Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

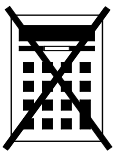
Higher Tier Paper 1 Non-Calculator

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- mathematical instruments
- the Formulae Sheet (enclosed).



You must **not** use a calculator.

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	

Please note that these worked solutions have neither been provided nor approved by AQA and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

.CG Maths.

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

Do not write outside the box

1 Which of these is the equation of a straight line?

Circle your answer.

[1 mark]

$y = 6x^2$ $\quad$ $y = x - 6$ $\quad$ $y = x^2 + 6$ $\quad$ $y = \frac{6}{x}$

The general equation of a straight line is y = mx + c. Only the second option is in this form

2 What is 0.28 as a fraction of 0.8 ?

Circle your answer.

[1 mark]

$\frac{7}{20}$ $\quad$ $\frac{2}{7}$ $\quad$ $\frac{20}{7}$ $\quad$ $\frac{7}{2}$

$\frac{0.28}{0.8} = \frac{28}{80}$ ← Expressing the fraction then simplifying. First getting rid of the decimals by multiplying both the numerator and denominator by 100. Then simplifying to 7/20 by dividing both the numerator and denominator by 4

3 Circle the calculation that increases 240 by 7.5%

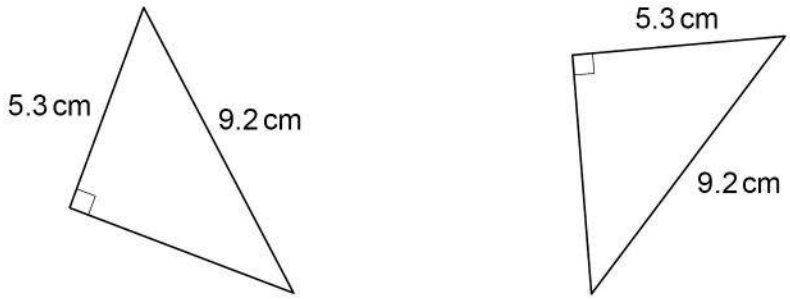
[1 mark]

240 × 1.0705 $\quad$ 240 × 1.705 $\quad$ 240 × 1.075 $\quad$ 240 × 1.75

100% + 7.5% = 107.5%. Dividing this by 100 converts the percentage into a decimal multiplier, which is 1.075. Multiplying the 240 by this multiplier increases it by 7.5%

Do not write outside the box

4



Not drawn accurately

Circle the reason why the triangles are congruent.

[1 mark]

ASA RHS SAS SSS

Both triangles have right angles, have the same hypotenuse and have another side which is the same. It is not SAS as the angle needs to be between both of the sides

5 Work out $80\,000\,0\cancel{00} \div 2\cancel{00}$

Give your answer in standard form.

[2 marks]

400000
2|800000

The 80000000 and 200 can both be divided by 100, which takes two zeros off, to make the division simpler

Answer 4×10^5

400000 must be divided by 10 5 times to get 4, which is between 1 and 10. The 4 must be multiplied by 10^5 to keep it equal and to put it into standard form

6

Do not write outside the box

6 (a) Work out $\frac{3^{12}}{3^7}$

Give your answer as a whole number.

[2 marks]

3^5 ← When dividing powers of the same number, the powers can be subtracted. $a^x \div a^y = a^{x-y}$. 12 - 7 = 5

27
x 3
81
x 3
243

← $3^5 = 3 \times 3 \times 3 \times 3 \times 3$. Starting with 3 and keep multiplying by 3: 3, 9, 27, 81, 243

Answer 243

6 (b) Simplify $8 \times 2^6 \times 2^4$

Give your answer as a power of 2

[2 marks]

$2^3 \times 2^6 \times 2^4$ ← Expressing 8 as a power of 2. $8 = 2^3$

Answer 2^{13}

When multiplying powers of the same number, the powers can be added. $a^x \times a^y = a^{x+y}$. 3 + 6 + 4 = 13

Do not write outside the box

7 In a group of 98 students

25 study both Art and French

10 study Art but do not study French

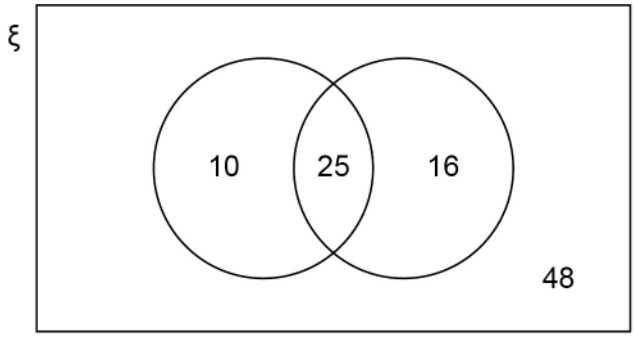
41 study French.

Joel draws this Venn diagram to represent the information.

ξ = the group of 98 students

A = the students who study Art

F = the students who study French



Make **two** criticisms of his diagram.

