

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

# GCSE MATHEMATICS

# H

Higher Tier

Paper 1 Non-Calculator

Thursday 25 May 2017

Morning

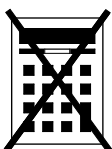
Time allowed: 1 hour 30 minutes

## Materials

**For this paper you must have:**

- mathematical instruments.

You must **not** use a calculator.



## Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- 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.

## 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        |      |
| <b>TOTAL</b> |      |



J U N 1 7 8 3 0 0 1 H 0 1

Answer **all** questions in the spaces provided

- 1** Simplify  $2^5 \times 2^3$   
Circle your answer.

[1 mark]

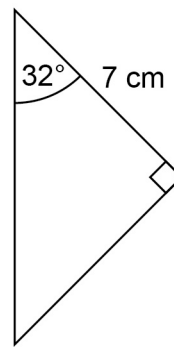
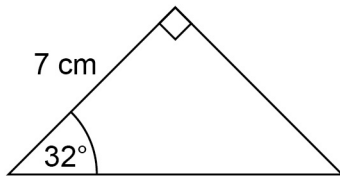
$4^8$

$2^8$

$2^{15}$

$4^{15}$

**2**



Not drawn  
accurately

Circle the reason why these triangles are congruent.

[1 mark]

SSS

SAS

ASA

RHS

- 3** Which of these is a geometric progression?  
Circle your answer.

[1 mark]

2, 4, 6, 8, 10

2, 3, 5, 8, 12

2, 6, 18, 54, 162

2, 6, 10, 14, 18



4  $a : b = 4 : 3$

Circle the correct statement.

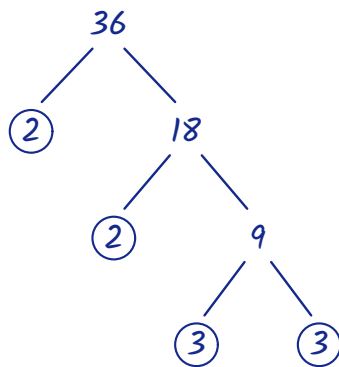
[1 mark]

 $b$  is  $\frac{4}{7}$  of  $a$  $b$  is  $\frac{3}{7}$  of  $a$  $b$  is  $\frac{4}{3}$  of  $a$  $b$  is  $\frac{3}{4}$  of  $a$ 

5 Write 36 as a product of prime factors.

Give your answer in index form.

[3 marks]



$$36 = 2 \times 2 \times 3 \times 3$$

$$= 2^2 \times 3^2$$

Answer                      $2^2 \times 3^2$                     

Turn over for the next question

Turn over ►



- 6 The table shows information about the times for 10 people to complete a task.

| Time, $t$ (minutes) | Frequency |
|---------------------|-----------|
| $0 < t \leq 20$     | 1         |
| $20 < t \leq 40$    | 6         |
| $40 < t \leq 60$    | 3         |

These statements are about the mean and range of the actual times.

Tick the correct box for each statement.

[4 marks]

|                                         | True                                | False                               |
|-----------------------------------------|-------------------------------------|-------------------------------------|
| The mean could be less than 20 minutes  | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |
| The mean could be more than 40 minutes  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| The mean could be less than 40 minutes  | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| The range could be more than 40 minutes | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| The range could be less than 40 minutes | <input checked="" type="checkbox"/> | <input type="checkbox"/>            |
| The range could be more than 60 minutes | <input type="checkbox"/>            | <input checked="" type="checkbox"/> |



- 7  $\frac{3}{5}$  of a number is 162

Work out the number.

[2 marks]

$$\frac{3}{5} \text{ of the number} = 162$$

$$162 \div 3 = 54 \quad (\text{this is } 1/5 \text{ of the number})$$

$$54 \times 5 = 270$$

Answer 270

- 8  $x$  km/h =  $y$  mph

Use  $8$  km/h =  $5$  mph to write a formula for  $y$  in terms of  $x$ .

[2 marks]

$$8 \text{ km/h} = 5 \text{ mph, so } 1 \text{ km/h} = 5 \div 8 \text{ mph}$$

$$x \text{ km/h} = x \times 5 \div 8 \text{ mph}$$

$$y = \frac{5}{8} \times x$$

Answer  $y = \frac{5x}{8}$

Turn over for the next question



9 (a)  $\text{Density} = \frac{\text{mass}}{\text{volume}}$

The mass of solid A is 6 times the mass of solid B.

The volume of solid A is 3 times the volume of solid B.

Complete the sentence.

