Examiner only

1. In 2019,

- €1 = £0.90,
- $1.25 = £1.

In 2019, a silver pencil cost €110 in Germany.
The same pencil cost $125 in the USA.

In which country was the pencil cheaper?

Germany ✓ USA ☐

You must show all your working. [3]

(G) 110 x 0·9 = £99 ✓

(U) 125 ÷ 1·25 = £100 ✓

C100UA01
01

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2. The diagram shows a parallelogram, *ABCD* and the diagonal *AC*.

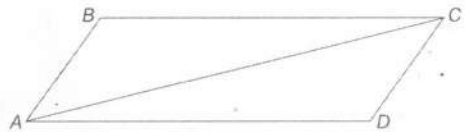

Diagram not drawn to scale

Tick (✓) the **two** correct statements. [2]

✗	$A\hat{B}C$ is not equal to $C\hat{D}A$	
	$AB = DC$ and $AD = BC$ and AC is a side of both triangle ABC and triangle CDA	✓
✗	Triangle ABC is similar to triangle CDA with enlargement scale factor 0·5	
✗	Triangle ABC is not congruent to triangle CDA	
	Triangle ABC is congruent to triangle CDA	✓
✗	AB represents the shortest distance from B to AC	

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3. The diagram shows a cone placed with its circular base on a table.

It has

- base radius 15 cm,
- height 30 cm.

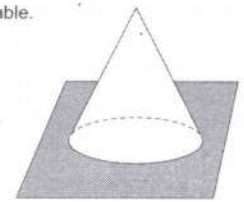

Diagram not drawn to scale

(a) Work out the volume of this cone.
Give your answer as a multiple of π. [3]

$V = \frac{1}{3}\pi \times 15^2 \times 30$ ✓

$= 225 \times 10 \times \pi$ ✓

Volume is 2250π cm^3 ✓

(b) On the 1 cm grid opposite, make an accurate scale drawing of the plan and side elevation of this cone.

Use the ratio

actual cone : scale drawing = 5 : 1. [4]

$r = 15 \div 5 = 3cm$

$h = 30 \div 5 = 6cm$

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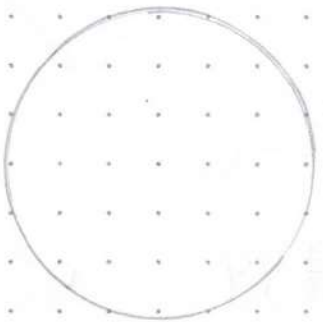
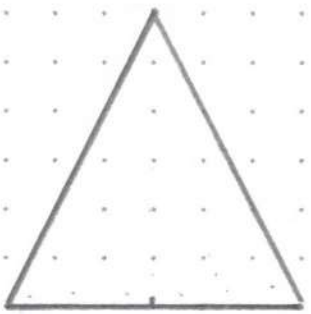
Plan