[2 marks]

Criticism 1 The circles aren't labelled

It isn't clear which circle represents Art and which one represents French

Criticism 2 The numbers don't add up to 98

10 + 25 + 16 + 48 = 99 and there are 98 students in total

Turn over for the next question

6

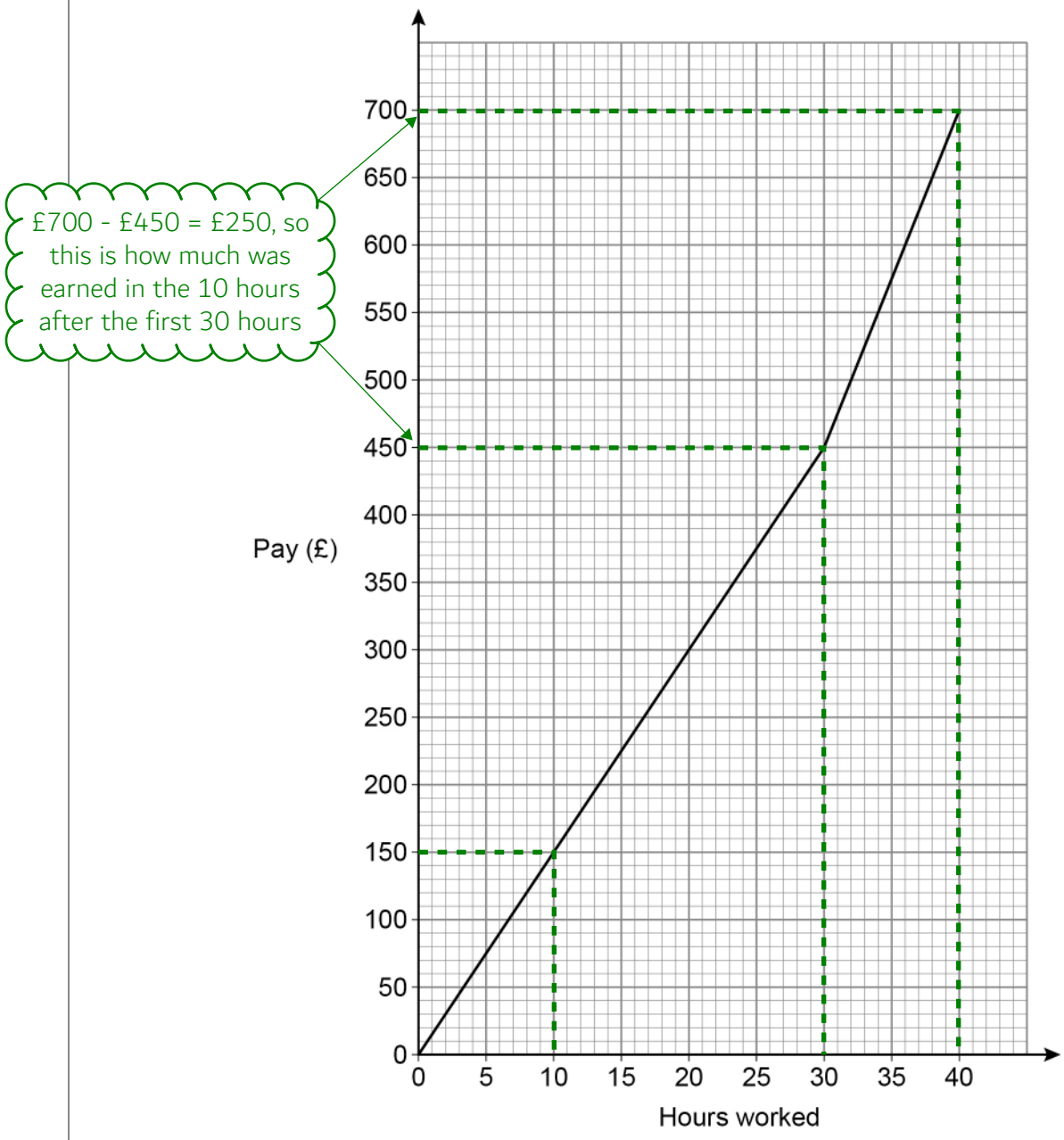
Do not write outside the box

8 In a week, Samir is paid

a basic hourly rate for the first 30 hours worked

an overtime hourly rate for any extra hours worked.

The graph shows his pay for working up to 40 hours in a week.



Do not write outside the box

Work out the ratio basic hourly rate : overtime hourly rate

Give your answer in its simplest form.

[3 marks]

150 ÷ 10 ← £150 was earned in 10 hours within the range of the first 30 hours. Dividing the £150 by the 10 hours works out that the basic hourly rate is £15 per hour

250 ÷ 10 ← £250 was earned in the 10 hours after the first 30 hours. Dividing the £250 by the 10 hours works out that the overtime hourly rate is £25 per hour

15:25 ← Expressing the ratio of the basic hourly rate : overtime hourly rate

Answer 3 : 5

Dividing both sides of the ratio by 5 simplifies the ratio. It cannot go any simpler as 3 and 5 cannot be divided by the same amount to get smaller whole numbers

9 (a) In each box, write a fraction **less** than 1 to make a correct calculation.

[1 mark]

$$\frac{1}{2} \times \frac{3}{5} = \frac{3}{10}$$

To multiply fractions, multiply the numerators and multiply the denominators. The fraction is less than 1 if the denominator is more than the numerator

9 (b) In each box, write a decimal **less** than 1 to make a correct calculation.

