of the number of blue discs in the bag.

[1 mark]

$0.32 \times 1000 = 320$ (uses all 100 trials)

Answer 320



16 $a > 0$ and $b < 0$

Circle the correct statement.

[1 mark]

$$a - b < 0$$

$$-\frac{b}{a} < 0$$

$$\frac{1}{a} < 0$$

$$b^3 < 0$$

17 190 people were asked how much they spent on takeaways one month.
The table shows information about the results.

Amount, x (£)	Cumulative frequency
$0 < x \leq 10$	16
$0 < x \leq 20$	64
$0 < x \leq 30$	140
$0 < x \leq 40$	184
$0 < x \leq 50$	190

17 (a) How many people spent **more** than £20 ?

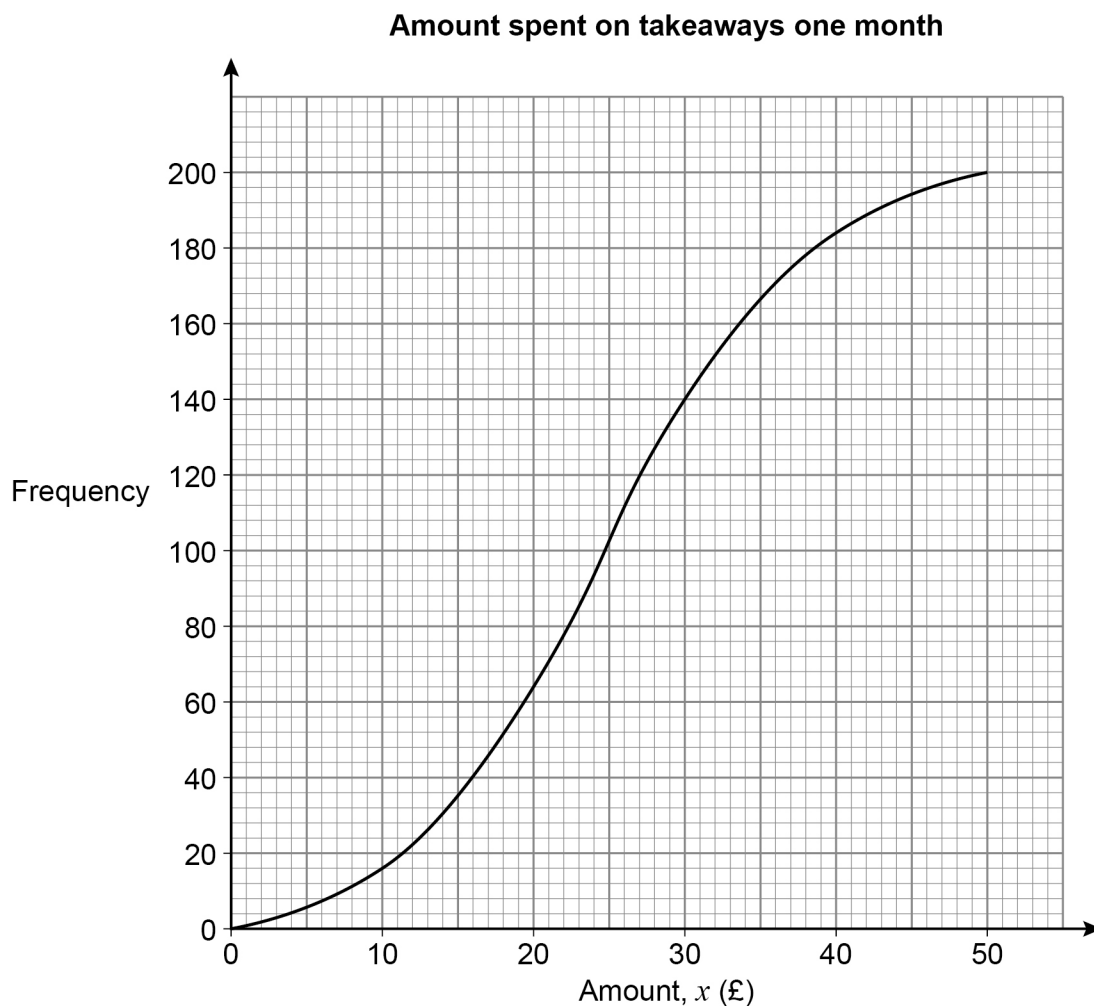
[2 marks]

$$190 - 64 = 126$$

Answer 126



- 17 (b) Farah draws this cumulative frequency curve to represent the results.