[1 mark]

The density of solid A is 2 times the density of solid B.

$$\text{density} = 6 \div 3 = 2 \text{ times}$$

9 (b)  $\text{Average speed} = \frac{\text{distance}}{\text{time}}$

If the distance is halved and the time is doubled, what happens to the average speed?

Circle your answer.

[1 mark]

$\times 2$

$\times 4$

no change

$\div 2$

$\div 4$

$$\text{distance} \div 2 \text{ and } \text{time} \times 2, \text{ so } \text{speed} \div 2 \div 2 = \div 4$$



10 Solve the simultaneous equations.

$$2x + y = 18$$

$$x - y = 6$$

[3 marks]

$$2x + y = 18$$

$$x - y = 6$$

$$\text{Add: } 3x = 24$$

$$x = 8$$

$$\text{Substitute: } 8 - y = 6$$

$$y = 2$$

$$\text{Check: } 2 \times 8 + 2 = 18 \checkmark$$

Answer  $x = 8, y = 2$

Turn over for the next question

Turn over ►



11 Billy wants to buy these tickets for a show.

4 adult tickets at £15 each

2 child tickets at £10 each

A 10% booking fee is added to the ticket price.

3% is then added for paying by credit card.

Work out the **total** charge for these tickets when paying by credit card.

[5 marks]

$$\text{Adults: } 4 \times 15 = £60$$

$$\text{Children: } 2 \times 10 = £20$$

$$\text{Tickets: } 60 + 20 = £80$$

$$\text{Booking fee 10\%: } 80 \div 10 = £8$$

$$80 + 8 = £88$$

$$\text{Card fee 3\%: 1\% of 88} = £0.88$$

$$3\% = 3 \times 0.88 = £2.64$$

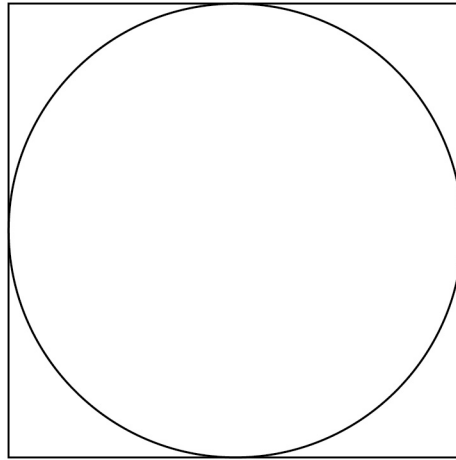
$$\text{Total: } 88 + 2.64 = £90.64$$

Answer £ 90.64



12

Here is a circle touching a square.

Not drawn  
accuratelyThe area of the square is  $64 \text{ cm}^2$ 

Work out the area of the circle.

Give your answer in terms of  $\pi$ .**[3 marks]**

$$\text{Side of square} = \sqrt{64} = 8 \text{ cm}$$

$$\text{Diameter of circle} = 8 \text{ cm, so radius} = 4 \text{ cm}$$

$$\text{Area} = \pi r^2 = \pi \times 4^2$$

$$= 16\pi$$

Answer 16π  $\text{cm}^2$ **Turn over for the next question****Turn over ►**

- 13 Write the number six million five thousand two hundred in standard form. [2 marks]

$$6\,000\,000 + 5000 + 200 = 6\,005\,200$$

$$= 6.0052 \times 10^6$$

Answer  $6.0052 \times 10^6$

- 14 Solve  $-3x > 6$  [1 mark]

$$-3x > 6 \text{ divide by } -3 \text{ (reverse the inequality)}$$

$$x < -2$$

Answer  $x < -2$

- 15  $\frac{1}{6}$ ,  $\frac{1}{7}$ ,  $\frac{1}{8}$  and  $\frac{1}{9}$  are four fractions.

How many of these fractions convert to a recurring decimal?

Circle your answer.

[1 mark]

