

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

MODEL SOLUTIONS

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier

Paper 3 Calculator

Monday 11 November 2019 Afternoon Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments.



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.
- 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	
TOTAL	

Advice

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



Answer **all** questions in the spaces provided

- 1 Circle the relative frequency that represents 13 successes out of 50 trials.

[1 mark]

0.13

26

13 : 50

0.26

- 2 The equation of a straight line is $2y = 3x + 5$

Circle the gradient of the line.

[1 mark]

 $\frac{2}{3}$ $\frac{3}{2}$

3

5

- 3 $(2x - 4)(3x + 5)$ is expanded and simplified.

Circle the term which is part of the answer.

[1 mark]

2x

-2x

22x

-22x



- 4 When rounded to 3 significant figures, $x = 6.37$

Circle the correct error interval.

[1 mark]

$$6.365 \leq x < 6.375$$

$$6.36 \leq x < 6.38$$

$$6.369 \leq x < 6.379$$

$$6.365 \leq x < 6.3749$$

- 5 Solve the simultaneous equations

$$\textcircled{1} \quad 7x + 2y = 36$$

$$\textcircled{2} \quad 3x + 2y = 16$$

[3 marks]

$$\textcircled{1} - \textcircled{2} \quad (7x - 3x) + (2y - 2y) = (36 - 16)$$

$$4x = 20$$

$$x = 5$$

$$3(5) + 2y = 16$$

$$2y = 1$$

$$y = 0.5$$

$$x = \underline{5} \quad y = \underline{0.5}$$

Turn over ►



6 (a) Tom is tiling a wall.

He needs to buy at least 100 tiles.

The tiles are sold in large packs and small packs.

Large pack 40 tiles £18

Small pack 28 tiles £14

Special offer

25% reduction when you buy 3 or more **large** packs

Work out the cheapest cost for Tom to buy the packs of tiles he needs.

[3 marks]

$$\text{large: } 3 \times 18 = 54 \rightarrow 54 \times 0.75 = 40.5$$

$$2L \quad 1S: 2 \times 18 + 14 = 50$$

$$1L \quad 3S: 18 + 3 \times 14 = 60$$

$$\text{small: } 4 \times 14 = 56$$

Answer £ 40.5



- 6 (b) Tom is also tiling a floor.

The floor is a rectangle with length 600 cm and width 240 cm

Each tile is a square with side 40 cm

Tom uses this method to work out the number of tiles he needs.

$$\begin{aligned} \text{Number of tiles that will fit along the length} &= 600 \div 40 \\ &= 15 \end{aligned}$$

$$\begin{aligned} \text{Number of tiles that will fit along the width} &= 240 \div 40 \\ &= 6 \end{aligned}$$

$$\begin{aligned} \text{Total number of tiles needed} &= 15 + 6 \\ &= 21 \end{aligned}$$

Give a reason why Tom's method is wrong.

[1 mark]

15 should have been multiplied by 6

Turn over for the next question

Turn over ►



7 An equilateral triangle has side length 16 metres.

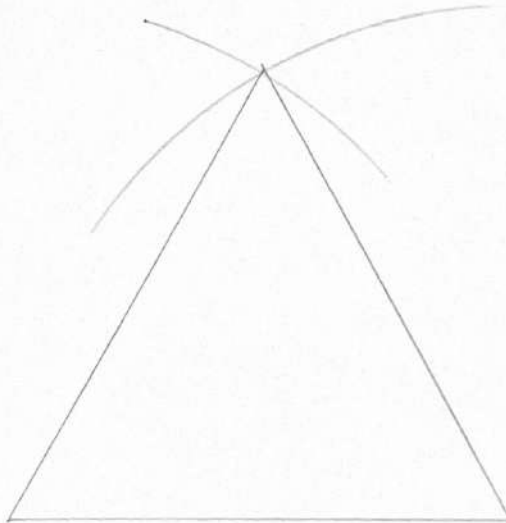
Using ruler and compasses only, construct a scale drawing of the triangle.

Use the scale 1 centimetre represents 2 metres.

[3 marks]

$$16\text{ m} = 8\text{ cm}$$

Scale: 1 cm represents 2 m



8 In a choir there are 35 men and 48 women.

The probability that a man chosen at random wears glasses is $\frac{2}{5}$

The probability that a woman chosen at random wears glasses is $\frac{3}{8}$

8 (a) Work out the number of people in the choir who wear glasses.