Give **two** criticisms of her graph.

[2 marks]

Criticism 1 The last point should be at (50, 190), not (50, 200)

because only 190 people were asked.

Criticism 2 The vertical axis should be labelled

cumulative frequency, not frequency.



- 18 By completing the square, prove that $x^2 + 6x + 13$ is always positive. [3 marks]

$$x^2 + 6x + 13 = (x + 3)^2 - 9 + 13$$

$$= (x + 3)^2 + 4$$

$$(x + 3)^2 \geq 0 \text{ for all values of } x$$

$$\text{so } (x + 3)^2 + 4 \geq 4$$

$$\text{so } x^2 + 6x + 13 \geq 4 > 0$$

$$\text{so } x^2 + 6x + 13 \text{ is always positive}$$



19

 A is directly proportional to B^4 The value of B is doubled.Pete thinks that the value of A will be 8 times bigger because 4×2 is 8

Is he correct?

Tick a box.

Yes

☐

No

☒

Give a reason for your answer.

[1 mark]

No. $A = kB^4$, so when B is doubled *$A = k(2B)^4 = 16kB^4$* *$2^4 = 16$, so A will be 16 times bigger, not 8 times.*

Turn over for the next question

Turn over ►



20

Rearrange $p = \frac{2m+1}{1-m}$ to make m the subject.

[4 marks]

$$p(1-m) = 2m+1$$

$$p - pm = 2m+1$$

$$p - 1 = 2m + pm$$

$$p - 1 = m(2 + p)$$

$$m = \frac{p-1}{2+p}$$

Answer $m = \frac{p-1}{2+p}$



21

Jack is loading a van.

The van can safely carry 1375 kg of furniture.

Jack has already loaded 1200 kg of furniture to the nearest 50 kg

A table has mass 140 kg to the nearest 10 kg

Can the table safely be added to the furniture in the van?

You **must** show your working.**[3 marks]**

$$\text{Upper bound of furniture} = 1200 + 25 = 1225 \text{ kg}$$

$$\text{Upper bound of table} = 140 + 5 = 145 \text{ kg}$$

$$\text{Maximum total} = 1225 + 145 = 1370 \text{ kg}$$

$$1370 \text{ kg} \leq 1375 \text{ kg}$$

Yes, the table can safely be added.

