FEB MOCK

AQA

PRACTICE PAPER SET 3

Please write clearly in block capitals. WRITTEN SOLUTIONS

Centre number

Candidate number

Surname

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier Paper 2 Calculator

Date of Exam Morning 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.
- 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.

Do not write outside the box

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

2 IS GRADIENT

1 The equation of a line is $y = 2x - 1$ → Y-INTERCEPT

Circle the point that is the intercept with the y-axis.

(0, -1) **[1 mark]**

(0, –1) (–1, 0) $(0, \frac{1}{2})$ $(\frac{1}{2}, 0)$

2 Simplify $\frac{a^4 \times a^6}{a^3}$ $= \frac{a^{4+6}}{a^3} = \frac{a^{10}}{a^3} = a^{10-3} = a^7$

Circle your answer.

[1 mark]

a^7 a^8 a^{21} a^6

3 A coin is thrown 50 times.

The coin lands on heads 30 times. =

Circle the relative frequency of landing on heads. = 30 OUT OF TOTAL TIMES

[1 mark]

30 3 : 5 30% $\frac{3}{5}$

$\frac{30}{50} = \frac{3}{5}$

4 A number, x, is 15.8 when rounded to 3 significant figures.

Circle the error interval.

[1 mark]

$15.75 < x < 15.85$	$15.75 \leqslant x < 15.85$
$15.75 < x \leqslant 15.85$	$15.75 \leqslant x \leqslant 15.85$

x CAN BE 15.75 BUT CANNOT BE 15.85

0.1

$\frac{1}{10}$

T U . t

15.8

3rd SIGNIFICANT FIGURE IS IN $\frac{1}{10}$ COLUMN SO $0.1 \div 2 = 0.05$

$15.8 + 0.05 = 15.85$

$15.8 - 0.05 = 15.75$

BUT x CANNOT BE 15.85 SO $x < 15.85$

5 (a) Expand and simplify $(x + 5)(x - 4)$

[2 marks]

$= x^2 - 4x + 5x - 20$

$= x^2 + x - 20$

Answer $x^2 + x - 20$

5 (b) Solve $(x - 8)(x + 7) = 0$

[1 mark]

WHAT VALUES OF x MAKE THE EQN. ZERO

Let $x = 8$

$(8 - 8)(8 + 7)$

$= 0 \times 15 = 0$

Let $x = -7$

$(-7 - 8)(-7 + 7)$

$= -15 \times 0 = 0$

Answer $x = 8$ $x = -7$

Do not write outside the box

6 Dev invests £1500 for 2 years.

The compound interest rate is 1.6% per year. MULTIPLIER = $\frac{100 + 1.6}{100} = 1.016$

6 (a) Which calculation works out the total value after 2 years?

Circle your answer. $1500 \times 1.016 \times 1.016 = 1500 \times 1.016^2$

[1 mark]

£1500 × 1.6 × 2	£1500 × 1.6^2
£1500 × 1.016 × 2	£1500 × 1.016^2

6 (b) Emma invests £1500 for 2 years.

The interest rate is

1.8% for the first year MULTIPLIER = $\frac{100 + 1.8}{100} = 1.018$

1.3% for the second year. MULTIPLIER = $\frac{100 + 1.3}{100} = 1.013$

Whose investment is worth more after 2 years?

You **must** show your working.

[4 marks]

EMMA: $1500 \times 1.018 = 1527$

$1527 \times 1.013 = 1546.85$ (2 d.p.)

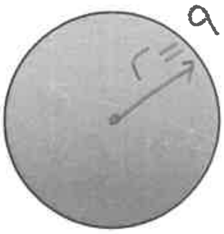
DEV: $1500 \times 1.016^2 = 1548.38$ (2dp)

Answer DEV

Do not write outside the box

7 Volume of a sphere = $\frac{4}{3}\pi r^3$

A steel sphere, radius 9 cm, is shown.



7 (a) Work out the volume of the sphere.

[2 marks]

$V = \frac{4}{3} \times \pi \times 9^3 = 972\pi = 3054.1$

$= 3050$ (NEAREST TEN)

Answer 972π or 3050 (NEAREST TEN) or 3054 cm³

7 (b) The density of the steel is 7.8 grams/cm³

Work out the mass of the sphere.

M / D | V or $D = \frac{M}{V}$

[2 marks]

$7.8 = \frac{m}{3054}$

$m = 3054 \times 7.8$

$= 23821.2$

Answer 23821.2 grams

Turn over for the next question

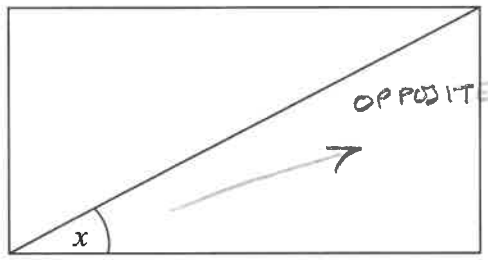
Do not write outside the box

8 The area of the rectangle is 68 cm^2

Not drawn accurately

2 USE SOH CAH TOA

$\tan = \dfrac{\text{OPPOSITE}}{\text{ADJACENT}}$



$= w$

16 cm $= l$

ADJACENT

FIND MISSING SIDE USING AREA $= l \times w$

$68 = 16 \times w$

Work out the size of angle x.

[3 marks]

$\text{AREA} = l \times w = 16 \times w = 68$

$w = 68 \div 16 = 4.25$

$\tan x = \dfrac{4.25}{16}$

$x = \tan^{-1}(4.25 \div 16) = 14.87$

Answer 14.87 degrees

or 14.9 etc.

9 Which number is **not** in standard form?

Circle your answer.

[1 mark]

1.01×10^{9} 0.99×10^{-2} 9.8×10^{6} 4.632×10^{-5}

STANDARD FORM MUST HAVE A NUMBER BETWEEN 1 AND 9 INCLUSIVE IN FRONT OF DECIMAL POINT

Do not write outside the box

10 A charity collection was made.

Information about the amounts given by men is shown in the table.