[3 marks]

$$\frac{2}{5} \times 35 = 14 \quad \frac{3}{8} \times 48 = 18$$

$$18 + 14 = 32$$

Answer 32

8 (b) A person is chosen at random from the choir.

Work out the probability that the person does **not** wear glasses.

[2 marks]

$$\text{Total} = 35 + 48 = 83$$

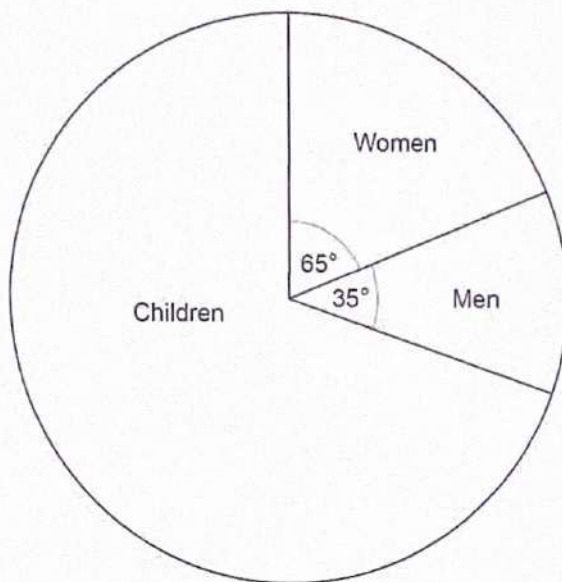
$$83 - 32 = 51$$

Answer $\frac{51}{83}$



9

The pie chart shows information about people at a theme park.



There were 450 **more** women than men.

Work out the number of children.

[3 marks]

$$\frac{450}{65 - 35} = 15$$

$$360 - 65 - 35 = 260$$

$$260 \times 15 = 3900$$

$$\text{Answer } 3900$$



- 10 Density = $\frac{\text{mass}}{\text{volume}}$
- The mass is divided by 2 and the volume is multiplied by 4
- What happens to the density?
- Circle your answer.
- [1 mark]

 $\times 2$ $\div 2$ $\times 8$ $\div 8$

- 11 Work out
- cube root of 512 : reciprocal of 0.4
- Give your answer in the form $n : 1$
- [3 marks]

$$\sqrt[3]{512} = 8$$

$$\frac{1}{0.4} = 2.5$$

$$8 : 2.5$$

$$3.2 : 1$$

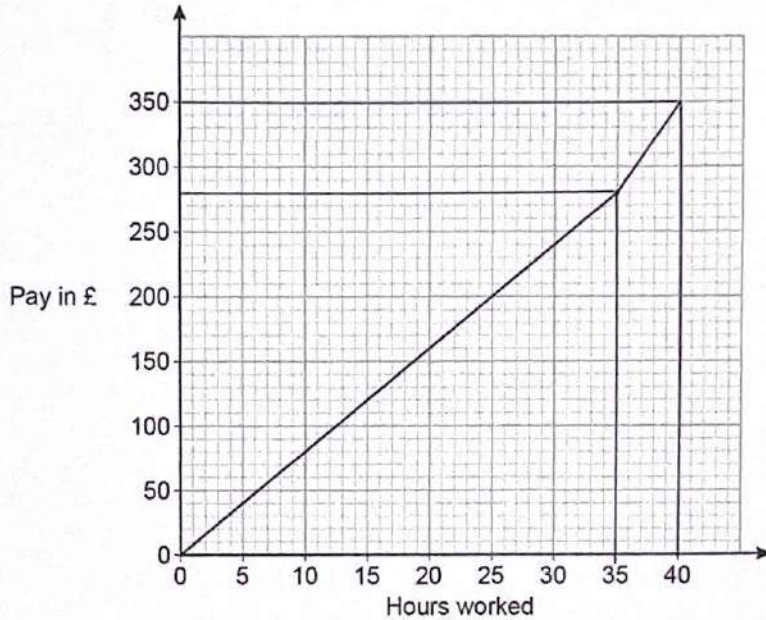
Answer 3.2 : 1

Turn over for the next question



- 12 The graph shows how much Molly is paid for working for up to 40 hours.
She receives

- a basic rate of pay for the first 35 hours worked
- a higher rate of pay for the next 5 hours worked.



Work out the difference between the higher rate of pay and the basic rate of pay.
Give your answer in £ per hour.