circle ✓

r = 3 ✓

Side elevation



triangle ✓

6

6 ✓

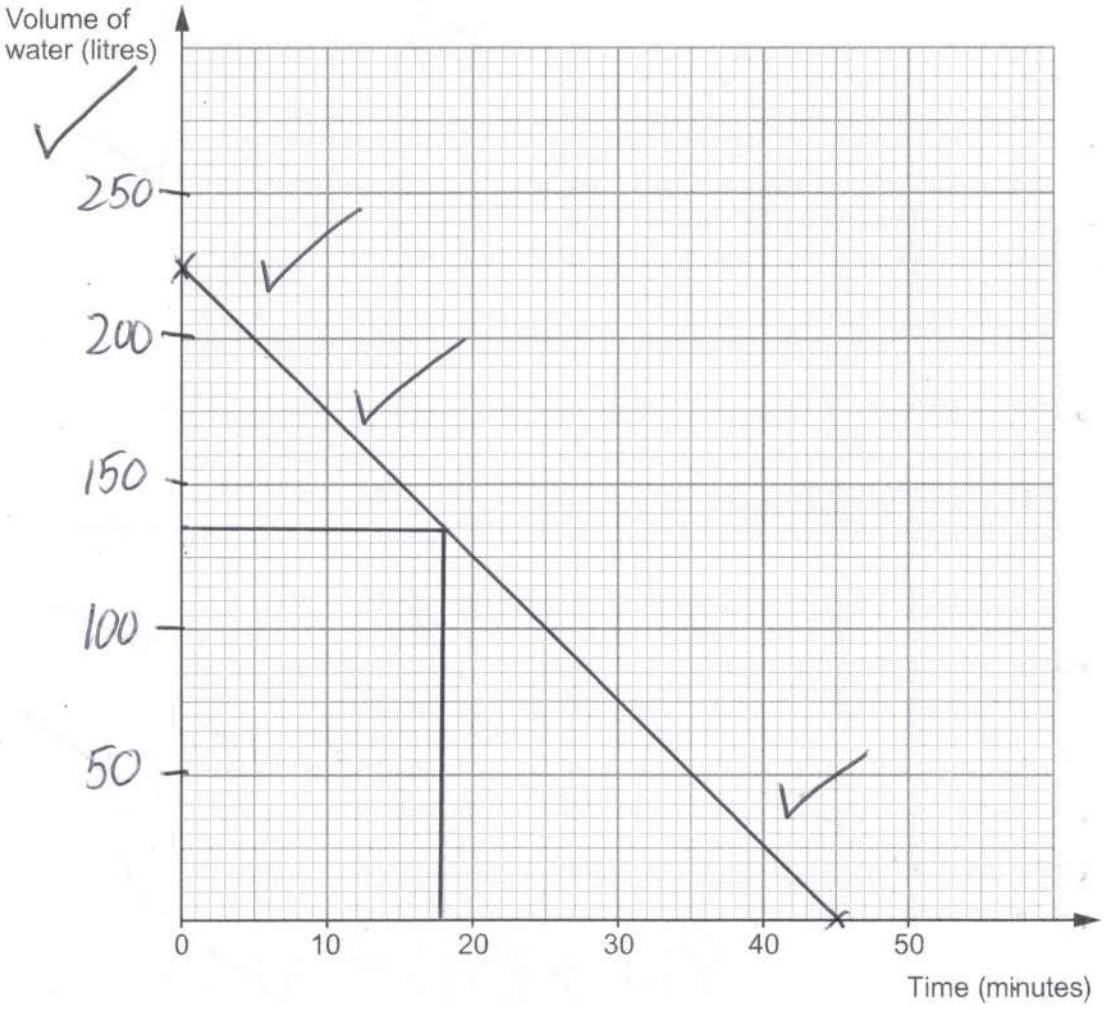
Turn over.

Examiner only

4. A tank contains 225 litres of water.
A tap at the bottom is opened so that water flows out at a constant rate of 5 litres every minute until the tank is empty.

(a) On the graph paper below, draw a line to show the volume of water in the tank at any time after the tap has been opened. [4]

45
5) 225



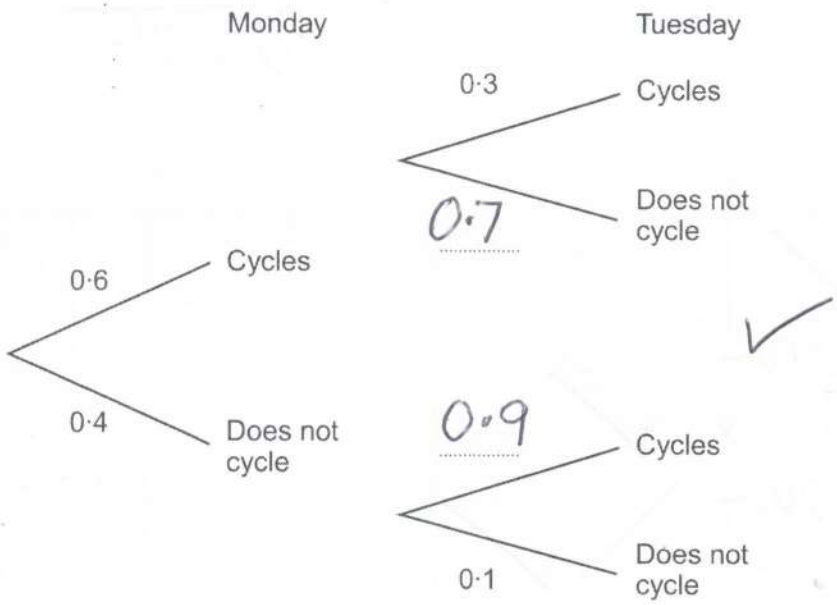
(b) How many minutes does it take for the volume of water in the tank to decrease by 40% of the original volume? [2]

10% = 22.5 225 - 90 = 135 ✓
40% = 90 = 18 mins ✓

Examiner only

5. The probability that Kathy cycles to work on Monday is 0·6.
If she cycles to work on Monday, the probability that she cycles to work on Tuesday is 0·3.
If she does **not** cycle to work on Monday, the probability that she does **not** cycle to work on Tuesday is 0·1.