0

1

2

3

4

$$1/6 = 0.1666..., 1/7 = 0.142857..., 1/8 = 0.125, 1/9 = 0.111...$$

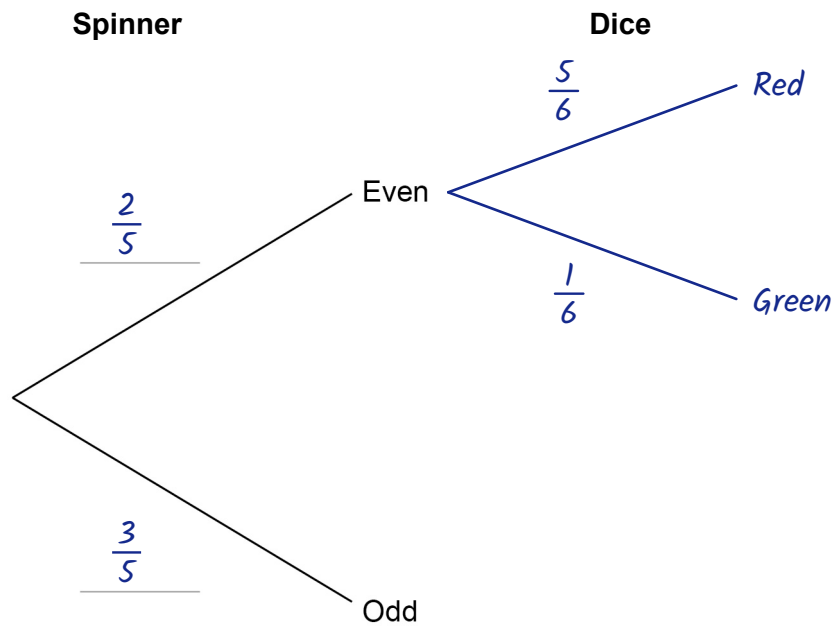
Only 1/8 terminates, so 3 are recurring



- 16** A fair spinner has five equal sections numbered 1, 2, 3, 4 and 5  
A fair six-sided dice has five red faces and one green face.  
The spinner is spun.  
If the spinner shows an even number, the dice is thrown.

- 16 (a)** Complete the tree diagram for the spinner and the dice.

**[2 marks]**



- 16 (b)** Work out the probability of getting an even number and the colour green.

**[2 marks]**

$$\frac{2}{5} \times \frac{1}{6} = \frac{2}{30} = \frac{1}{15}$$


---



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Answer  $\frac{1}{15}$



- 17 A is the point (2, -5)  
B is the point (4, -9)

- 17 (a) Show that the gradient of the straight line passing through A and B is -2

[2 marks]

*gradient = change in y ÷ change in x*

$$\text{gradient} = \frac{-9 - (-5)}{4 - 2} = \frac{-4}{2} = -2$$

*So the gradient of the line through A and B is -2*

- 17 (b) C is the point (-301, 601)

Does C lie on the straight line passing through A and B?

You **must** show your working.

[2 marks]

*Line AB:  $y = -2x + c$*

*Through A (2, -5):  $-5 = -2 \times 2 + c$ , so  $c = -1$*

*$y = -2x - 1$*

*When  $x = -301$ :  $y = -2 \times (-301) - 1$*

*$y = 602 - 1 = 601$ , which is the y-coordinate of C*

*(or gradient AC =  $(601 + 5) \div (-301 - 2) = 606 \div -303 = -2$ )*

Answer Yes, C lies on the line



18

Bottles of drink are for sale at three shops.

The normal price of a bottle is the same at each shop.

**Shop A**

Buy 1 bottle

Get 2 more bottles at half price

**Shop B**

Buy 2 bottles

Get 3 more bottles at half price

**Shop C**

30% off a bottle

What is the cheapest way to buy **exactly** 8 bottles?

You can buy from more than one shop.

You **must** show your working.

[3 marks]