22

Factorise $25a^2 - b^2$ **[1 mark]**

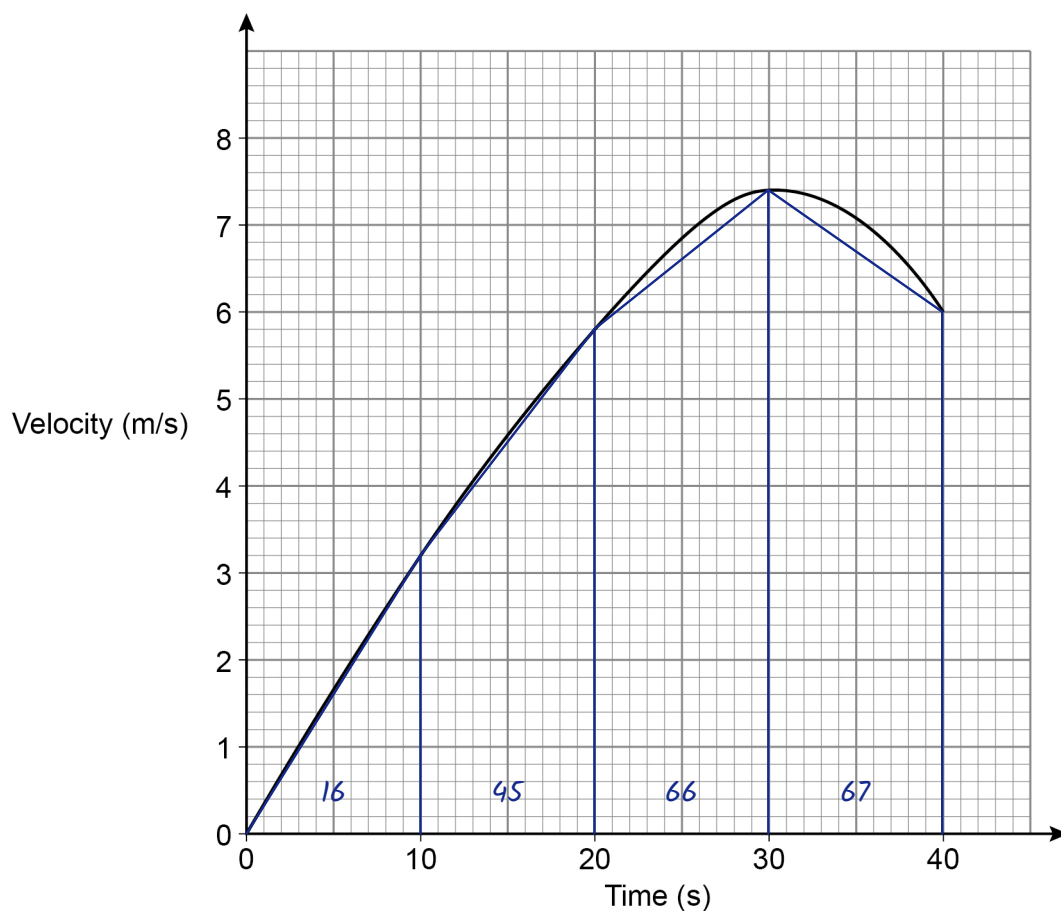
$$(5a)^2 - b^2$$

Answer $(5a + b)(5a - b)$



23

Here is the velocity-time graph of a cyclist for 40 seconds.



- 23 (a) By dividing the area under the graph into four sections of equal widths, estimate the distance travelled during the 40 seconds.

[3 marks]

Velocities at $t = 0, 10, 20, 30, 40$: 0, 3.2, 5.8, 7.4, 6

$$\frac{1}{2} \times 10 \times 3.2 = 16$$

$$\frac{1}{2} \times (3.2 + 5.8) \times 10 = 45$$

$$\frac{1}{2} \times (5.8 + 7.4) \times 10 = 66$$

$$\frac{1}{2} \times (7.4 + 6) \times 10 = 67$$

$$\text{Distance} = 16 + 45 + 66 + 67 = 194$$

Answer 194 m



- 23 (b) Work out the average acceleration of the cyclist during the 40 seconds.
State the units of your answer.

[2 marks]

$$\text{Acceleration} = \text{change in velocity} \div \text{time}$$

$$= (6 - 0) \div 40 = 0.15$$

Answer 0.15 m/s²

- 24 Simplify fully $\frac{8x^2 + 4}{5x} \times \frac{3x}{14x^2 + 7}$

You **must** show your working.

[3 marks]

$$\frac{8x^2 + 4}{5x} \times \frac{3x}{14x^2 + 7}$$

$$= \frac{4(2x^2 + 1)}{5x} \times \frac{3x}{7(2x^2 + 1)}$$

$$= \frac{4}{5x} \times \frac{3x}{7}$$

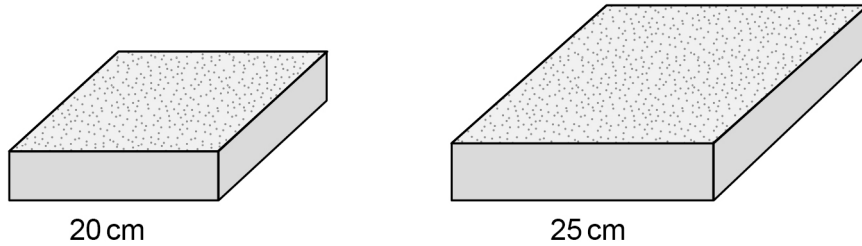
$$= \frac{12x}{35x} = \frac{12}{35}$$

Answer $\frac{12}{35}$



25

Here are two square-based paving stones.
The stones are similar solids.