[1 mark]

$$0.1 \times 0.6 = 0.06$$

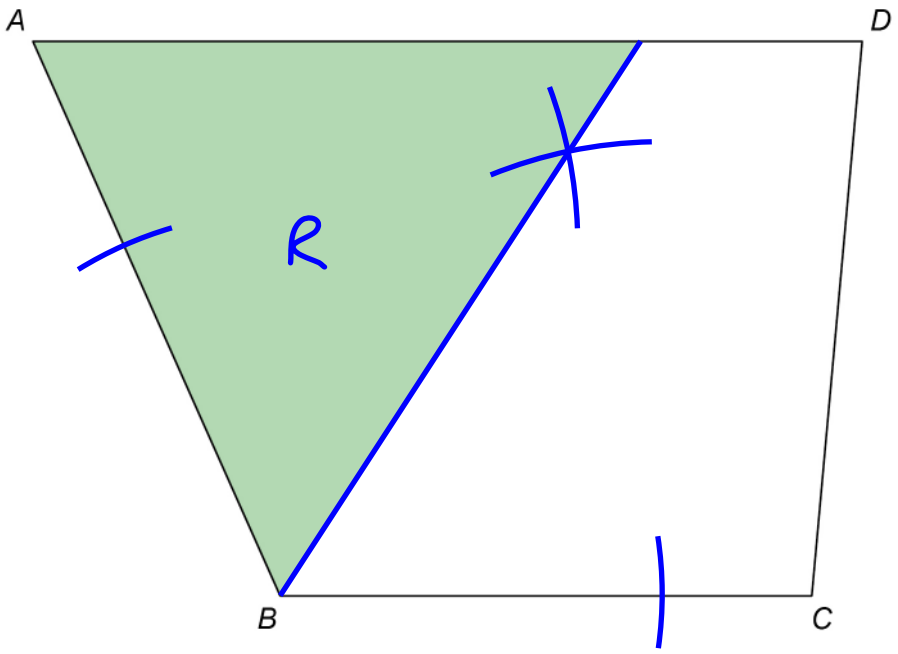
Ignoring the decimals, 1 x 6 = 6. There is 2 decimal places in 0.06 therefore there must be 2 decimal places in total in first and second number

5

Do not write outside the box

10 Use a ruler and compasses in this question.

ABCD represents a garden.



A tree is to be planted in the garden.

The tree will be in the region that is closer to *AB* than to *BC*.

Label the region, R, where the tree could be planted.

Show all your construction lines.

[3 marks]

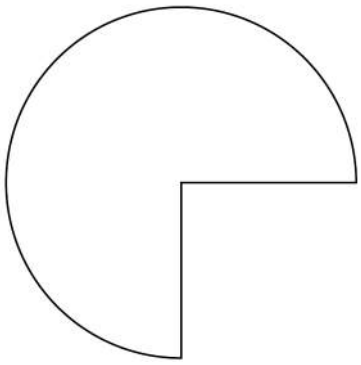
The line which represents all points which are an equal distance from AB and BC needs to be drawn. This will be an angle bisector of angle ABC. To draw this, put the needle of the compass in at B and scribe two arcs using the same radius, one which cuts line AB and the other which cuts line BC. Then put the needle of the compass in the arc which cuts line AB and draw another arc which is at least half way between lines AB and BC. Repeat this step but put the needle in the arc which cuts line BC. This should form a cross. Draw a straight line from point B through this cross. The region is everything to the left of the line and is shaded in green (but it does not need to be shaded in the exam)

Do not write outside the box

11 Here are two shapes, P and Q.

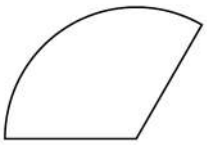
P

$\frac{3}{4}$ of a circle, radius 20 cm



Q

$\frac{1}{3}$ of a circle, radius 15 cm



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How many times bigger is the area of P than the area of Q?

You **must** show your working.

[4 marks]

20^2
$400 \div 4$
100×3
300π

Area of circle = π x radius^2. The radius of P is 20cm. $2^2 = 2 \times 2 = 4$, so $20^2 = 400$. Doing 3/4 of this by dividing the 400 by 4 to get 100 then multiplying this by 3 to get 300, which is then multiplied by π. The area of P is 300π

15
x15
75
150
225

Area of circle = π x radius^2. The radius of Q is 15cm. $15^2 = 15 \times 15 = 225$. Doing 1/3 of this by dividing the 225 by 3 to get 75, which is then multiplied by π. The area of Q is 75π

075
3|225

$\frac{300\pi}{75\pi}$

004
75|300
150
225
300

Dividing the area of P by the area of Q works out how many times bigger the area of P is than the area of Q. π cancels out from the numerator and denominator of the fraction then 300 can be divided by 75

Answer 4

7

Do not write outside the box

12 In a game, two bags, A and B, contain cards.

Each card is marked Yes or No.

The table shows the number of each type of card in the bags.

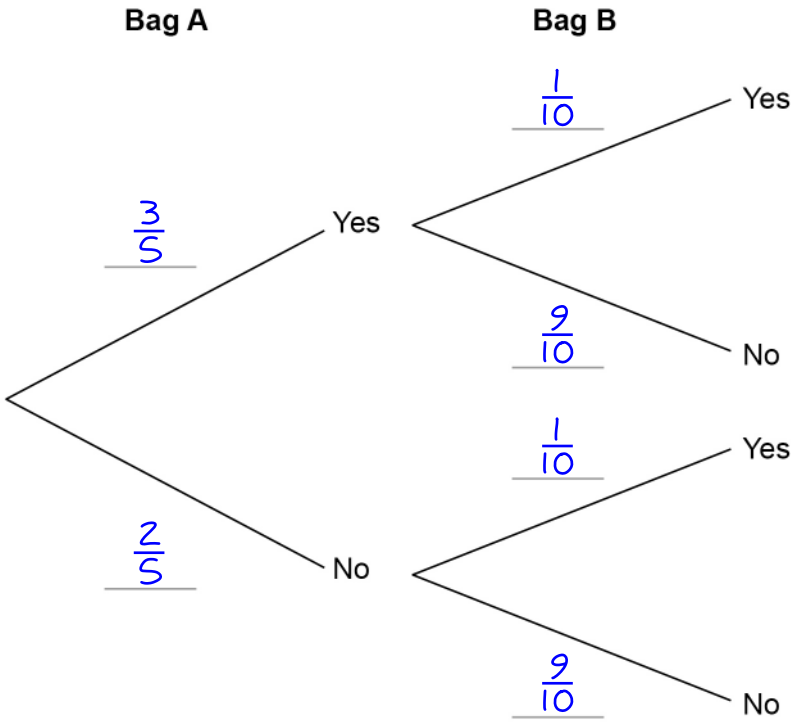
	Yes	**No**
Bag A	3	2
Bag B	1	9

In the game, a player picks one card at random from each bag.