*Let the normal price be £1 per bottle*

*Shop A: 3 bottles for  $1 + 0.50 + 0.50 = £2$ , so  $2/3 \approx 67p$  each*

*Shop B: 5 bottles for  $2 + 3 \times 0.50 = £3.50$ , so 70p each*

*Shop C: 1 bottle for  $0.70 = 70p$  each*

*A is cheapest per bottle but comes in groups of 3*

*6 bottles from A (two offers) =  $2 \times £2 = £4$*

*2 bottles from C =  $2 \times £0.70 = £1.40$*

*Total for 8 bottles =  $4 + 1.40 = £5.40$*

*Compare: 3 from A + 5 from B =  $2 + 3.50 = £5.50$*

*8 from C =  $8 \times 0.70 = £5.60$*

*So 6 from A and 2 from C is cheapest (£5.40)*

Answer *6 bottles from Shop A and 2 from Shop C*

Turn over ►

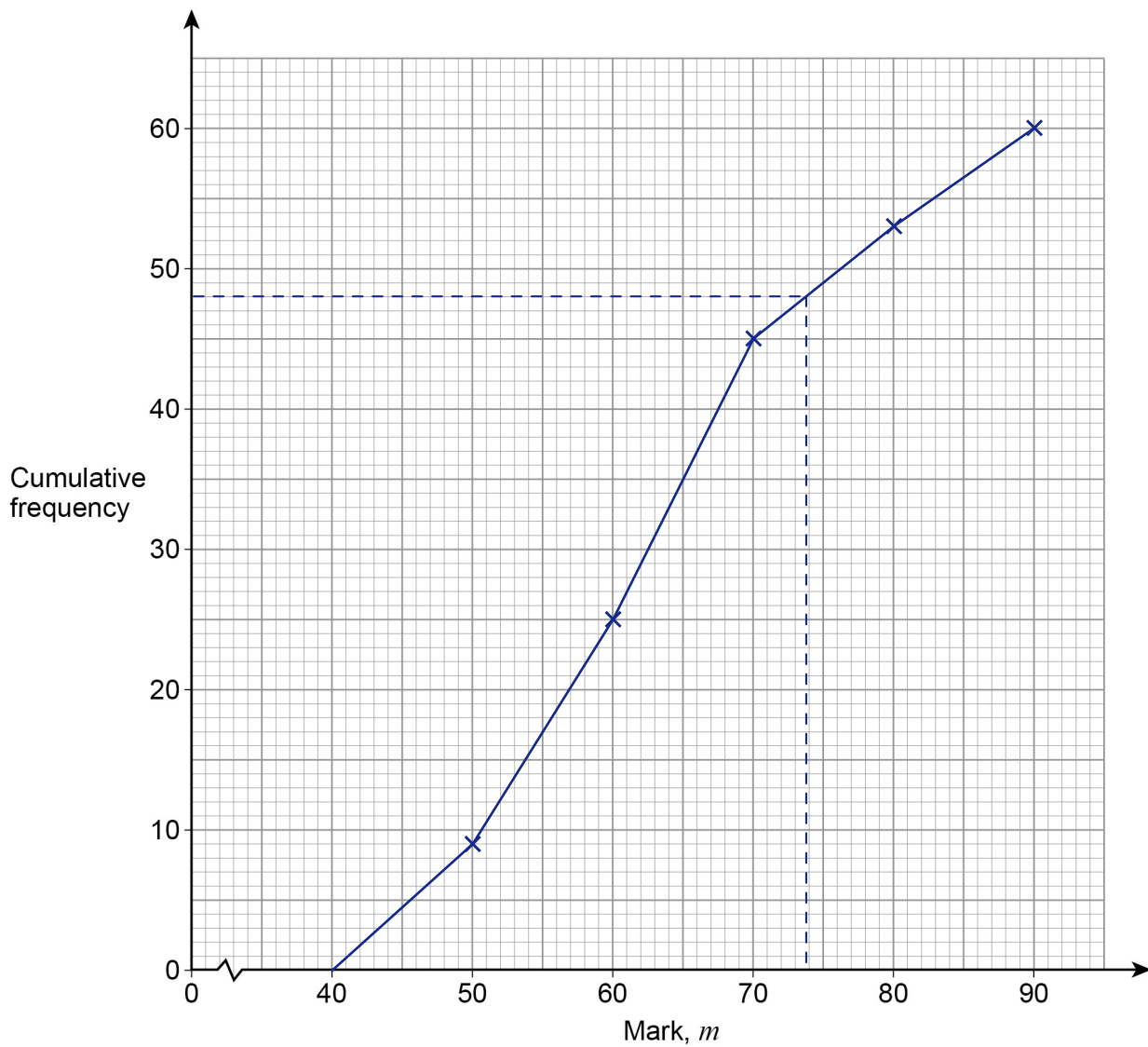


- 19** Here is some information about the marks of 60 students in a test.

| Mark, $m$        | Frequency | Mark, $m \leq$ | Cumulative frequency |
|------------------|-----------|----------------|----------------------|
| $40 < m \leq 50$ | 9         | 50             | 9                    |
| $50 < m \leq 60$ | 16        | 60             | 25                   |
| $60 < m \leq 70$ | 20        | 70             | 45                   |
| $70 < m \leq 80$ | 8         | 80             | 53                   |
| $80 < m \leq 90$ | 7         | 90             | 60                   |

- 19 (a)** On the grid, draw a cumulative frequency graph.

**[3 marks]**



- 19 (b)** Use your graph to estimate the lowest mark of the top 20% of students.

[2 marks]

*20% of 60 = 12, so  $60 - 12 = 48$  students*

*Read across from cumulative frequency 48 to the graph*

*and down: mark  $\approx 73.75$*

Answer 74

- 20** Work out the diameter of the circle  $x^2 + y^2 = 64$

Circle your answer.