(a) Complete the tree diagram. [1]



(b) Calculate the probability that Kathy cycles to work on both Monday and Tuesday. [2]

0.6×0.3 ✓

$= 0.18$ ✓

(c) Calculate the probability that Kathy does **not** cycle to work on either day. [2]

0.4×0.1 ✓

$= 0.04$ ✓

C300UA01 09

Examiner only

6. In a factory, 6 identical machines can make 3000 erasers in 2 hours.

How long would it take 8 of these machines to make 1000 erasers? [3]

3000e = 6 x 2 = 12 machine hrs ✓

1000e needs 4 m/hr ✓

$\frac{4}{8} = \frac{1}{2}$ hr = 30mins ✓

7. (a) Expand and simplify $(4x + 5)(2x - 1)$. [3]

✓✓ $8x^2 - 4x$
$+10x - 5$ $= 8x^2 + 6x - 5$ ✓

+ x

(b) (i) Factorise $x^2 - 10x + 21$. [2]

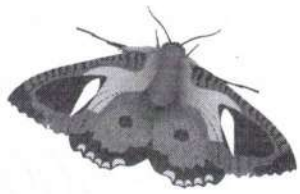
$(x - 7)(x - 3)$ ✓✓

(ii) Use your answer to part (b)(i) to write down the solutions of the equation $x^2 - 10x + 21 = 0$. [1]

$x =$ 7 or $x =$ 3 ✓

Examiner only

8. Vikram wanted to find out how many moths there were in a small woodland.



One night, Vikram captured a random sample of 12 moths and marked them.
He then released them back into the woodland.

The next night, Vikram captured a second random sample of 30 moths.
He found that 9 of the moths in the second sample had been marked.

Vikram estimated that there were 40 moths in the woodland.

(a) Show that Vikram's estimate of the number of moths was correct. [2]

$\frac{12}{N} = \frac{9}{30}$ ✓

$360 = 9N$ ✓

$40 = N$

(b) Comment on how reliable Vikram's estimate was likely to be. [1]

Unreliable as samples are small ✓

Examiner only

9. Deena sells a painting for £8690.
This is 10% more than she originally paid for it.

How much did Deena pay for the painting? [3]

110% = 8690 ✓

10% = 790 ✓

100% = £7900 ✓

$$11\overline{)86^{9}90}\quad 790$$

Examiner only

10. (a) Write 378 as a product of its prime factors.
Give your answer in index form. [3]

$2 \overline{)378}$ = 189

$3 \overline{)189}$ = 63

378 → (2), 189
189 → (3), 63
63 → 9, (7)
9 → (3), (3)

$= 7 \times 3 \times 3 \times 3 \times 2$

Product of prime factors in index form $7 \times 3^3 \times 2$

(b) Use prime factors to prove that 1 is the only common factor of 378 and 275. [2]

275 → 55, (5)
55 → (11), (5)

2, 3, 7 / 5, 11

no prime factors in common
(no common factor > 1)

 (C300UA0-1) Turn over.