Amount, x (£)	**Midpoint**	**Number of men**	
$0 \leqslant x < 5$	$(5-0) \div 2 = 2.5$ ×	11	27.5
$5 \leqslant x < 10$	7.5 ×	7	52.5
$10 \leqslant x < 15$	12.5 ×	2	25
		Total = 20	105

ADD

The mean amount given by **women** was £6.30 per person.

Compare the mean amounts given by men and women.

[4 marks]

MEAN FOR MEN $= 105 \div 20 = £5.25$

WOMEN GAVE MORE

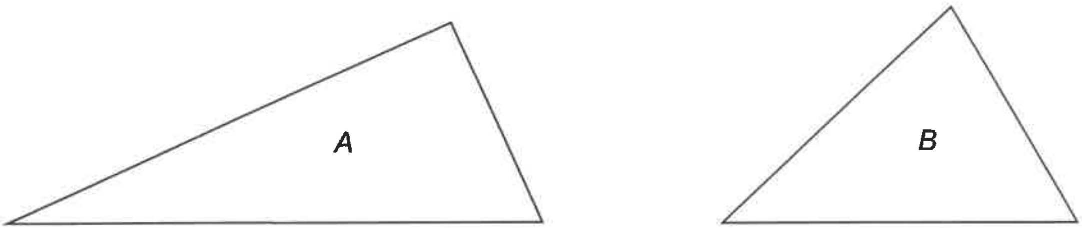
Turn over for the next question

Do not write outside the box

11 The angles in triangle A are in the ratio $1 : 2 : 3$

The angles in triangle B are in the ratio $4 : 5 : 6$

Not drawn accurately



Jack says,

"The middle number in each ratio is one third of the total, so one of the angles in each triangle is 60 degrees"

Is he correct?

Show working to support your answer.

[2 marks]

FOR A: $1 : 2 : 3$ ADD $= 6$ $180° \div 6 = 30°$

SO ANGLES FOR A MUST BE $1 \times 30 : 2 \times 30 : 3 \times 30$

$= 30 : 60 : 90$

FOR B: $4 : 5 : 6$ ADD $= 15$ $180° \div 15 = 12°$

$4 \times 12 : 5 \times 12 : 6 \times 12$

$48° : 60° : 72$

MIDDLE NUMBER IS $60°$ SO YES

GIRLS = y

12 In a class, the ratio boys : girls is $x : y$

Circle the fraction of the class that are girls.

[1 mark]

$\frac{x}{y}$ $\frac{y}{x}$ $\frac{x}{x+y}$ $\frac{y}{x+y}$

TOTAL IN CLASS = $x + y$

FRACTION OF GIRLS MUST BE $\frac{y}{x+y}$

13 The price of a computer is reduced by 17.5%

The reduced price is £264

By how much is the price reduced?

[4 marks]

MULTIPLIER = $\frac{100 - 17.5}{100}$ = 0.825

$$\text{ORIGINAL PRICE} \underset{\div 0.825}{\overset{\times 0.825}{\rightleftarrows}} £264$$

TO FIND ORIGINAL AMOUNT : $264 \div 0.825$
= 320

REDUCTION = 320 - 264 = 56

Answer £ 56

14 ξ = numbers between 0 and 1 with 3 decimal places

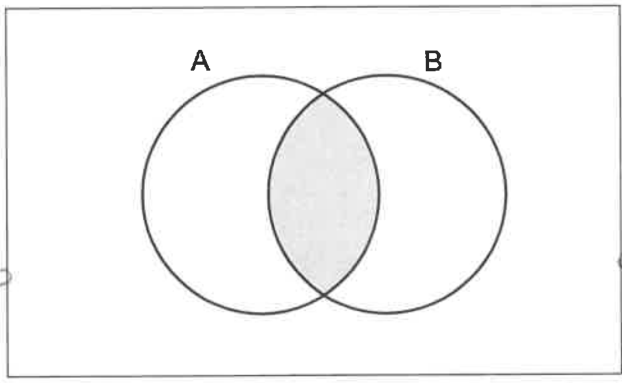
A = numbers that round to 0.7 to 1 decimal place

B = numbers that round to 0.75 to 2 decimal places

14 (a) Work out a possible number, with 3 decimal places, that is in the shaded area.

A
NUMBERS THAT ROUND TO 0.7 TO 1dp
0.65, 0.66, 0.67, 0.68, 0.69, 0.70, 0.71 0.72 0.73 0.74

ξ



B
NUMBERS THAT ROUND TO 0.75 TO 2 dp
0.750 0.751, 0.752, 0.753, 0.754, 0.745 0.746 0.747 0.748 0.749

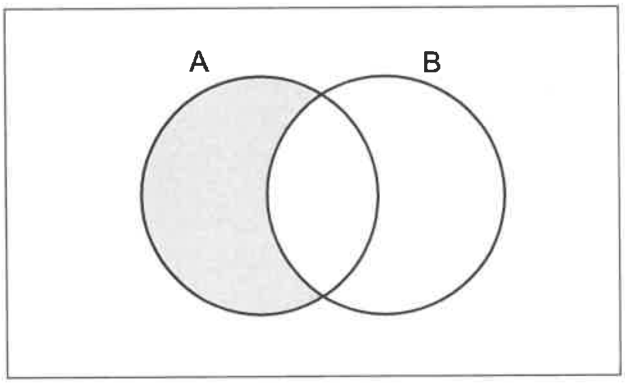
[1 mark]

0.745, 0.746, 0.747, 0.748, 0.749
ARE 3dp NUMBERS THAT ROUND TO 0.7 to 1dp AND 0.75 to 2dp

Answer AS ABOVE

14 (b) Work out a possible number, with 3 decimal places, that is in the shaded area.