[1 mark]

8

16

32

128

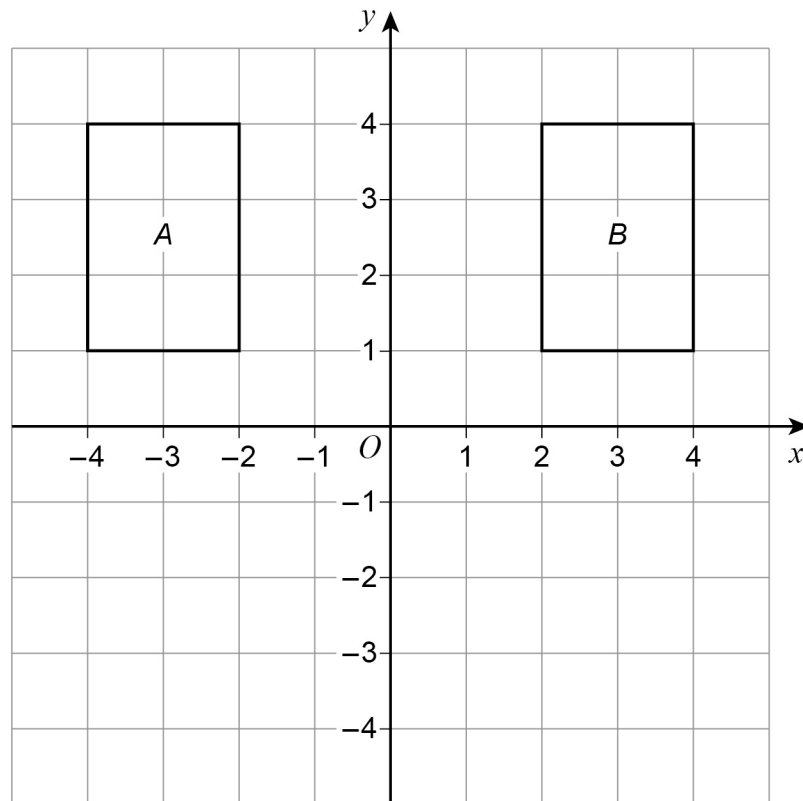
*$r^2 = 64$ , so  $r = 8$  and diameter  $= 2 \times 8 = 16$*

Turn over for the next question

Turn over ►



21 (a) The diagram shows rectangles A and B.



Rectangle A can be mapped to rectangle B by a **single** transformation.

Javed says,

“The **only** single transformation is a reflection in the  $y$ -axis because the rectangles are on opposite sides of the  $y$ -axis.”

Is he correct?

Tick a box.

Yes

☐

No

☒

Give a reason for your answer.

[1 mark]

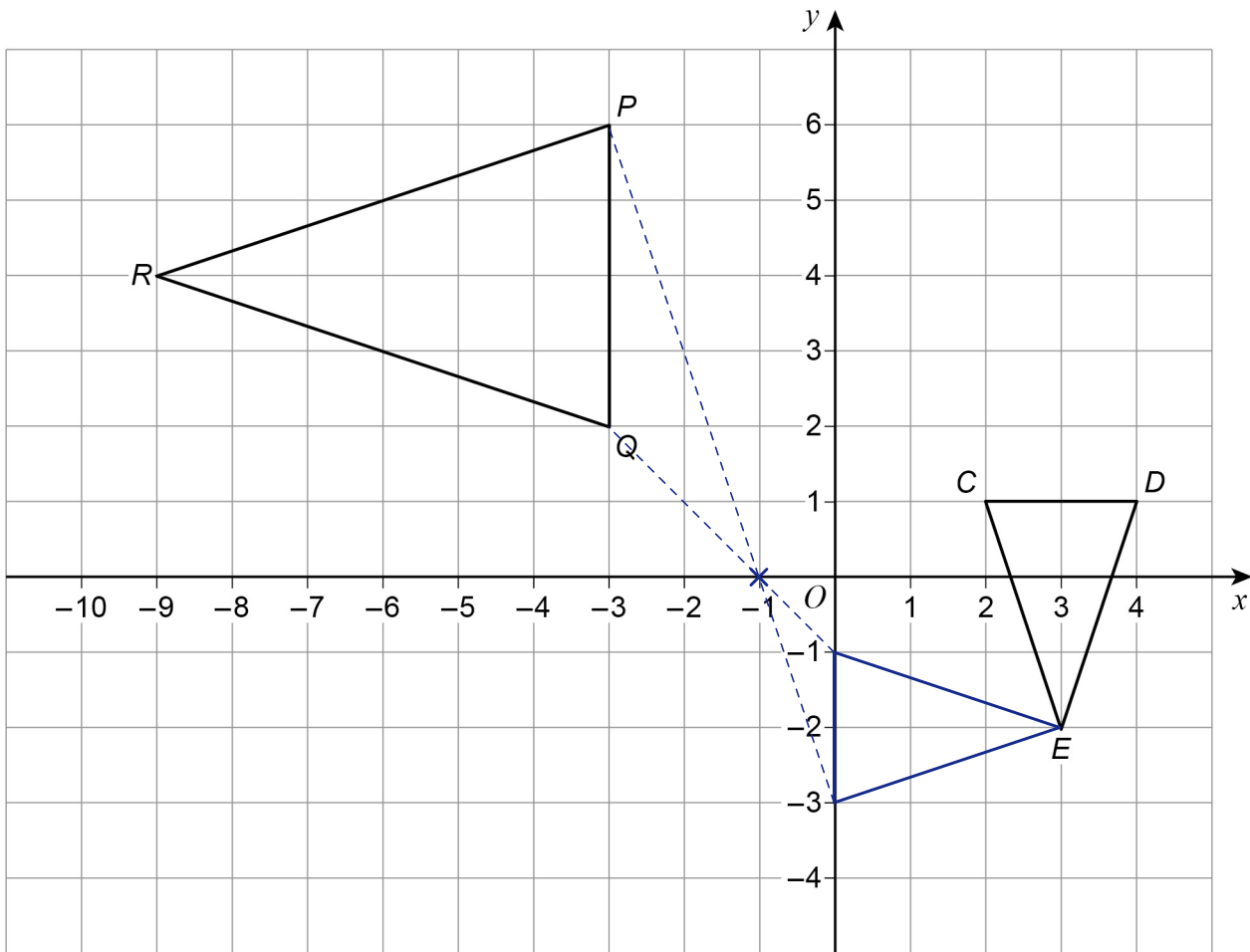
*No. It could also be a translation 6 to the right*