The cards are then put back into the bags.

12 (a) Complete the tree diagram.

[2 marks]



3 + 2 = 5 so there are 5 cards in total in bag A. Out of these, there are 3 which are yes and 2 which are no. 1 + 9 = 10 so there are 10 cards in total in bag B. Out of these, there is 1 which is yes and 9 which are no

Do not write outside the box

12 (b) To win a prize, a player must pick two cards marked Yes.

450 people each play the game once.

How many people are expected to win a prize?

[3 marks]

$\frac{3}{5} \times \frac{1}{10} = \frac{3}{50}$ ← Yes AND yes. AND means to multiply the probabilities. To multiply fractions, multiply the numerators and the denominators

450 ÷ 50
9 x 3 ← Working out 3/50 of the 450 by dividing 450 by 50 then multiplying the result by 3. 450 ÷ 50 = 45 ÷ 5 = 9

Answer 27

13 Solve $\frac{2w}{15} = \frac{4}{5}$

[2 marks]

$\frac{12}{15}$ ← Multiplying both the numerator and denominator of 4/5 by 3 makes the denominator of both fractions the same and converts it into 12/15

2w = 12 ← The numerator of the fraction on the left of the equation must equal to the numerator on the right of the equation as both fractions have the same denominator

$w =$ 6

Dividing both sides of the equation by 2 finds that w = 6

7

Do not write outside the box

14 15 workers can complete a job in 8 days.

How many **more** workers are needed to complete the job in 6 days?

Assume that all of the workers work at the same rate.

[3 marks]

$15 \times 8 = 120$ ← 15 workers working for 8 days each do 120 days worth of work in total

$120 \div 6 = 20$ ← Dividing the 120 days worth of work by the 6 days works out that 20 workers would be needed

$20 - 15 = 5$ ← Subtracting the 15 workers from the 20 workers needed works out how many more workers are needed

Answer 5

15 The cross section of a prism has n sides.

Circle the expression for the number of faces of the prism.

[1 mark]

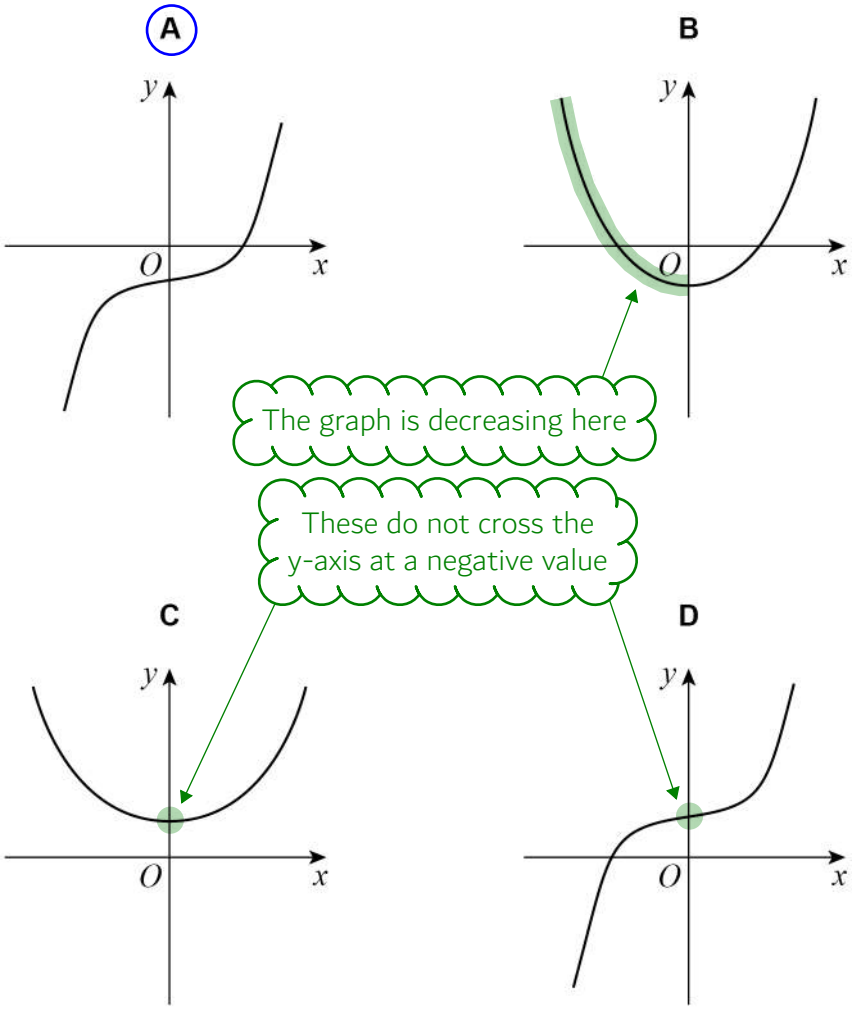
n $\quad$ $2n$ $\quad$ $3n$ $\quad$ $(n+2)$

A triangular prism has a triangle as its cross section. This has 3 sides so n would be 3. It has 5 faces. The only expression which takes n to the number of faces is the last option