ξ

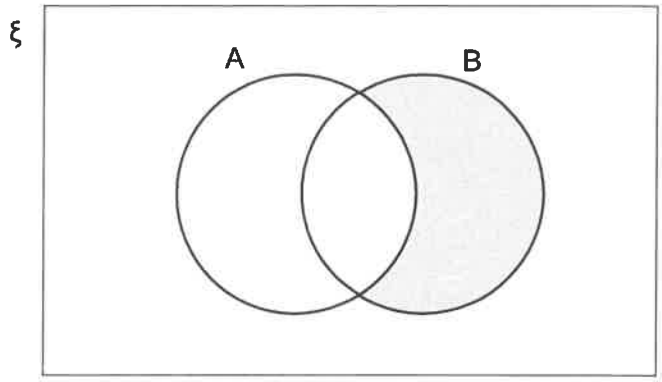


[1 mark]

ANY 3dp NUMBER FROM 0.650 TO 0.744 WILL ONLY ROUND TO 0.7 TO 1dp BUT NOT 0.75 TO 2dp

Answer eg 0.651

14 (c) Work out a possible number, with 3 decimal places, that is in the shaded area.

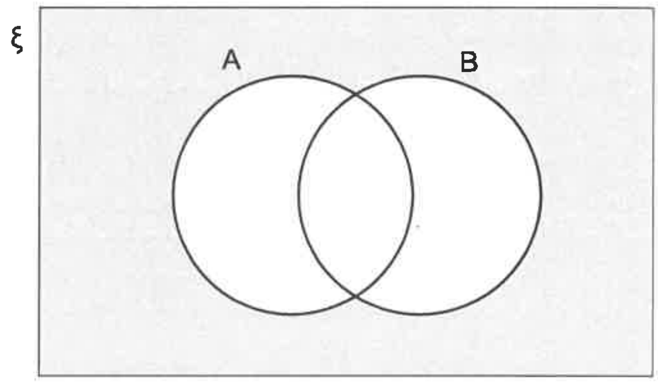


[1 mark]

B: NUMBERS FROM 0·750 TO 0·754

Answer eg 0·751

14 (d) Work out a possible number, with 3 decimal places, that is in the shaded area.



[1 mark]

BETWEEN 0 AND 1

eg. 0·001 WILL NOT BE IN A OR B

Answer 0·001

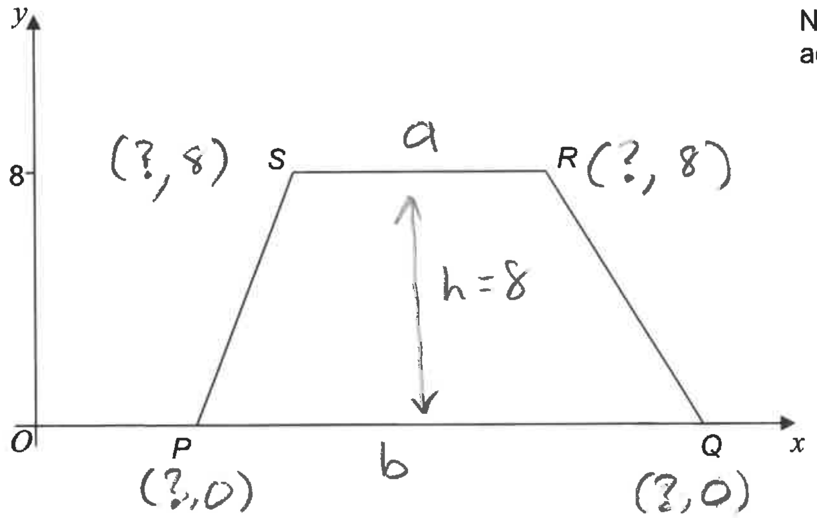
15 *PQRS* is a trapezium with *PQ* parallel to *SR*.

P and *Q* are on the x-axis.

The y-coordinate of *S* is 8

PQ > *SR*

Not drawn accurately



The area of *PQRS* is 48 square units.

Work out one possible set of points for *P*, *Q*, *R* and *S*.

[4 marks]

AREA OF TRAPEZIUM $= \frac{1}{2}(a+b) \times h$

SO $48 = \frac{1}{2} \times (a+b) \times 8 = 4(a+b)$

$48 = 4(a+b)$ (DIVIDE BOTH SIDES BY 4)

$12 = a+b$

b IS BIGGER THAN a SO a COULD BE 4

AND b COULD BE 8 (OR a = 5, b = 7 etc)

SO DIFFERENCE BETWEEN P + Q x COORDINATES COULD BE 8, AND S AND R COULD BE 4

eg

P (2 , 0) (2 + 8 = 10)

Q (10 , 0)

R (5 , 8) MAKE R SAY 5 = x

S (9 , 8) 5 + 4 = 9

Do not write outside the box

16 (a) I am thinking of two different numbers.

They are both greater than 10

Their highest common factor (HCF) is half the smaller number.

Work out one possible pair of numbers.

[1 mark]

TRY : 16 24

FACTORS: 1, 2, 4, 8, 16 1, 2, 3, 4, 8, 12, 24

HCF = 8

Answer 16 and 24

OR : 12 18

OR 100 250 etc

16 (b) a, b and c are prime numbers.

$$N = a^3 \times b^2 \times c$$

a COULD BE 2, OR b COULD BE 2 OR C COULD BE 2 : SEE BELOW

Is N always odd?

Tick a box.

Yes ☐ No ☑

Give reasons for your answer.