[3 marks]

$$280 \div 35 = 8$$

$$(350 - 280) \div (40 - 35) = 14$$

$$14 - 8 = 6$$

Answer £ 6 per hour



- 13 Naga states a hypothesis.

"Most people read more than 100 books a year."

She asks a sample of five people in a book club how many books they read last month. The table shows the results.

	Lynn	Ali	Paul	Chen	Ruth
Number of books	10	11	8	10	13

- 13 (a) Show how Naga could use the data to support her hypothesis.

[2 marks]

per year: Lynn Ali Paul Chen Ruth
 120 132 96 120 156

∴ 4 out of 5 would read over 100 in
 a year

- 13 (b) Give two reasons why this sample should **not** be used to support her hypothesis.

[2 marks]

Reason 1 They may not read the same amount
 of books every year/month

Reason 2 The sample is biased as they all go to
 book club so are more likely to read more
 books



14

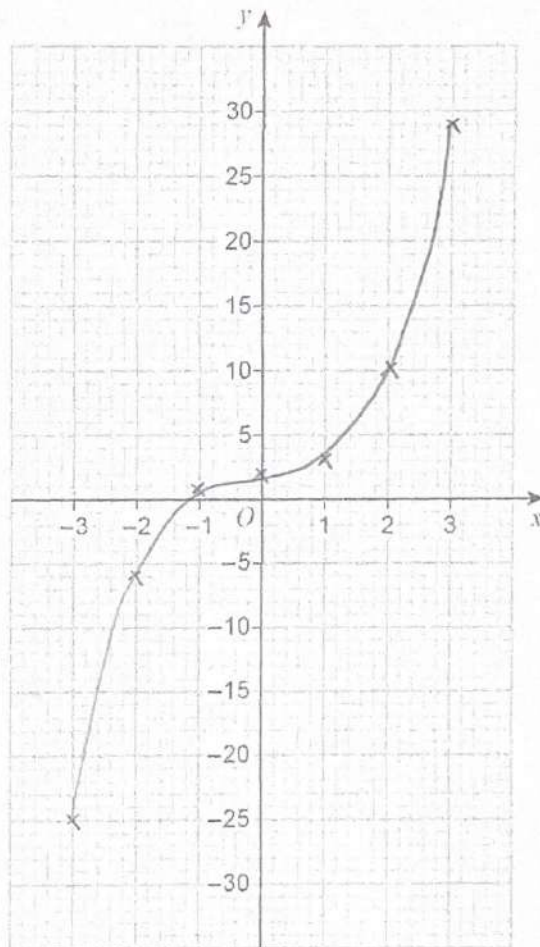
A graph has equation $y = x^3 + a$ where a is an integer.

The graph passes through the point (3, 29)

Draw the graph for values of x from -3 to 3

[3 marks]

x	-3	-2	-1	0	1	2	3
y	-26	-6	4	2	3	10	29



15

When you earn money you pay income tax.

The amount you pay depends on how much you earn that year.

You pay

0% on the first £12500 you earn

20% on the next £37500 you earn

40% on the next £112500 you earn.

One year, Kim paid £9260 income tax.

Work out how much she earned that year.

[4 marks]

$$20\% \text{ on } 37500 = 37500 \times 0.2 = 7500$$

$$9260 - 7500 = 1760$$

$$40\% \rightarrow 1760 \div 0.4 = 4400$$

$$\text{Total} = 4400 + 37500 + 12500$$

$$= 54400$$

Answer £ 54400



- 16 A building company employs
 2 labourers
 14 joiners
 9 electricians
 8 plumbers.

For a job, the company needs one of each type of worker.

- 16 (a) In how many ways can the company choose the four workers?

[2 marks]

$$2 \times 14 \times 9 \times 8 = 2016$$

Answer 2016

- 16 (b) One labourer and two plumbers are on holiday.

In how many ways can the company now choose the four workers?

[2 marks]

$$1 \times 14 \times 9 + 6 = 756$$

Answer 756



17

$$f(x) = 3x^2 - 4x + 8 \quad \text{for all values of } x$$

Jenny says,

" $f(10)$ must equal $2 \times f(5)$, because 10 is 2×5 "

Is Jenny correct?

Show working to support your answer.