Do not write outside the box

16 Circle the letter of the possible sketch graph of $y = x^3 - 4$

[1 mark]



x	-1	0	1
y	-5	-4	-3

Doing a small table of values for the graph of $y = x^3 - 4$ works out that it can only be A as this is the only one crossing the y-axis with a negative value which continually increases as x increases.
$(-1)^3 - 4 = -5$. $(0)^3 - 4 = -4$. $(1)^3 - 4 = -3$

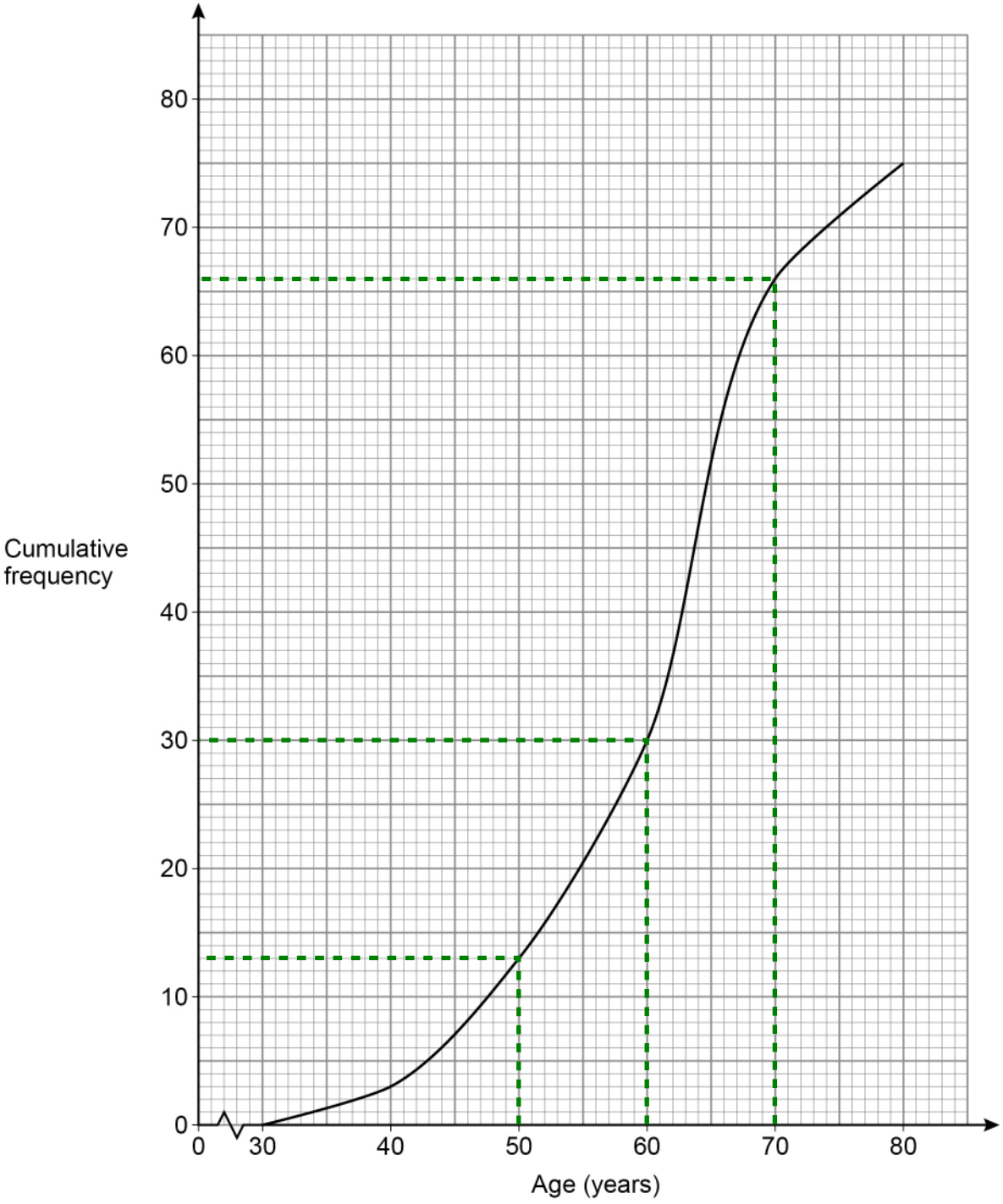
Turn over for the next question

5

Do not write outside the box

17 75 people attend a clinic.

Their ages are recorded and a cumulative frequency diagram is drawn.



Do not write outside the box

A nurse makes a statement about the **ages** of the people at the clinic.

He says,

"More than twice as many people are in their 60s as in their 50s."

Is he correct?

Tick a box.

Yes ✓ No ☐

Show working to support your answer.

[3 marks]

30 have an age of less than 60. Subtracting the 13 who have an age of less than 50 leaves 17 who are in their 50s. Multiplying this by 2 works out twice as many as this

66 have an age of less than 70. Subtracting the 30 who have an age of less than 60 leaves 36 who are in their 60s. This is more than twice the 17

Turn over for the next question

3

Do not write outside the box

18 $12x^3 + 7x^2 + 3x - 10 \equiv 2(ax^3 + x^2 + 2x - 5) + x(bx + c)$

Work out the values of a, b and c.

[3 marks]

$2ax^3+2x^2+4x-10+bx^2+cx$ ← Expanding the brackets on the right side

$2ax^3+(2+b)x^2+(4+c)x-10$ ← Collecting like terms to put in the same form as the left side of the identity

$a =$ 6 $b =$ 5 $c =$ -1

As it is an identity, both sides are identical. Therefore there must be $12x^3$ on both sides. Equating the coefficients finds that $2a = 12$ so $a = 6$. There must be $7x^2$ on both sides. $2 + b = 7$ so $b = 5$. There must be $3x$ on both sides. $4 + c = 3$ so $c = -1$

Do not write outside the box

19 The first three terms of a sequence are x y xy xy^2

The sequence is continued by multiplying the previous two terms.