[2 marks]

PRIME CAN BE ODD OR EVEN (2)

ODD × ODD = ODD EVEN × EVEN = EVEN

EVEN × ODD = EVEN LET C = 2 (EVEN)

THEREFORE a^3 CAN BE ODD IF a IS ODD

b^2 = ODD × ODD = ODD

$a^3 \times b^2$ = ODD × ODD = ODD

$a^3 \times b^2 \times c$ = ODD × ODD × EVEN = ODD × EVEN = EVEN

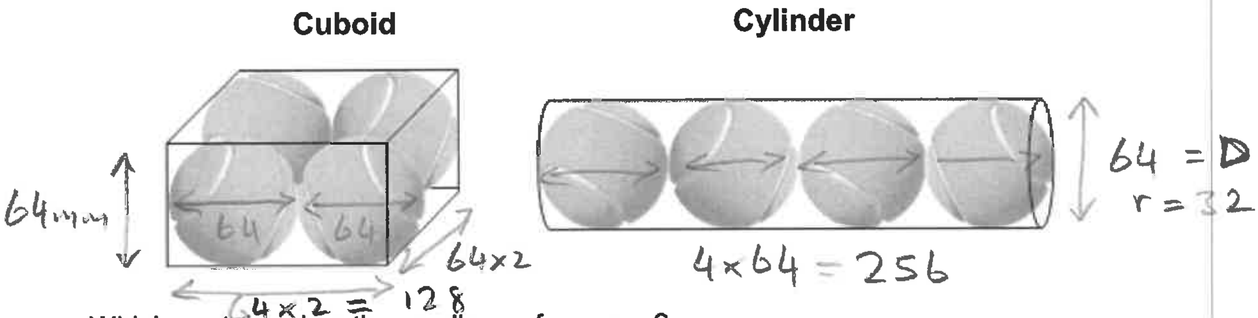
SO NOT ALWAYS ODD

Do not write outside the box

17 Here are two closed containers.

Four tennis balls just fit in each container.

Each tennis ball has diameter 64 mm



Which container has the smaller surface area?

You **must** show your working.

[5 marks]

CUBOID MUST HAVE DIMENSIONS $h = 64$, $w = 64 \times 2 = 128$

AND DEPTH $= 64 \times 2 = 128$

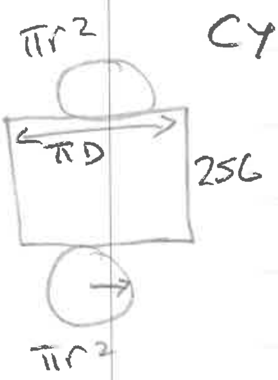
SO SURFACE AREA: FRONT AND BACK: $64 \times 128 + 64 \times 128$

$= 16384$

TWO SIDES $= 128 \times 64 + 128 \times 64 = 16384$

TOP + BOTTOM $= 128 \times 128 + 128 \times 128 = 32768$

TOTAL $= 32768 + 16384 + 16384 = 65536$



CYLINDER: 2 CIRCULAR ENDS: AREA $= \pi r^2 \times 2$

$= \pi \times 32^2 \times 2 = 2048\pi$

AREA OF BODY = CIRCUMFERENCE $\times 256$

$= \pi \times 64 \times 256 = 16384\pi$

TOTAL $= 2048\pi + 16384\pi = 18432\pi$

$= 57906.19\ldots$

CYLINDER HAS SMALLER SURFACE AREA

Answer CYLINDER

Do not write outside the box

18 Here is some information about the times, in minutes, 80 teachers took to get to work.

Time t (minutes)	Frequency		CUMULATIVE FREQUENCY
$0 < t \leqslant 20$	12		12
$20 < t \leqslant 40$	32	$12+32 =$	44
$40 < t \leqslant 60$	25	$44+25 =$	69
$60 < t \leqslant 90$	11	$69+11 =$	80

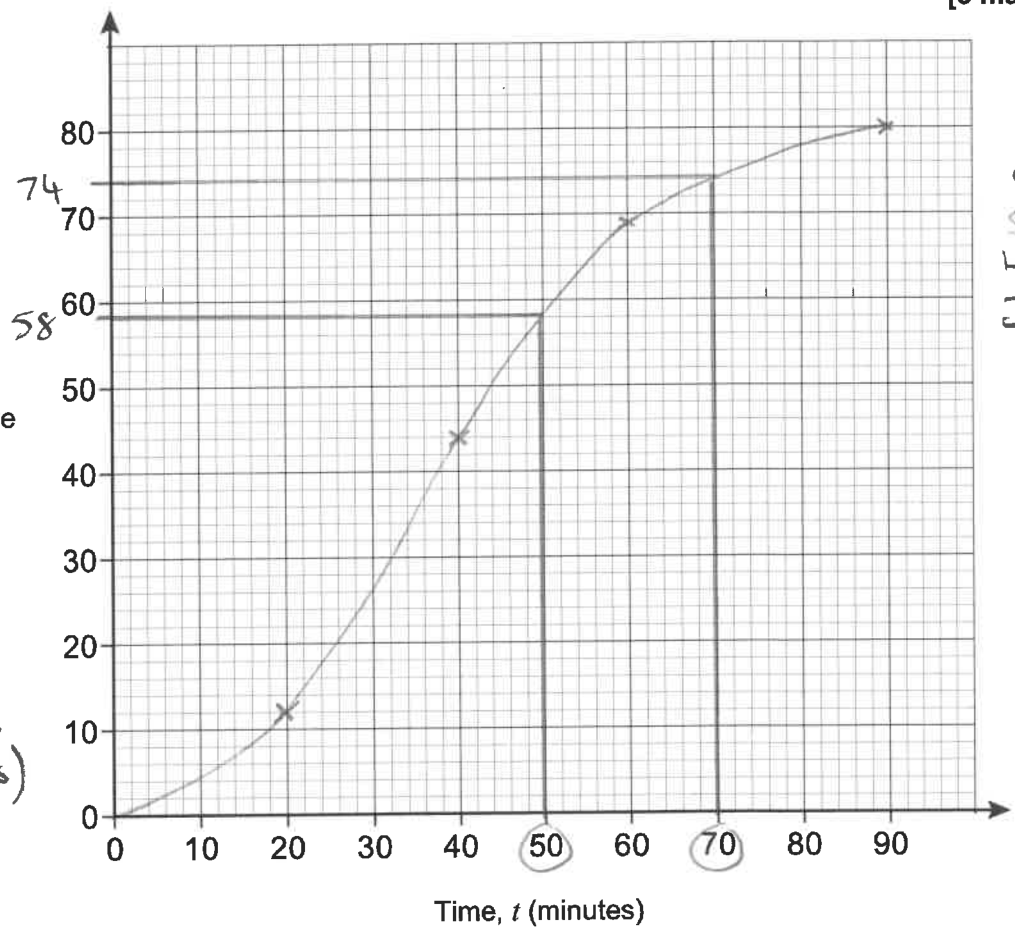
18 (a) On the grid, draw a cumulative frequency graph.