*(vector 6 right, 0 up), or a rotation of  $180^\circ$*

*about (0, 2.5)*



21 (b) This diagram shows triangles  $CDE$  and  $PQR$ .



$CDE$  is mapped to  $PQR$  by combining two single transformations.

The first is a rotation of  $90^\circ$  anticlockwise about  $E$ .

Describe fully the second transformation.

[3 marks]

*Enlargement, scale factor  $-2$ ,*

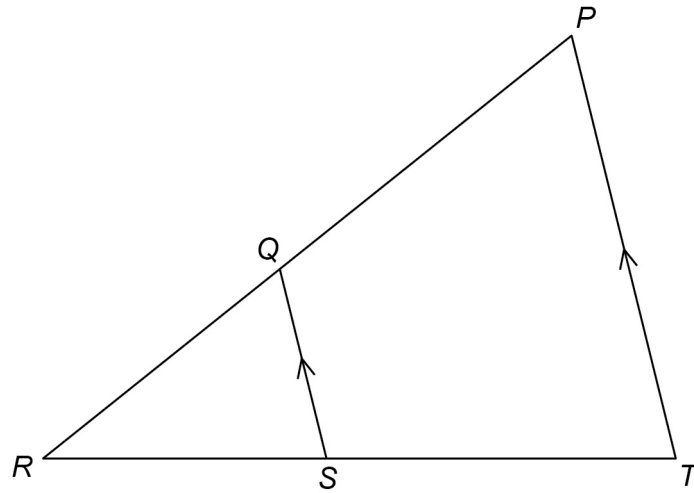
*centre  $(-1, 0)$*

Turn over for the next question

Turn over ►



22

 $PRT$  and  $QRS$  are similar triangles.Not drawn  
accuratelyWhich of these is equivalent to  $\frac{QR}{PR}$ ?

Circle your answer.

[1 mark]