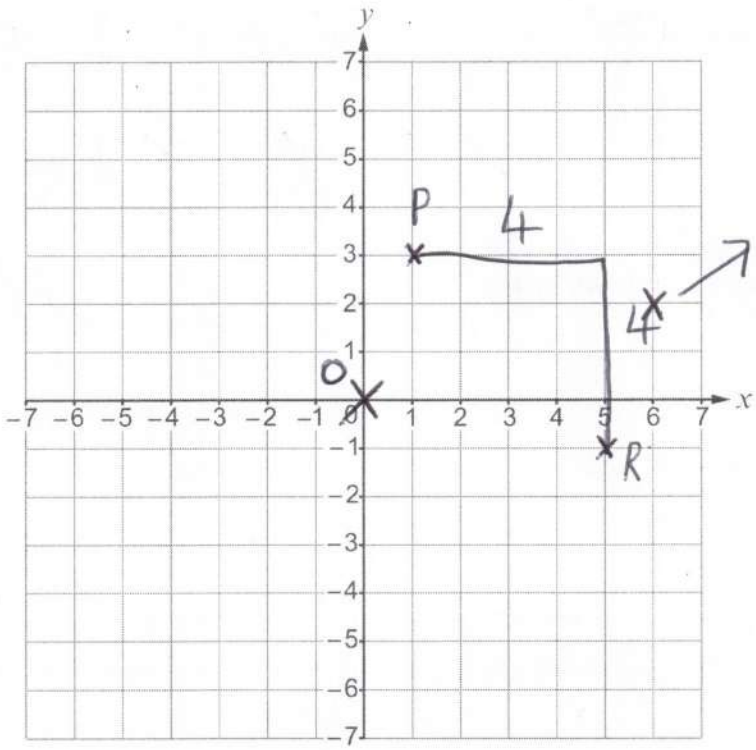
C300UA01 13

Examiner only

11. (a) The point O is the origin.

The points O, P, and R are such that $\mathbf{OP} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$ and $\mathbf{OR} = \begin{pmatrix} 5 \\ -1 \end{pmatrix}$.

(i) Find **PR**. [2]
You may use this grid to help you.



$$\mathbf{PR} = \begin{pmatrix} 4 \\ -4 \end{pmatrix}$$

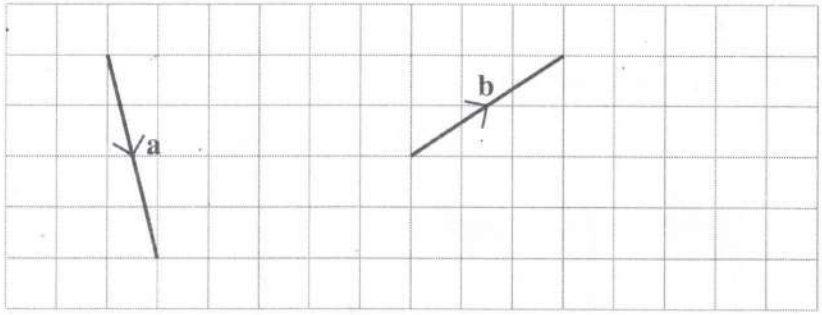
(ii) The point Q is such that, when taken in a clockwise direction, the points O, P, Q and R form a parallelogram.

Find **OQ**. [2]
You may use the grid above to help you.

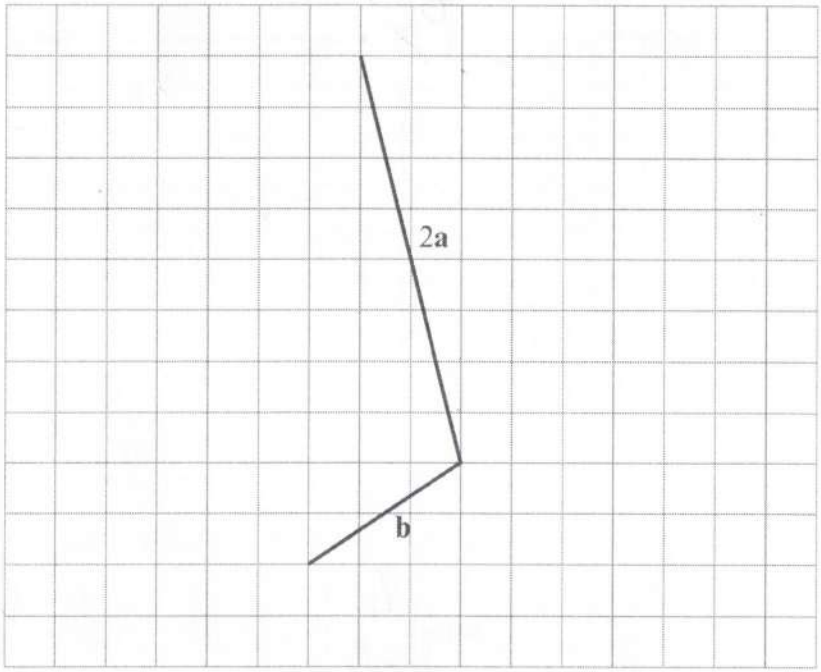
$$\mathbf{OQ} = \begin{pmatrix} 6 \\ 2 \end{pmatrix}$$

Examiner only

(b) The grid shows the vectors **a** and **b**.



Mitch wants to draw the vector $2\mathbf{a} + \mathbf{b}$.
His diagram is shown below.



Make **two** criticisms of Mitch's diagram. [2]

Criticism 1 No direction arrows ✓

Criticism 2 He's drawn 2a - b ✓OE

Examiner only

12. (a) Three quantities A, B and C are in the ratio

$A : B : C$ is $13 : 7 : 2$.