19 (a) Circle the 5th term of the sequence.

[1 mark]

x^3y^3 x^5y^5 x^3y^4 x^2y^3

Multiplying y and xy gives the fourth term, which is xy^2.
Multiplying this with xy gives the fifth term, which is x^2y^3

19 (b) The 8th term of the sequence is x^8y^{13}

The value of this term is negative.

What does this mean about the values of x and y ?

Tick **one** box for each row.

[2 marks]

	Must be positive	Must be negative	Could be either
x			✓
y		✓	

When two numbers are multiplied together and the result is negative, one of the two numbers must be negative. x^8 cannot be negative as it has an even power (for example, raising a negative to the power of 2 makes it positive as a negative multiplied by a negative gives a positive) so y^{13} must be negative. x could be either positive or negative as raising it to an even power will make x^8 positive. y must be negative as raising it to an odd power will make y^{13} negative

Turn over for the next question

6

Do not write outside the box

20 Rearrange $y = \frac{5x + 9}{x}$ to make x the subject.

[4 marks]

$yx = 5x + 9$ ← Multiplying both sides by x to get rid of x as the denominator

$yx - 5x = 9$ ← Subtracting 5x from both sides to get all of the x terms on the same side

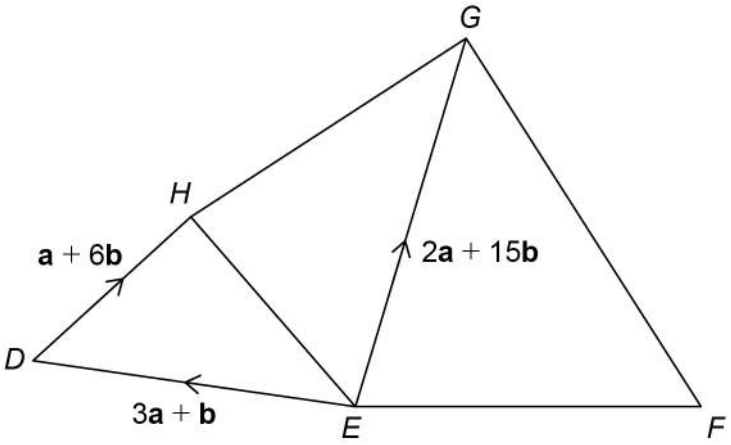
$x(y - 5) = 9$ ← Bringing x out as a factor to get it out of the two terms it is in

Answer $x = \frac{9}{y-5}$

Dividing both sides by (y - 5) gets x on its own

Do not write outside the box

21 Five points are connected by vectors.



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$\overrightarrow{FG} = 2\overrightarrow{EH}$

Work out $\overrightarrow{FE}$ in terms of **a** and **b**.

[4 marks]

4a+7b ← $\overrightarrow{EH} = \overrightarrow{ED} + \overrightarrow{DH} = 3a + b + a + 6b$

8a+14b-2a-15b ← $\overrightarrow{FE} = \overrightarrow{FG} + \overrightarrow{GE} = 2\overrightarrow{EH} + \overrightarrow{GE}$. $\overrightarrow{GE}$ is going the opposite way to $\overrightarrow{EG}$ so it becomes -2a - 15b

Answer 6a-b

Collecting like terms

8

Do not write outside the box

22 Work out $0.6\dot{8} - 0.4\dot{5}$

Give your answer as a fraction in its simplest form.

[5 marks]

$$\begin{array}{r} 0.68\dot{} \\ -0.45\dot{} \\ \hline 0.23\dot{} \end{array}$$

The two decimals can be subtracted

$x = 0.23\dot{}$
$10x = 2.33\dot{}$

Let x be the recurring decimal. There is one recurring digit so multiplying by 10 once allows the recurring digit to be written in the same decimal place as the original decimal

$$\begin{array}{r} 2.33\dot{} \\ -0.23\dot{} \\ \hline 2.10 \end{array}$$
$9x = 2.1$

Subtracting x from 10x gets rid of of the recurring digit

$x = \frac{2.1}{9} = \frac{21}{90}$

Rearranging to express x as a fraction then simplifying the fraction by multiplying the numerator and denominator by ten to get rid of the decimal

Answer $\frac{7}{30}$

Dividing both the numerator and denominator by 3 simplifies the fraction. It cannot go any simpler as 7 and 30 cannot be divided by the same amount to get smaller whole numbers