[2 marks]

$$\begin{aligned} f(10) &= 3(10^2) - 4(10) + 8 \\ &= 268 \end{aligned}$$

$$\begin{aligned} f(5) &= 3(5^2) - 4(5) + 8 \\ &= 63 \end{aligned}$$

$$2 \times 63 \neq 268 \quad \therefore \text{No}$$

18

Work out the **two** roots of $(7x + 1)(2x - 3) = 0$

Circle **both** roots.

[1 mark]

$$\left(\frac{-1}{7}\right)$$

$$\frac{1}{7}$$

$$-\frac{3}{2}$$

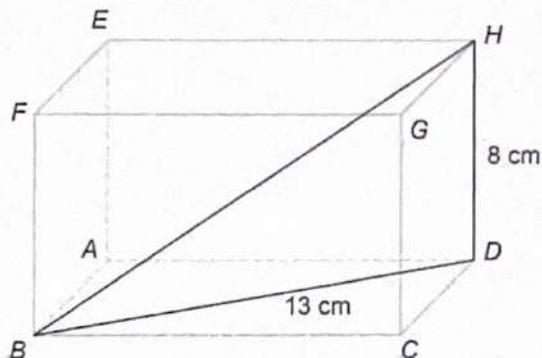
$$\left(\frac{3}{2}\right)$$



19 Here is a cuboid.

$$DH = 8 \text{ cm}$$

$$DB = 13 \text{ cm}$$



19 (a) Work out the size of angle DBH .

[2 marks]

$$\tan(DBH) = \frac{8}{13}$$

$$\tan^{-1}\left(\frac{8}{13}\right) =$$

Answer 31.6 degrees

19 (b) Using your answer to part (a), work out the size of angle ECG .

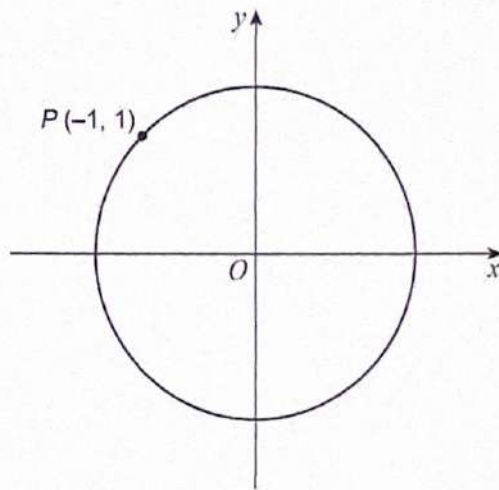
[1 mark]

$$90 - 31.6 =$$

Answer 58.4 degrees



20

 $P(-1, 1)$ is a point on the circle, centre O , radius r .Not drawn
accuratelyWork out the value of r .

Circle your answer.

[1 mark]

1

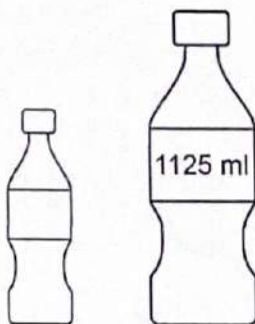
2

 $\sqrt{2}$ $2\sqrt{2}$ 

21

Juice is sold in small bottles and large bottles.

The volume of the large bottle is 1125 ml.



volume of small bottle : volume of large bottle = 2 : 5

A café has small glasses and large glasses.

volume of small glass : volume of large glass = 4 : 7

A small bottle fills 6 small glasses with no juice left over.

How many large glasses can be filled by a large bottle?

You **must** show your working.

[4 marks]

$$1125 \div 5 \times 2 = 450$$

$$450 \div 6 = 75 \quad 75 \times (7/4) = 131.25$$

$$1125 \div 131.25 = 8.6$$

Answer 8.6



22 The **only** solution to $x^2 + bx + c = 0$ is $x = 5$

Work out the values of b and c .

[2 marks]

$$(x-5)^2 = 0$$

$$x^2 - 10x + 25 = 0$$

$$b = -10 \quad c = 25$$

$$b = \underline{-10} \quad c = \underline{25}$$

23

$$x : y = \frac{1}{4} : \frac{2}{3}$$

What is x as a fraction of y ?

Circle your answer.