Given that $A - B = 48$, find the value of $A + B + C$. [4]

A B C
13 7 2
6 ✓

×8
104 56 16 ✓

Total = 176 ✓

(b) x cars travel a **total** of 1000 kilometres. → $\frac{1000}{x}$ each
Each car uses f litres of fuel.
Each car travels the same number of kilometres per litre.

Find an algebraic expression for the number of kilometres per litre travelled by each car. [1]

÷f

$\frac{1000}{xf}$ ✓ kilometres per litre

Examiner only

13. The table shows the population and area of land for country X.

	Population	Area (km^2)
Country X	$2{\cdot}16 \times 10^7$	3000

Population density can be measured in number of people per square kilometre.
The population density of country Y is 8000 people per km^2.

Which country has the greater population density and by how much is it greater? [4]

(X) PD = $\frac{2{\cdot}16 \times 10^7}{3 \times 10^3}$ ✓ $= 0{\cdot}72 \times 10^4$ ✓

$= 7200$ ✓

0.72
3) 2.16

The population density of country Y ✓

is greater by 800 people per km^2.

Examiner only

14. Rearrange this formula to make a the subject. [4]

$$\frac{a^3b}{7}+5=c$$

$\frac{a^3b}{7} = c-5$ ✓

$a^3b = 7(c-5)$ ✓

$a^3 = \frac{7(c-5)}{b}$ ✓

$a = \sqrt[3]{\frac{7(c-5)}{b}}$ ✓

or $\sqrt[3]{\frac{7c-35}{b}}$

Examiner only

15.

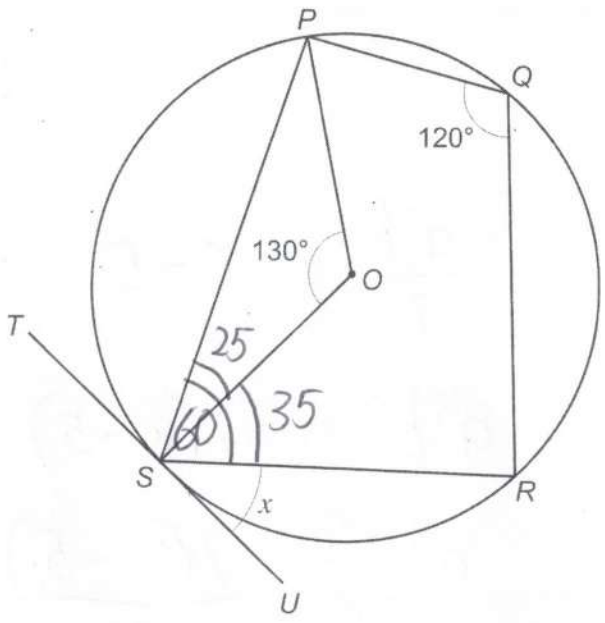


Diagram not drawn to scale

P, *Q*, *R* and *S* are points on a circle with centre *O*.
The line *TU* is a tangent to the circle at the point *S*.
$P\hat{O}S = 130°$ and $P\hat{Q}R = 120°$.

Show that $x = 55°$.
Give a reason for each step of your answer. [5]

$\angle PSO = \frac{180-130}{2} = 25$ (base angles of isosceles triangle) ✓

$\angle PSR = 60$ (opposite angles, cyclic quadrilateral) ✓

$\angle OSR = 60 - 25 = 35$ ✓

$\angle OSU = 90$ (radius perpendicular to tangent) ✓

$x = 90 - 35$

$= 55$ ✓

Examiner only

16. Brian and Yvonne are gardeners.
They each have an orchard of fully-grown apple trees.

(a) The table shows information about the height, in cm, of Yvonne's 43 apple trees on 1st September.