Do not write outside the box

23 On the grid, identify the region represented by

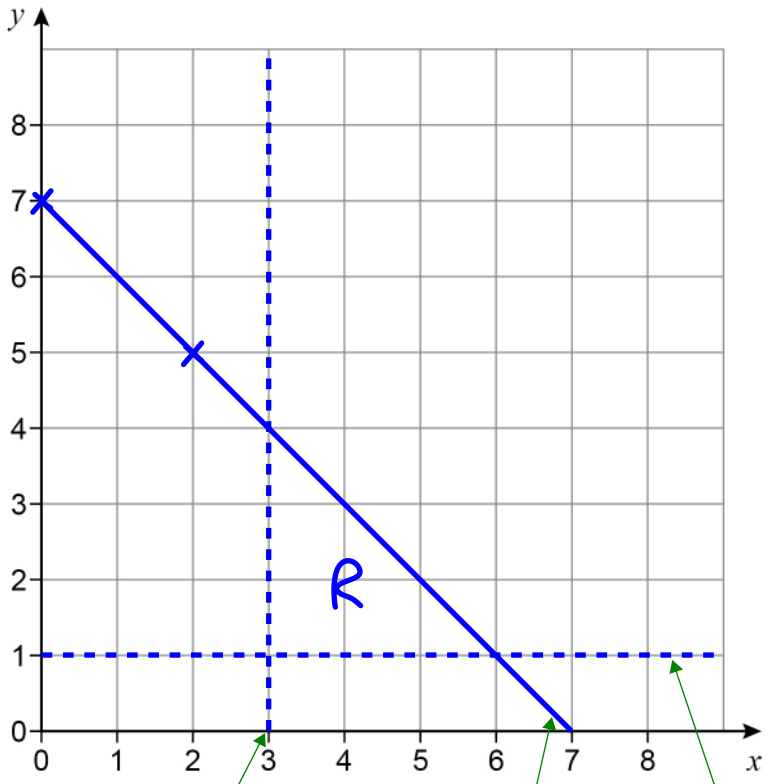
$x > 3$ and $y > 1$ and $x + y \leqslant 7$

$y \leq 7 - x$

Rearranged to make y the subject to make it easier to draw

Label the region R.

[3 marks]



The line of x = 3. The region must be to the right of this line as x is greater, so everything on the left is crossed out. The line is dashed as it is not equal to

The line of y = 1. The region must be to above this line as y is greater, so everything below is crossed out. The line is dashed as it it not equal to

The line of y = 7 - x. When x = 0, y = 7 - 0 = 7 and when x = 2, y = 7 - 2 = 5. The coordinates of (0 , 7) and (2 , 5) are plotted then because it is a straight line, it can be drawn through both of these points. The region must be below this line as y is less, so everything above is crossed out. The line is solid as it can be equal to

The region is everything which is not crossed out

Turn over for the next question

8

Turn over ►

Do not write outside the box

24 (a) Simplify fully $\frac{6}{a} - \frac{11}{4a}$

[2 marks]

$\frac{24}{4a} - \frac{11}{4a}$

The fractions need to have the same denominators so that they can be subtracted. The denominator of the first fraction can be multiplied by 4 to get 4a then the numerator also needs to be multiplied by 4 to get 24

Answer $\frac{13}{4a}$

Once the denominators are the same, the numerators can be subtracted

24 (b) Simplify fully $(y^2 - 3y) \times \frac{y^2 + 10y + 21}{y^2 - 9}$

[4 marks]

$\frac{y(y-3)(y+3)(y+7)}{(y+3)(y-3)}$

To multiply by a fraction, the numerators can be multiplied and the denominators can be multiplied.
To simplify a fraction, the numerator and denominator should be divided by a common factor.
Factorising the numerator and denominator expresses both as factors.

y is the highest common factor of y^2 and -3y so this is brought out as a factor and the rest is left in a bracket. (y^2 - 3y) factorises to y(y - 3).

To factorise the y^2 + 10y + 21, two numbers which multiply to the 21 and add to the 10 can be found. 3 and 7 do this so these can be put in brackets with y. y^2 + 10y + 21 factorises to (y + 3)(y + 7).

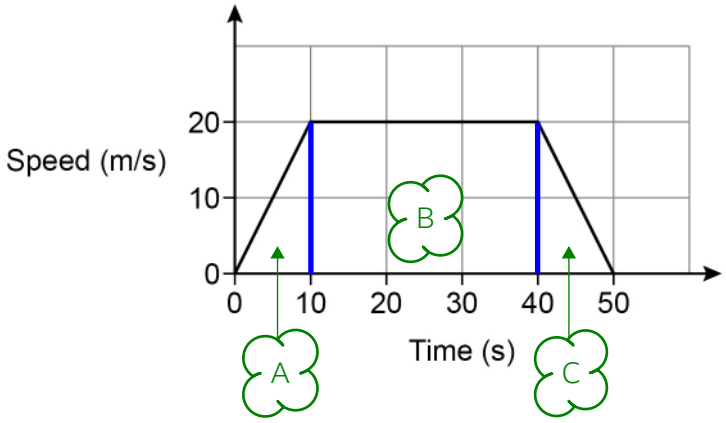
y^2 - 9 can be factorised by using difference of two squares: $A^2 - B^2 = (A + B)(A - B)$. A is y and B is 3. y^2 - 9 factorises to (y + 3)(y - 3)

Answer $y(y+7)$

The factors which are common to the numerator and denominator can be cancelled out. (y - 3) and (y + 3) are common factors. This leaves y(y + 7)

Do not write outside the box

25 Here is the speed-time graph for a 50-second journey.



The distance travelled on a speed-time graph is the area under the line

25 (a) Circle the acceleration, in m/s^2, halfway through the journey.

[1 mark]

0 2 20 25

Halfway through the 50 seconds is 25 seconds. The speed at this time is not changing therefore the acceleration is 0

25 (b) Work out the total distance travelled.