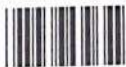
[1 mark]

$$\frac{8}{3}$$

$$\frac{1}{6}$$

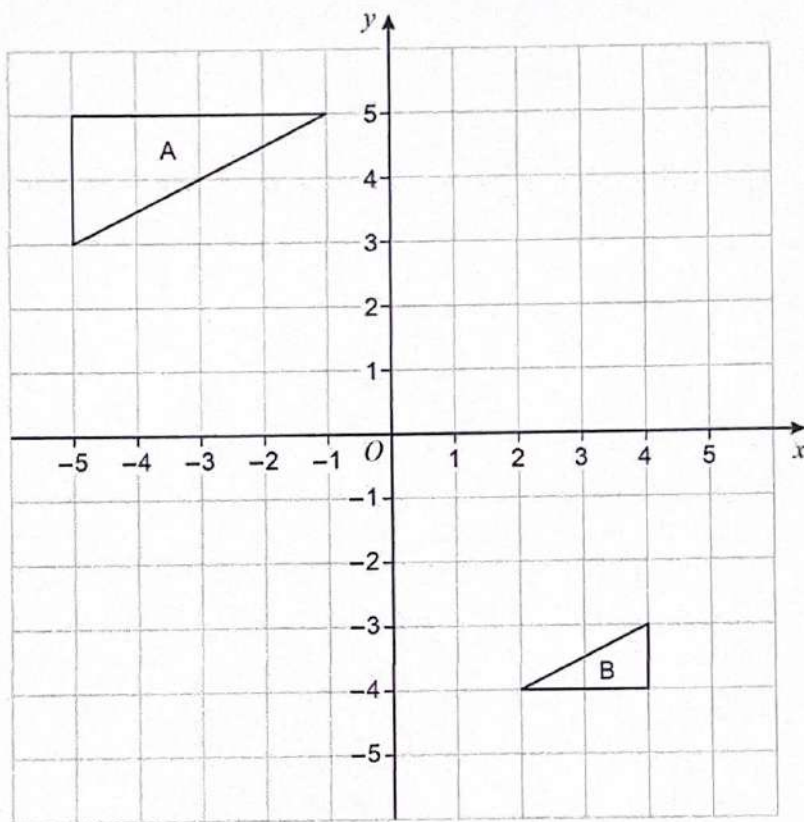
$$\frac{3}{7}$$

$$\frac{3}{8}$$



24

Shape A and shape B are shown on the grid.

Describe the **single** transformation that maps shape A to shape B.

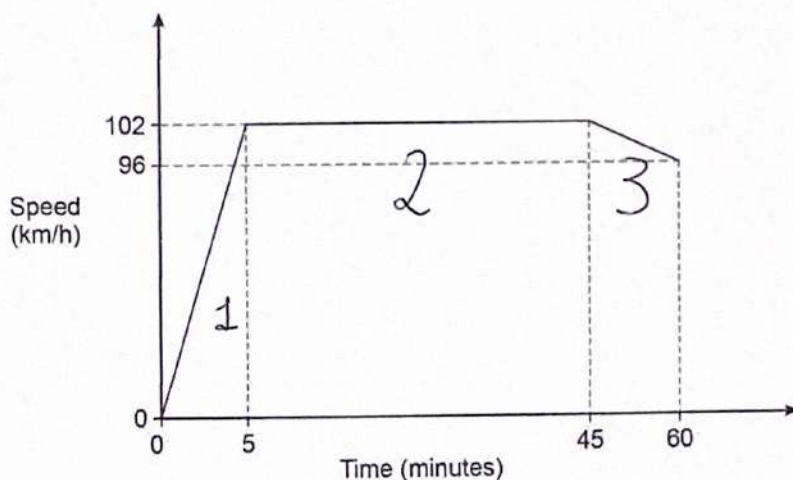
[3 marks]

Enlargement scale factor $-\frac{1}{2}$ with
centre $(1, -1)$



25

Here is a sketch of a speed-time graph for the first part of a journey.



The total distance for the journey is 130 kilometres.

How far is left to travel?

[4 marks]

travelled so far:

$$\textcircled{1} \quad \frac{1}{2} \times \frac{5}{60} \times 102 = 4.25$$

$$\textcircled{2} \quad 102 \times \frac{40}{60} = 68$$

$$\textcircled{3} \quad \frac{1}{2} (102 + 96) \times \frac{15}{60} = 24.75$$

$$\text{Total} = 4.25 + 68 + 24.75 = 97$$

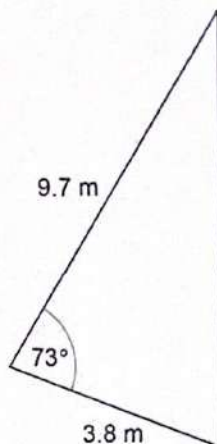
$$130 - 97 = 33 \text{ left}$$

Answer 33 km

Turn over ▶



26 Here is a triangular sail.



Not drawn
accurately

26 (a) Vicky needs to buy waterproofing liquid for the sail.