width 50 10 30 10 20

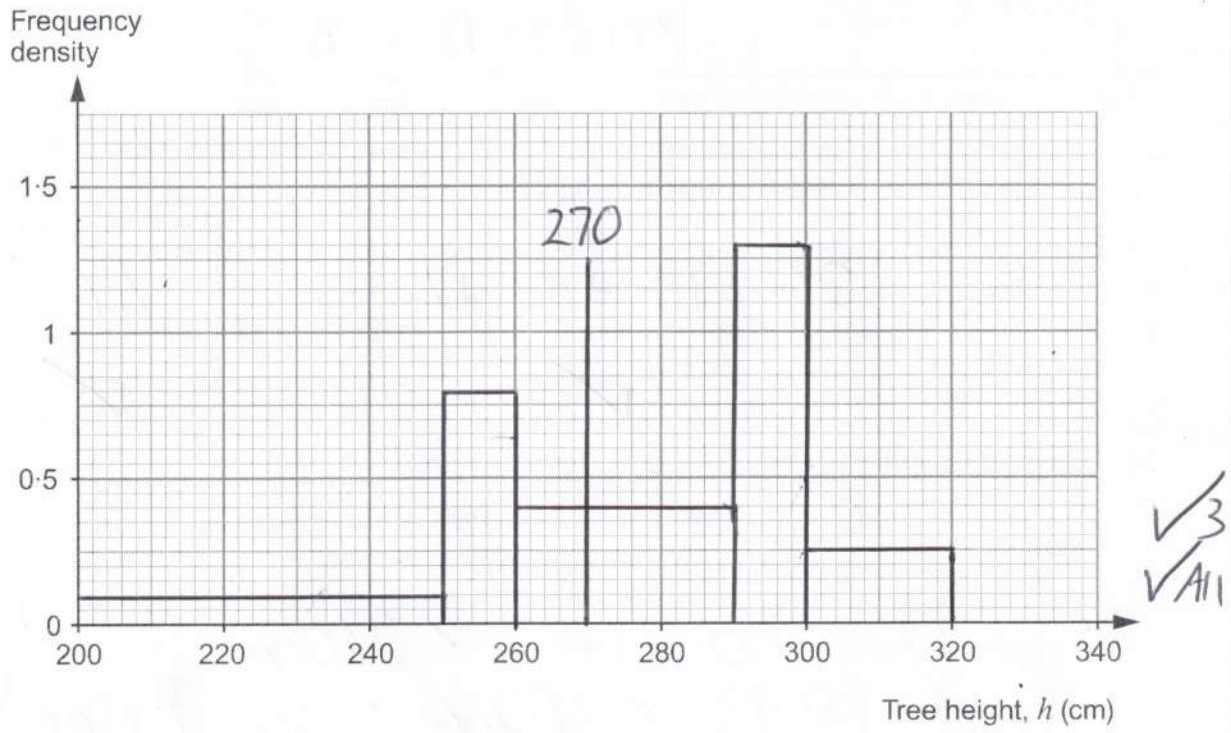
Tree height, h (cm)	$200 < h \leqslant 250$	$250 < h \leqslant 260$	$260 < h \leqslant 290$	$290 < h \leqslant 300$	$300 < h \leqslant 320$
Frequency	5	8	12	13	5
Frequency density	0·1	0·8	0·4	1·3	0·25

√3 √All

(i) Complete the frequency density row in the table above. [2]

$\frac{5}{50} = \frac{1}{10}$ $\frac{12}{30} = \frac{4}{10}$ $\frac{5}{20} = \frac{1}{4}$

(ii) Draw a histogram to illustrate the data in the table. [2]