[3 marks]

PLOT POINTS AT UPPER END OF CLASS INTERVALS:
(20, 12)
(40, 44)
(60, 69)
(90, 80)

(SMALL SQUARES GOING UP IN TWO'S)

Cumulative frequency



DRAW CURVED OR STRAIGHT LINES TO JOIN POINTS

18 (b) Estimate the number of teachers who took between 50 minutes and 70 minutes to travel to work.

[2 marks]

AT 50 MINS : APPROXIMATELY 58

AT 70 MINS : APPROX : 74

$74 - 58 = 16$

Answer 16

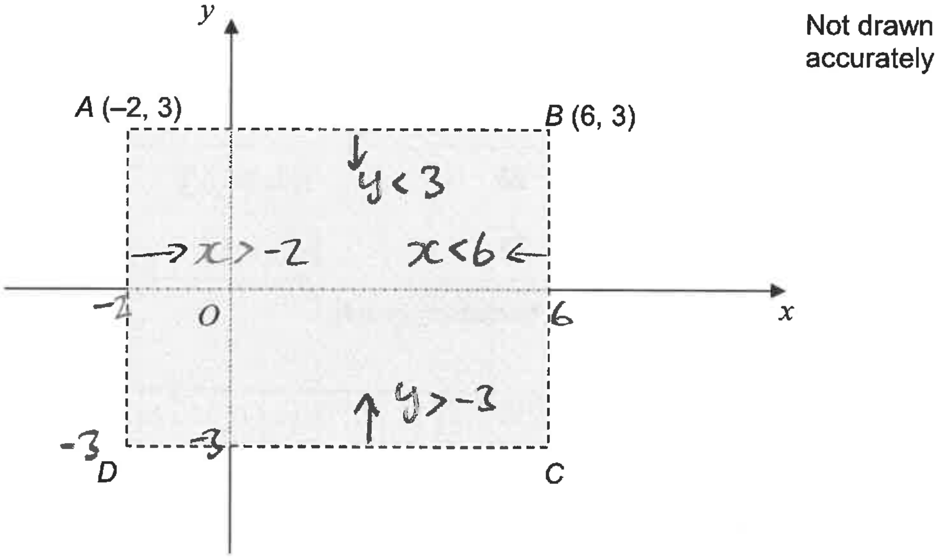
ANSWERS AROUND 15, 16, 17

Turn over ▶

Do not write outside the box

19 (a) *ABCD* is a rectangle.

The x-axis is a line of symmetry.



These inequalities describe the shaded region.

$p < x < q$ and $r < y < s$

Write down the values of p, q, r and s.

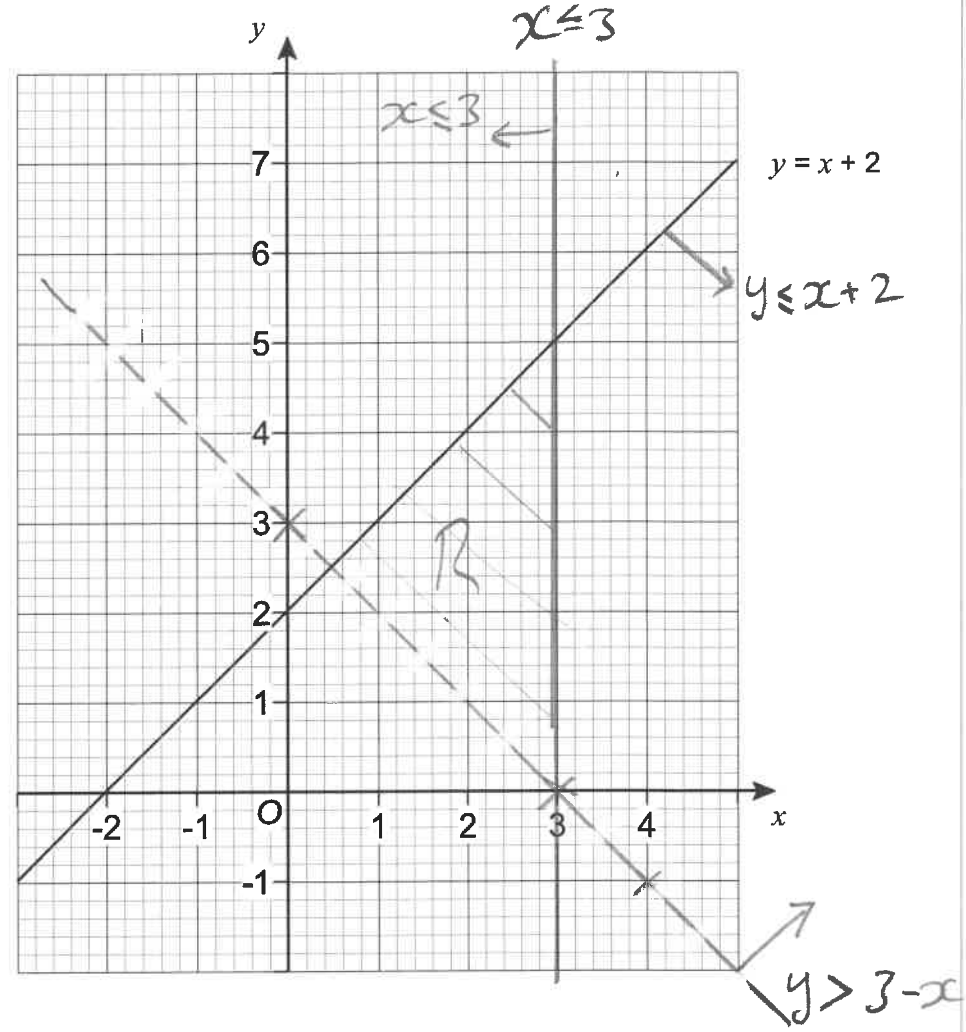
[2 marks]