She will put **3 coats** of liquid on **each** side of the sail.

A litre of liquid covers 8.5 square metres of sail.

How many 1-litre bottles of liquid does Vicky need?

[3 marks]

$$\frac{1}{2} \times 9.7 \times 3.8 \sin 73 = 17.6 \text{ m}^2$$

$$2 \text{ sides: } 17.6 \times 2 = 35.2 \text{ m}^2$$

$$3 \text{ coats: } 35.2 \times 3 = 105.6 \text{ m}^2$$

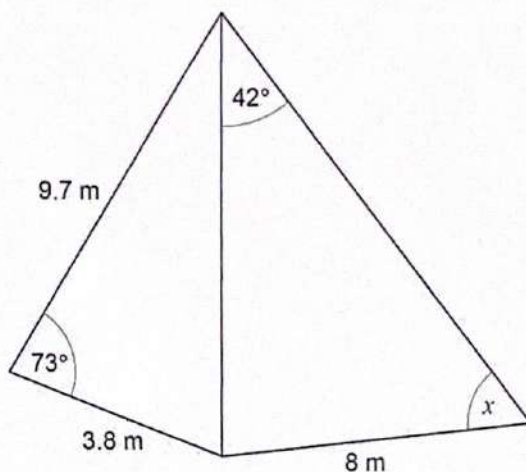
$$105.6 \div 8.5 = 12.4$$

needs 13 bottles to cover 12.4

Answer 13



- 26 (b) Another sail is joined to the first sail as shown.



Not drawn
accurately

x is an acute angle.

Work out the size of angle x .

[5 marks]

$$9.7^2 + 3.8^2 - 2(9.7 \times 3.8 \times \cos 73)$$

$$= 86.976$$

$$\sqrt{86.976} = 9.33$$

$$\frac{\sin x}{9.33} = \frac{\sin 42}{8}$$

$$\sin^{-1}\left(\frac{9.33 \sin 42}{8}\right)$$

Answer 51.3 degrees

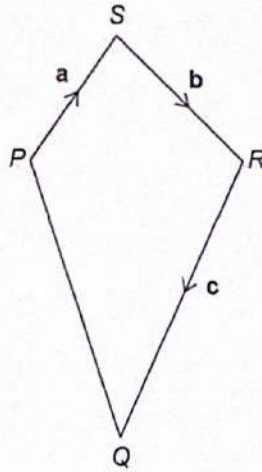
Turn over ►



27

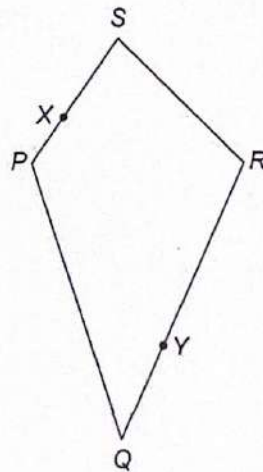
Here is quadrilateral $PQRS$.

$$\overrightarrow{PS} = \mathbf{a} \quad \overrightarrow{SR} = \mathbf{b} \quad \overrightarrow{RQ} = \mathbf{c}$$

Not drawn
accurately

X is a point on PS where $PX : XS = 1 : 2$

Y is a point on RQ where $RY : YQ = 2 : 1$

Not drawn
accurately

Is XY parallel to PQ ?

Show working to support your answer.

[3 marks]

$$PQ = a + b + c$$

$$XY = \frac{2}{3}a + b + \frac{2}{3}c$$

No as XY is not a multiple of PQ so
they are not parallel

Turn over for the next question

Turn over ►



28 $f(x) = 2x - 3$ and $g(x) = x^2$

Show that $f^{-1}(55) = fg(4)$

[4 marks]

$$f^{-1}(55) \quad y = 2x - 3 \quad y + 3 = 2x \quad \frac{y+3}{2} = x$$

$$x = \frac{y+3}{2} \quad x+3 = \frac{y+3}{2} \quad y = \frac{x+3}{2}$$

$$fg(4) \quad y = \frac{55+3}{2} = 29$$

$$2x^2 - 3 \quad 2 \times 4^2 - 3 = 29$$

END OF QUESTIONS