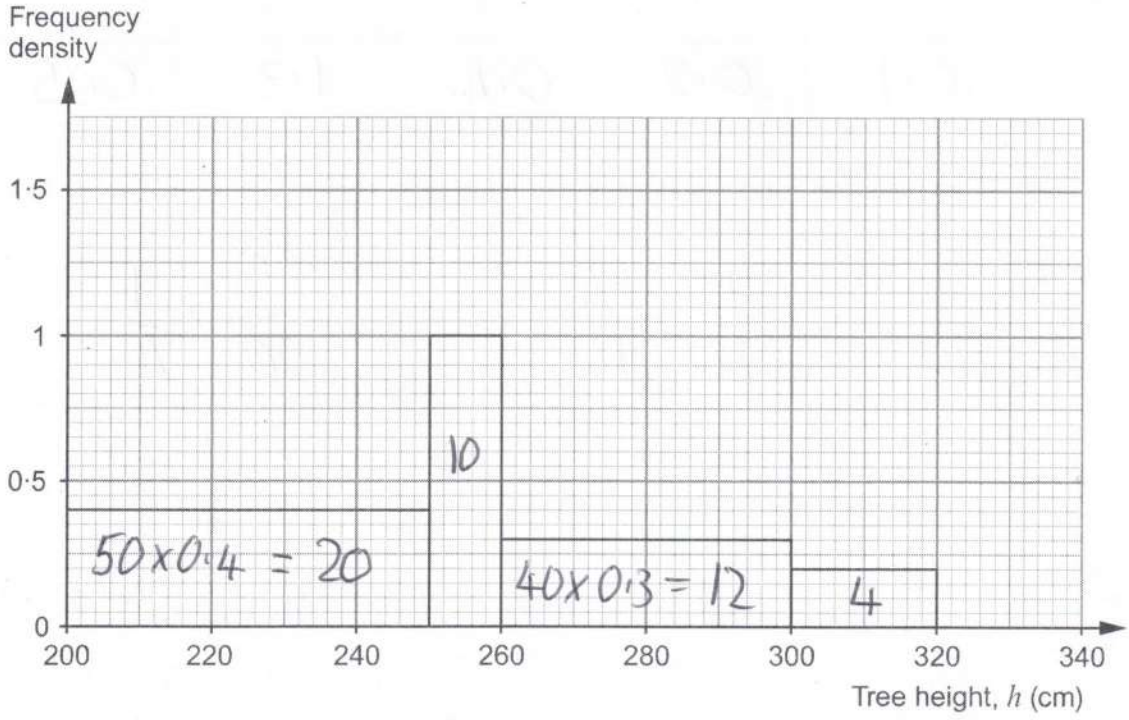
√3 √All

Examiner only

(iii) Calculate an estimate of the probability that an apple tree has a height of less than 270 cm. [2]

5+8+4=17 ✓ $\frac{17}{43}$ ✓

(b) This histogram shows the heights of the apple trees in Brian's orchard on 1st September.



How many apple trees are in Brian's orchard? [2]

20 + 10 + 12 + 4 = 46 ✓ ✓

(c) One of the gardeners says,

"I prefer to grow shorter apple trees as the fruit is easier to pick."

Which person is this likely to be?
You must justify your answer. [1]

Brian has 30 trees <260cm
Yvonne has 13 <260cm so Brian ✓

Examiner only

17. The diagram shows an equilateral triangle with side $2x$ cm.

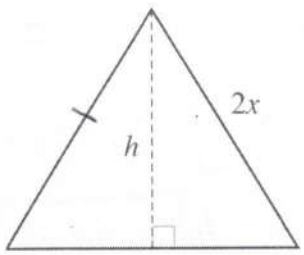
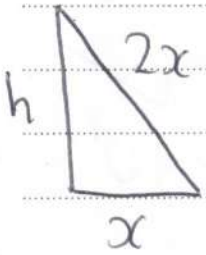


Diagram not drawn to scale

The height of the triangle is h cm.

Find and simplify an expression for h in terms of x. [4]



$h^2 + x^2 = (2x)^2$ ✓

$h^2 + x^2 = 4x^2$ ✓

$h^2 = 3x^2$ ✓

$h = \sqrt{3}\,x$ ✓

Examiner only

18. (a) Write $5^3 \div 5^{-4}$ as a single power of 5. [1]

$5^{3--4} = 5^7$ ✓

(b) Calculate the value of $10000^{\frac{3}{4}}$. [2]

$\sqrt[4]{10000^3} = 10^3$ ✓

$= 1000$ ✓

(c) Simplify $\sqrt{49 \times 10^{2n}}$. [2]

✓ $= \sqrt{49} \times \sqrt{10^{2n}}$

$= 7 \times (10^{2n})^{\frac{1}{2}} = 7 \times 10^n$ ✓

Examiner only

19. (a) Write $\frac{1}{27}$ as a recurring decimal. [1]

$$\begin{array}{r} 0.0370 \\ 27\overline{)1.^{10}0^{19}0^{10}0^{10}} \end{array} \qquad = 0.\dot{0}3\dot{7} \quad \checkmark$$

27, 54, 81, 108, 135, 162, 189

(b) By writing $1.2\dot{4}\dot{3}$ as a fraction, calculate $1.2\dot{4}\dot{3} - \frac{8}{9}$.