p = -2 q = 6

r = -3 s = 3

Do not write outside the box

19 (b) The grid shows the graph of $y = x + 2$



FOR $y > 3 - x$,
SELECT VALUES OF x
AND SUBSTITUTE
INTO $y = 3 - x$

x	0	3		
y	3	0		

$x = 0$
$y = 3 - 0 = 3$
$(0, 3)$
$x = 3$
$y = 3 - 3 = 0$
$(3, 0)$
$x = 4$
$y = 3 - 4 = -1$
$(4, -1)$
PLOT POINTS
BUT $y > 3 - x$
SO AREA
ABOVE THE
LINE
(DOTTED LINE
AS $y >$ NOT $y \geq$)

On the grid, identify the region represented by

$y \leqslant x + 2$ and $y > 3 - x$ and $x \leqslant 3$

LESS THAN
MEANS 'UNDER'
THE LINE

(DRAW LINE $x = 3$)

Label the region R.

[3 marks]

AS $x \leq 3$ IT MUST BE
A SOLID LINE.

Turn over for the next question

Do not write outside the box

20 $f(x) = 3^{2x}$ and $g(x) = x^3$ for all values of x.

20 (a) Work out the value of $f(1) + g(4)$

[2 marks]

$f(1) = 3^{2\times 1} = 3^2 = 9$ $g(4) = 4^3 = 64$

$9 + 64 = 73$

Answer 73

20 (b) Work out the value of $g^{-1}(-27)$

[2 marks]

$g^{-1}(x)$ EQUALS INVERSE OF $x^3 = \sqrt[3]{x}$

$g^{-1}(-27) = \sqrt[3]{-27} = -3$

(BECAUSE $-3 \times -3 \times -3 = (-3)^3 = -27$)

Answer -3

20 (c) Work out an expression for $gf(x)$

Give your answer as a power of 3 in its simplest form.

[2 marks]

$f(x) = 3^{2x}$, $g(x) = x^3$

so $gf(x) = g(3^{2x}) = (3^{2x})^3 = 3^{2x \times 3}$

$= 3^{6x}$

Answer 3^{6x}

Do not write outside the box

20 (d) One of these graphs is a sketch of $y = 3^{2x}$ EXPONENTIAL GRAPH

Which one?

Circle the correct letter.

TEST SOME VALUES

x	-2	-1	0	1	2	3	4
3^{2x}	3^{-4}	3^{-2}	$3^0 = 1$	3^2	3^4		
y	0.012	0.111	1	9	81		

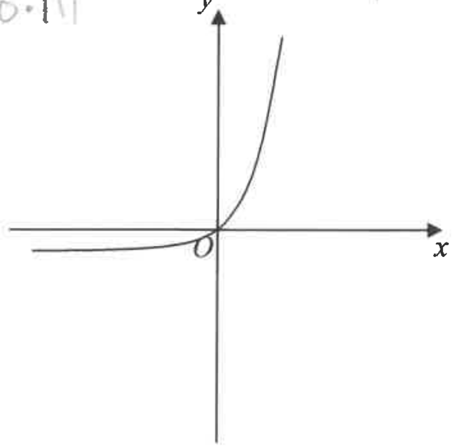
[1 mark]

$3^{-4} = \frac{1}{3^4} = 0.012$

$3^{-2} = \frac{1}{9} = 0.111$

SO GRAPH C

A



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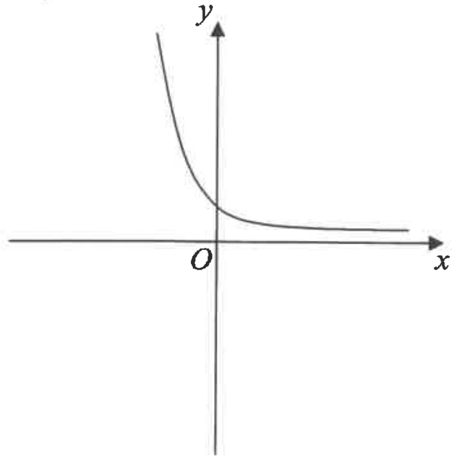
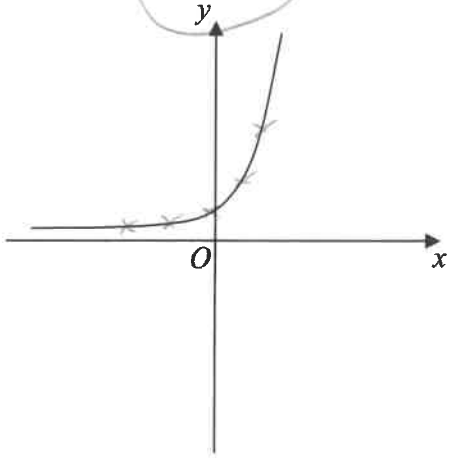


C



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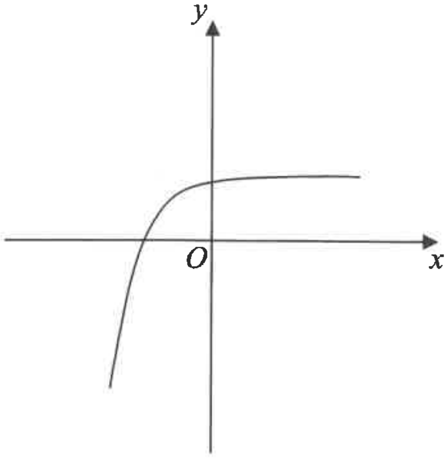