$$\frac{RS}{ST}$$

$$\frac{QS}{PT}$$

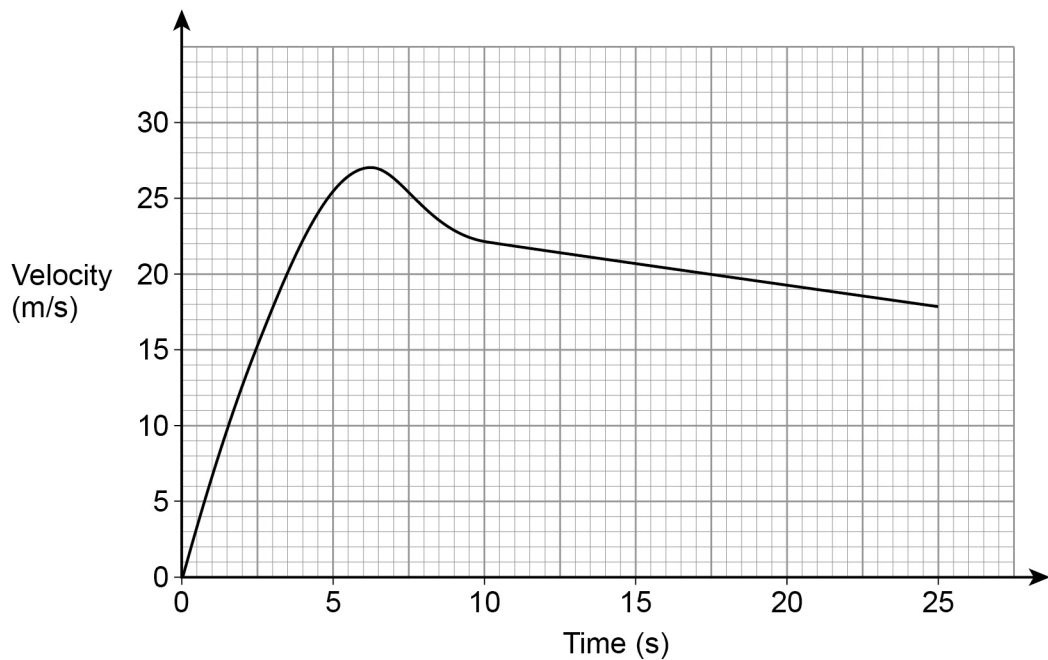
$$\frac{PT}{QS}$$

$$\frac{RT}{RS}$$



23

Here is a velocity-time graph of a motorbike for 25 seconds.



23 (a) After how many seconds was the acceleration zero?

[1 mark]

Answer 6 seconds

23 (b) Work out the distance travelled in the last 15 seconds.

[2 marks]

*At  $t = 10$ ,  $v = 22$  m/s; at  $t = 25$ ,  $v = 18$  m/s**Distance = area under graph (trapezium)*

*$$= \frac{1}{2} \times (22 + 18) \times 15$$*

*$$= 20 \times 15 = 300$$*

Answer 300 metres

Turn over ►



24 (a) Work out  $\sqrt{12\frac{1}{4}}$  as an improper fraction.

[1 mark]

$$12\frac{1}{4} = \frac{49}{4} \text{ so } \sqrt{\frac{49}{4}} = \frac{\sqrt{49}}{\sqrt{4}} = \frac{7}{2}$$

Answer  $\frac{7}{2}$

24 (b) Work out  $\sqrt[3]{16}$  as a power of 2

[2 marks]

$$16 = 2 \times 2 \times 2 \times 2 = 2^4$$

$$\sqrt[3]{16} = 16^{1/3} = (2^4)^{1/3}$$

$$= 2^{4 \times 1/3}$$

$$= 2^{4/3}$$

Answer  $2^{4/3}$



25

In an office there are twice as many females as males.

$\frac{1}{4}$  of the females wear glasses.

$\frac{3}{8}$  of the males wear glasses.

84 people in the office wear glasses.

Work out the number of people in the office.

[4 marks]

*Let the number of males =  $x$ , so females =  $2x$*

*Females with glasses:  $\frac{1}{4} \times 2x = \frac{2x}{4} = \frac{x}{2}$*

*Males with glasses:  $\frac{3}{8} \times x = \frac{3x}{8}$*

*$\frac{x}{2} + \frac{3x}{8} = 84$*

*$\frac{7x}{8} = 84$*

*$7x = 84 \times 8 = 672$*

*$x = 672 \div 7 = 96$  males*

*Females =  $2 \times 96 = 192$*

*Total =  $96 + 192 = 288$*

Answer 288

Turn over for the next question

Turn over ►



26

Expand and simplify  $(x - 4)(2x + 3y)^2$ 

[4 marks]