The price per cm^3 is the same for both stones.

The price of the **larger** stone is £17.50

Work out the price of the smaller stone.

[4 marks]

$$\text{Length scale factor} = 25 \div 20 = 1.25$$

$$\text{Volume scale factor} = 1.25^3 = 1.953125$$

Price is proportional to volume, so

$$\text{price of smaller} = 17.50 \div 1.953125$$

$$= 8.96$$

Answer £ 8.96



26

Rick borrows £1500 from a bank.

He pays back £100 each month.

This iterative formula works out the amount he still owes at the end of each month.

$$A_{n+1} = 1.02 \times A_n - 100$$

$$A_0 = 1500$$

Work out the amount he still owes at the end of the 2nd month.

[3 marks]

$$A_1 = 1.02 \times 1500 - 100 = 1430$$

$$A_2 = 1.02 \times 1430 - 100 = 1358.6$$

He still owes £1358.60

Answer £ 1358.60

Turn over for the next question



27 $g(x) = a \times b^x$ where a and b are constants.

$$g(0) = 8 \quad \text{and} \quad g(3) = 343$$

Work out the value of $g(1)$

[4 marks]

$$g(0) = a \times b^0 = a, \text{ so } a = 8$$

$$g(3) = 8 \times b^3 = 343$$

$$b^3 = 343 \div 8 = 42.875$$

$$b = \sqrt[3]{42.875} = 3.5$$

$$g(1) = 8 \times 3.5$$

$$= 28$$

Answer 28



28

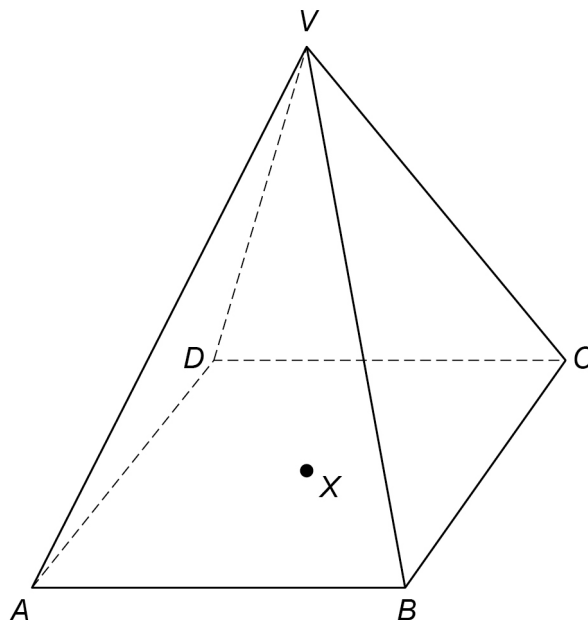
$VABCD$ is a pyramid with a horizontal square base.

X is the centre of the base.

V is vertically above X .

$$BD = 18 \text{ cm}$$

$$\text{Angle } VBX = 72^\circ$$



Work out the length of VB .

[3 marks]

$$BX = 18 \div 2 = 9 \text{ cm}$$

$$\cos 72^\circ = 9 \div VB$$

$$VB = 9 \div \cos 72^\circ$$

$$= 29.1246...$$

$$= 29.1 \text{ (3 s.f.)}$$

Answer 29.1 cm

Turn over ►



29

A code is three letters, each of which is in the word LOGIC

Vinny assumes that letters in the code may be used more than once.

He works out how many possible codes there are.

In fact, the first two letters are the same and the third is different.

How many of Vinny's codes are **not** possible?

[2 marks]

Vinny's codes: $5 \times 5 \times 5 = 125$

Possible codes: $5 \times 1 \times 4 = 20$

Not possible: $125 - 20 = 105$

Answer 105

END OF QUESTIONS

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3 2



2 3 B G 8 3 0 0 / 2 H