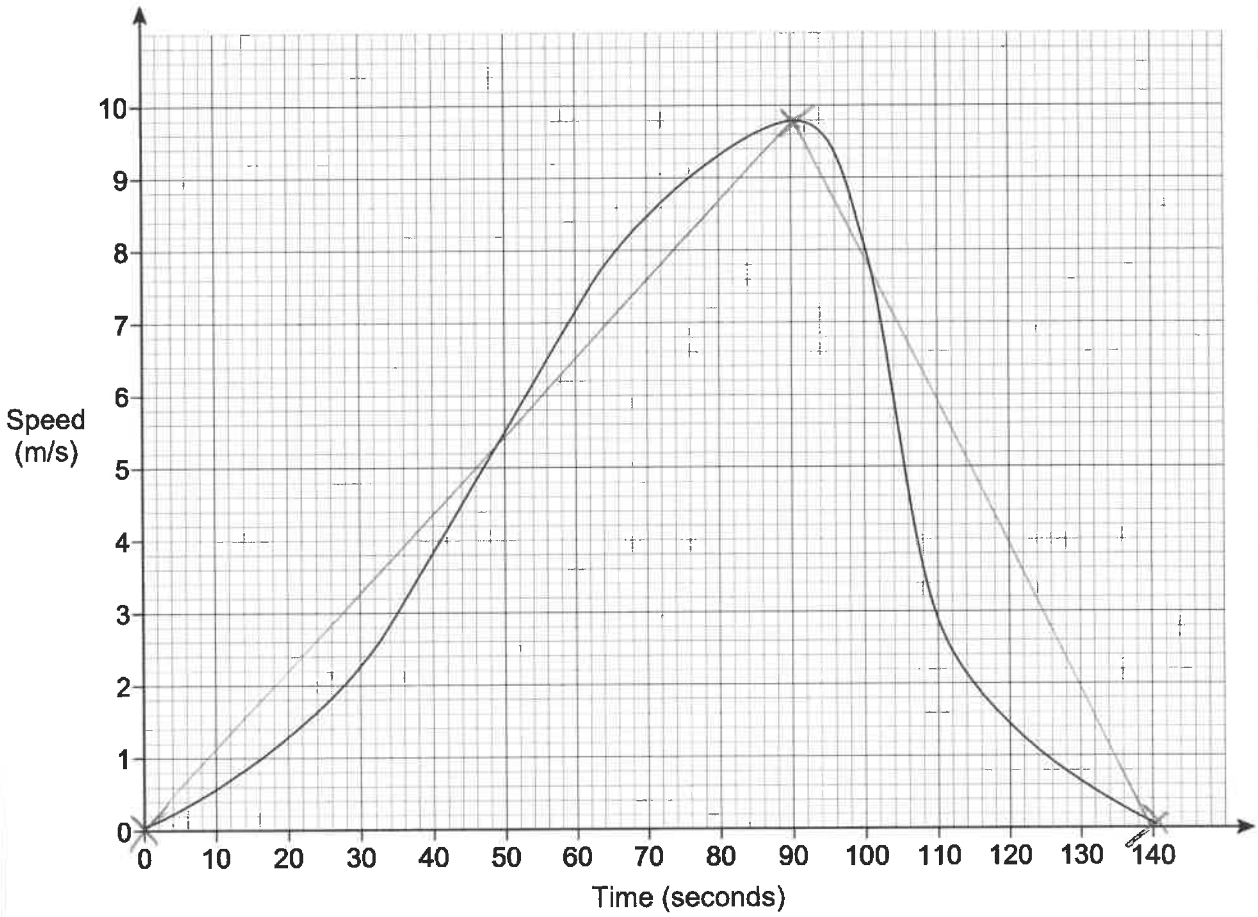
Turn over for the next question

Turn over ▶

21 The graph shows the speed of a skier.

Nick wants to estimate the distance travelled by the skier in 140 seconds.

AREA UNDER SPEED-TIME GRAPH GIVES DISTANCE TRAVELLED



21 (a) He works out the area of the triangle with vertices (0, 0), (140, 0) and (90, 9.8)

Does Nick's method give a good estimate?

Tick a box.

Yes ✓ No ☐

Give a reason for your answer.

[2 marks]

AN ESTIMATE OF THE AREA UNDER THE GRAPH GIVES THE DISTANCE TRAVELLED, AND THIS CAN BE FOUND BY FINDING THE AREA UNDER THE TRIANGLE. THE EXTRA AREAS ABOVE AND BELOW THE SIDES OF THE TRIANGLE 'APPROXIMATELY' CANCEL EACH OTHER OUT.

Do not write outside the box

21 (b) Use Nick's method to work out an estimate of the distance.

[1 mark]

AREA OF TRIANGLE $= \frac{1}{2} \times$ BASE $\times$ HEIGHT

$= \frac{1}{2} \times 140 \times 9.8 = 686$

Answer 686 metres

21 (c) Helen uses a different method.

She starts by estimating how many of the smallest squares are in the region between the graph and the horizontal axis.

Her estimate is 1550 squares.

Complete Helen's method to estimate the distance.

0.2 □ 2

[2 marks]

AREA OF EACH SMALL SQUARE IS $0.2 \times 2 = 0.4$

SO TOTAL $= 1550 \times 0.4 = 620$

Answer 620 metres

Turn over for the next question

Do not write outside the box

22 The value of a car, £V, after t years, is modelled by the equation

$$V = A \times k^{-t} \qquad \text{where } A \text{ and } k \text{ are constants.}$$

WHEN NEW, TIME EQUALS ZERO

The value of the car when new was £22 000 $V = 22000$ WHEN $t = 0$

The value of the car after 2 years is £14 080 $V = 14080$ WHEN $t = 2$

Work out the values of A and k.