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

$$= 4x^2 + 6xy + 6xy + 9y^2$$

$$= 4x^2 + 12xy + 9y^2$$

$$(x - 4)(4x^2 + 12xy + 9y^2)$$

$$x \times (...) = 4x^3 + 12x^2y + 9xy^2$$

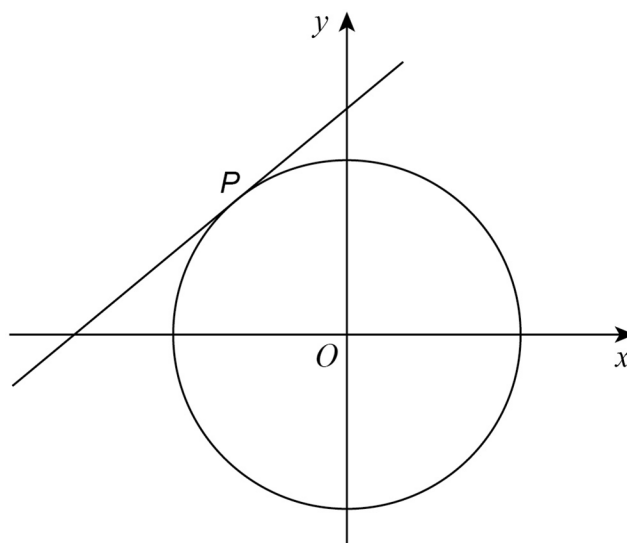
$$-4 \times (...) = -16x^2 - 48xy - 36y^2$$

$$= 4x^3 + 12x^2y + 9xy^2 - 16x^2 - 48xy - 36y^2$$

Answer  $4x^3 + 12x^2y + 9xy^2 - 16x^2 - 48xy - 36y^2$



27

 $P(-1, 4)$  is a point on a circle, centre  $O$ Not drawn  
accuratelyWork out the equation of the tangent to the circle at  $P$ .Give your answer in the form  $y = mx + c$ **[4 marks]**

---


$$\text{Gradient of } OP = \frac{4 - 0}{-1 - 0} = -4$$


---

The tangent is perpendicular to the radius  $OP$

---

---


$$\text{Gradient of tangent} = -1 \div -4 = \frac{1}{4}$$


---

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


---

$$y = \frac{1}{4}x + \frac{1}{4} + 4 = \frac{1}{4}x + \frac{17}{4}$$


---

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Answer  $y = \frac{1}{4}x + \frac{17}{4}$

---

Turn over ►



28

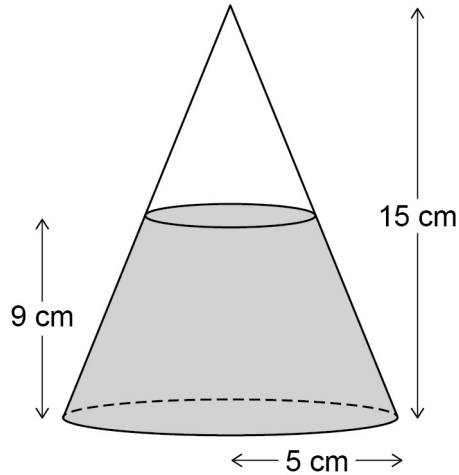
Volume of cone =  $\frac{1}{3}\pi r^2 h$  where  $r$  is the radius and  $h$  is the perpendicular height.

A cone has a

horizontal base of radius 5 cm

height of 15 cm

The cone contains water to a depth of 9 cm



Work out the volume of the water, in  $\text{cm}^3$

Give your answer in terms of  $\pi$ .

[4 marks]

$$\text{Whole cone: } V = \frac{1}{3} \times \pi \times 5^2 \times 15 = 125\pi$$

$$\text{Empty cone at the top: height} = 15 - 9 = 6 \text{ cm}$$

$$\text{Similar cones: } r \div 5 = 6 \div 15, \text{ so } r = 2 \text{ cm}$$

$$\text{Small cone: } V = \frac{1}{3} \times \pi \times 2^2 \times 6 = 8\pi$$

$$\text{Water} = \text{whole cone} - \text{small cone}$$

$$= 125\pi - 8\pi$$

$$= 117\pi$$

Answer 117π  $\text{cm}^3$



29 Simplify  $\frac{2 \sin 45^\circ - \tan 45^\circ}{4 \tan 60^\circ}$

Give your answer in the form  $\frac{\sqrt{a} - \sqrt{b}}{c}$  where  $a$ ,  $b$  and  $c$  are integers.

[4 marks]

$$\sin 45^\circ = \frac{\sqrt{2}}{2}, \quad \tan 45^\circ = 1, \quad \tan 60^\circ = \sqrt{3}$$

$$\frac{2 \times \frac{\sqrt{2}}{2} - 1}{4 \times \sqrt{3}} = \frac{\sqrt{2} - 1}{4\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{\sqrt{2} \times \sqrt{3} - \sqrt{3}}{4 \times 3} = \frac{\sqrt{6} - \sqrt{3}}{12}$$

Answer  $\frac{\sqrt{6} - \sqrt{3}}{12}$

END OF QUESTIONS



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