[2 marks]

$\frac{1}{2} \times 10 \times 20 = 100$ ← Areas of triangle A and triangle C. Area of triangle = 1/2 x base x height. The bases are 10 and the heights are 20

$30 \times 20 = 600$ ← Area of rectangle B. Area of rectangle = length x width. The length is 30 and the width is 20

$100 + 600 + 100$ ← Adding together the area of the three shapes gives the total area

Answer 800 m

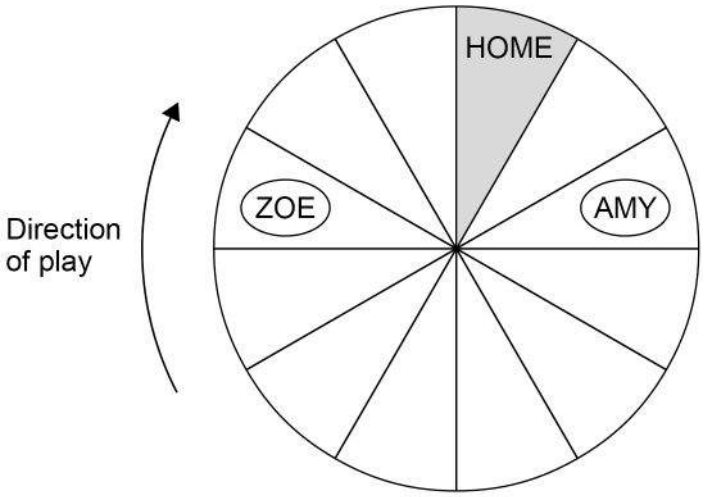
9

Do not write outside the box

26 Zoe and Amy are playing a board game.

- They each have one disc and take turns to roll a fair, ordinary dice.
- The player moves their disc **clockwise** the number of spaces shown on the dice.
- The winner is the first player whose disc is on HOME at the end of a turn.

Here is the board after Amy's turn.



Work out the probability that Zoe wins within her next two turns.

[4 marks]

$\frac{1}{6}+\frac{1}{6}\times\frac{1}{6}+\frac{1}{6}\times\frac{1}{6}$

Zoe needs to move another 3 spaces to win. The most she can move within two turns is 12 and it is more than this to go round the board then to home. The outcomes which result in a win are 3 OR 1 AND 2 OR 2 AND 1. OR means to add, AND means to multiply. The probability of each number is 1/6 as there are 6 outcomes and 1 of these is the number

$\frac{6}{36}+\frac{1}{36}+\frac{1}{36}$

To multiply fractions, multiply the numerators and multiply the denominators. 1/6 x 1/6 = 1/36. Then to add the fractions the denominators need to be the same so converting 1/6 into 6/36 by multiplying both the numerator and denominator by 6

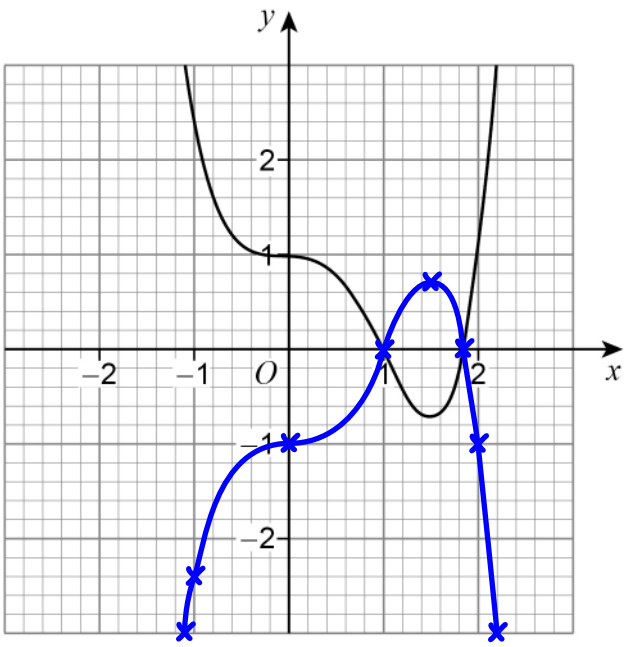
The fractions are added by adding the numerators and the denominator stays the same

$\frac{8}{36}$

Answer _____

Do not write outside the box

27 The grid shows the graph of $y = f(x)$



On the grid, draw the graph of $y = -f(x)$

[2 marks]

The whole function is negative, which means that all the values which were positive become negative and all the values which were negative become positive. This is a reflection in the x-axis. Plotting the key points then connecting them with a curve

Turn over for the next question

6

Do not write outside the box

28 Work out the value of $(\cos 30° \times \sin 45° \times \tan 60°)^2$

[4 marks]

	0	30	45	60	90
Sin	0	1	2	3	4
Cos	4	3	2	1	0

The angles we need to know the trig values for are 0, 30, 45, 60 and 90. Listing these out. Listing 0, 1, 2, 3, 4 underneath for the sin values and 4, 3, 2, 1, 0 for the cos values

$\frac{\sqrt{3}}{2} \div \frac{1}{2} = \frac{\sqrt{3}}{2} \times \frac{2}{1} = \sqrt{3}$

tan60 = sin60/cos60. Square rooting the values listed for sin and cos and putting them over 2 finds the exact values of each. The square root of 1 is 1. To divide by a fraction, keep the first fraction, change the division to a multiply and flip the second fraction. So tan60 = $\sqrt{3}$

$\frac{\sqrt{3}}{2} \times \frac{\sqrt{2}}{2} \times \sqrt{3}$

Square rooting the values listed for sin and cos and putting them over 2 finds the exact values of each. Multiplying together the values of cos30, sin45 and tan60

$\left(\frac{3\sqrt{2}}{4}\right)^2$

To multiply fractions, multiply the numerators and multiply the denominators. $\sqrt{3} \times \sqrt{3} = 3$. Squaring the result

Answer $\frac{18}{16}$

Squaring the numerator and squaring the denominator. $(3\sqrt{2})^2 = 3 \times \sqrt{2} \times 3 \times \sqrt{2} = 3 \times 3 \times \sqrt{2} \times \sqrt{2} = 9 \times 2 = 18$. $4^2 = 16$

END OF QUESTIONS

4