[4 marks]

TO FIND A: SUBSTITUTE IN $V=22000$, $t=0$

$V = A \times k^{-t}$

$22000 = A \times k^{0} = A$

SO $V = 22000 k^{-t}$

(SUBSTITUTE IN $V=14080$ AND $t=2$ TO FIND K)

$14080 = 22000 \times k^{-2}$

$14080 = \frac{22000}{k}$

$K = \frac{22000}{14080} = 1.25$

$A =$ 22000

$k =$ 1.25

Do not write outside the box

23 AFE is a straight line.

$AF : FE = 3 : 2$ so $\frac{3}{5}$ AND $2/5$, so $a = \frac{2}{5}$

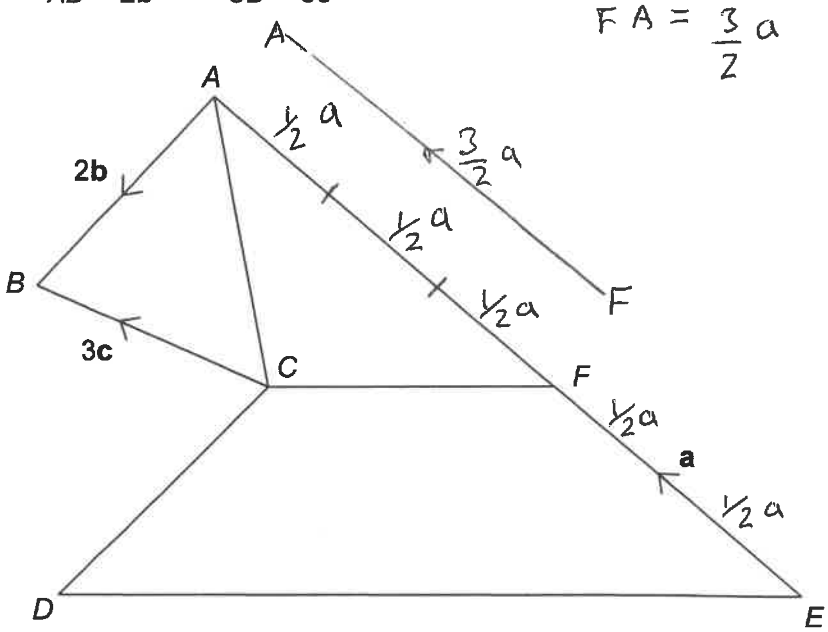
DE is parallel to CF.

$\frac{1}{2} a = \frac{1}{5}$

$DE = 2CF$

$FA = \frac{3}{2} a$

$\overrightarrow{EF} = \mathbf{a}$ $\overrightarrow{AB} = \mathbf{2b}$ $\overrightarrow{CB} = \mathbf{3c}$



Work out $\overrightarrow{DE}$ in terms of **a**, **b** and **c**.

[4 marks]

$DE = 2CF$

$CF = \overrightarrow{CB} + \overrightarrow{BA} + \overrightarrow{AF}$

$= 3c - 2b - \frac{3}{2} a$

$2CF = 2(3c - 2b - \frac{3}{2} \cdot a)$

$= 6c - 4b - 3a$

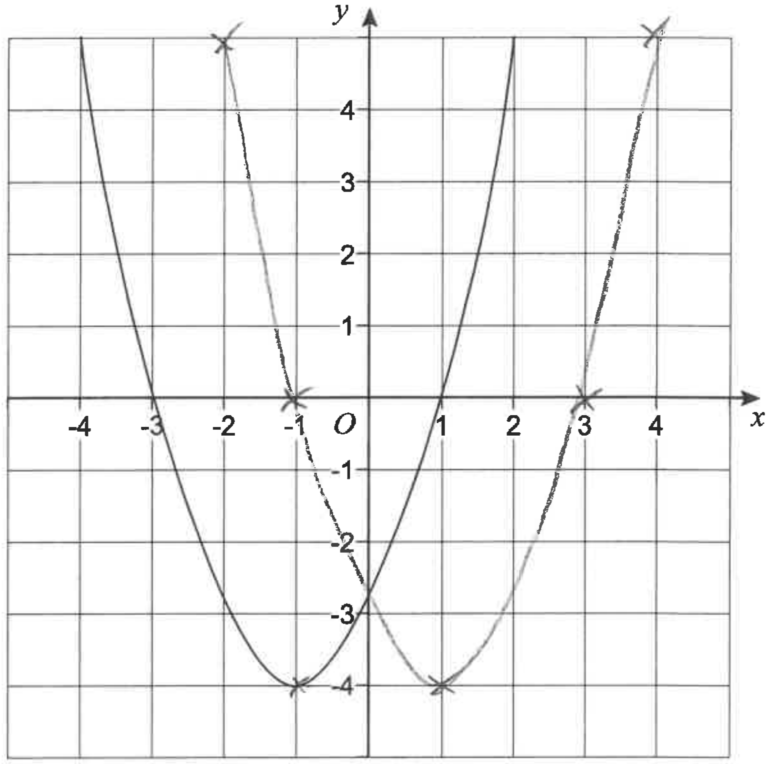
So

$DE = 2CF = 6c - 4b - 3a$

Answer

24 (a) Here is the graph of $y = f(x)$

The graph has a turning point at $(-1, -4)$



On the grid, draw the graph of $y = f(x - 2)$

[1 mark]

THIS TRANSLATES THE GRAPH,
TWO HORIZONTALLY TO THE RIGHT IN THE POSITIVE x DIRECTION

Do not write outside the box

24 (b) The graph of $y = -3x^2 + 4x - 5$ is reflected in the y-axis. so $f(-x)$

Work out the equation of the reflected graph.

Give your answer in its simplest form.

[2 marks]

SUBSTITUTE $(-x)$ IN FOR x

$y = -3(-x)^2 + 4(-x) - 5$

$= -3x^2 - 4x - 5$

Answer $y = -3x^2 - 4x - 5$

(or $y = -(3x^2 + 4x + 5)$)

END OF QUESTIONS

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