Give your answer as a fraction. [4]

$x = 0.2\dot{4}\dot{3}$

$10x = 2.\dot{4}\dot{3}$

$1000x = 243.\dot{4}\dot{3}$ ✓

$990x = 241$ $\quad x = \frac{241}{990} \Rightarrow \frac{241}{990}$

✓

$\frac{1231}{990} - \frac{880}{990}$ ✓

$= \frac{351}{990}$ ✓

Examiner only

20. $g(x) = \frac{x}{2}$

$h(x) = x^3$

(a) Find $hg\left(\frac{1}{3}\right)$. [2]

$g\left(\frac{1}{3}\right) = \frac{\frac{1}{3}}{2} = \frac{1}{6}$ ✓

$h\left(\frac{1}{6}\right) = \left(\frac{1}{6}\right)^3 = \frac{1}{216}$ ✓

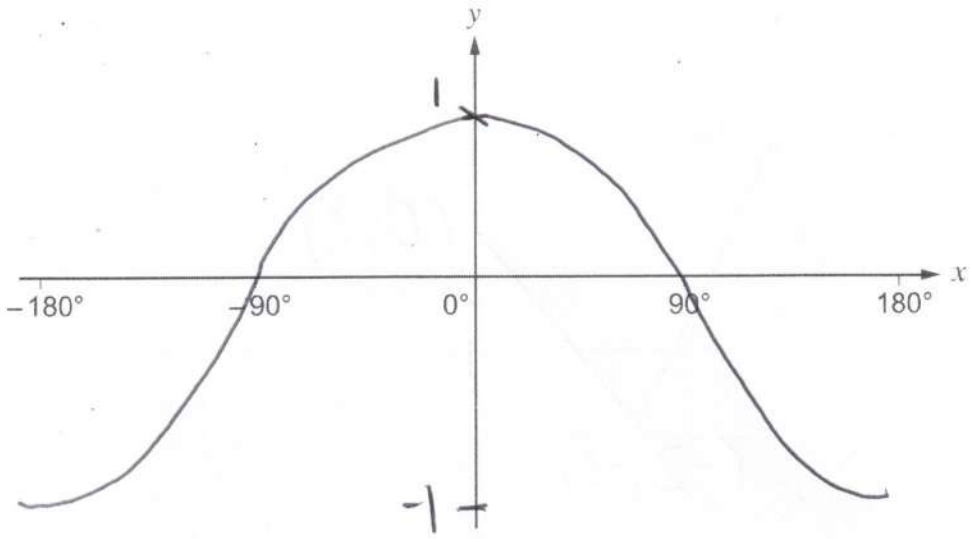
(b) Solve $h^{-1}(x) = -2$. [2]

$h^{-1}(x) = \sqrt[3]{x} = -2$ ✓

$x = (-2)^3 = -8$ ✓

Examiner only

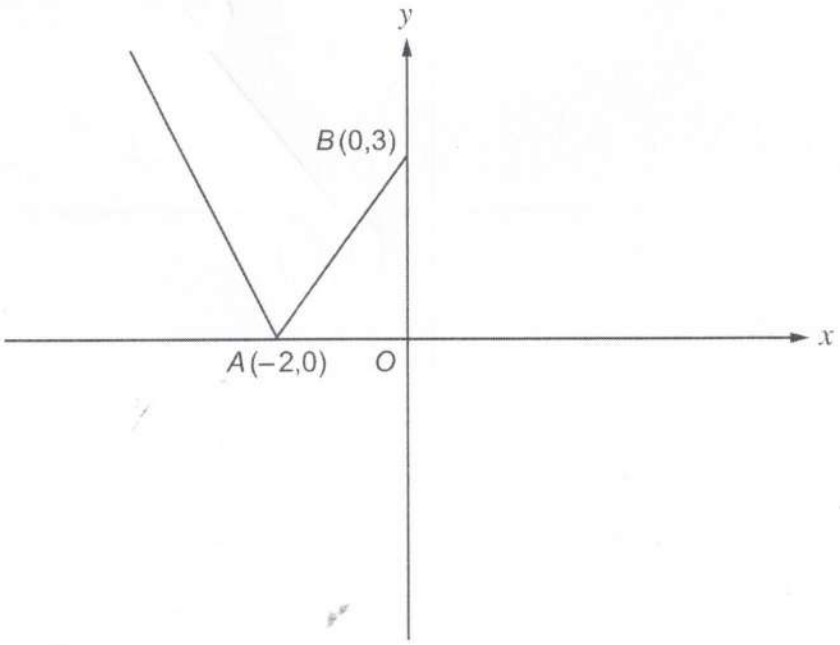
21. (a) (i) On the axes below, sketch the graph of $y = \cos x$ for $-180° \leqslant x \leqslant 180°$. [2]



(ii) Solve $\cos x = \frac{\sqrt{3}}{2}$ for $-180° \leqslant x \leqslant 180°$. [2]

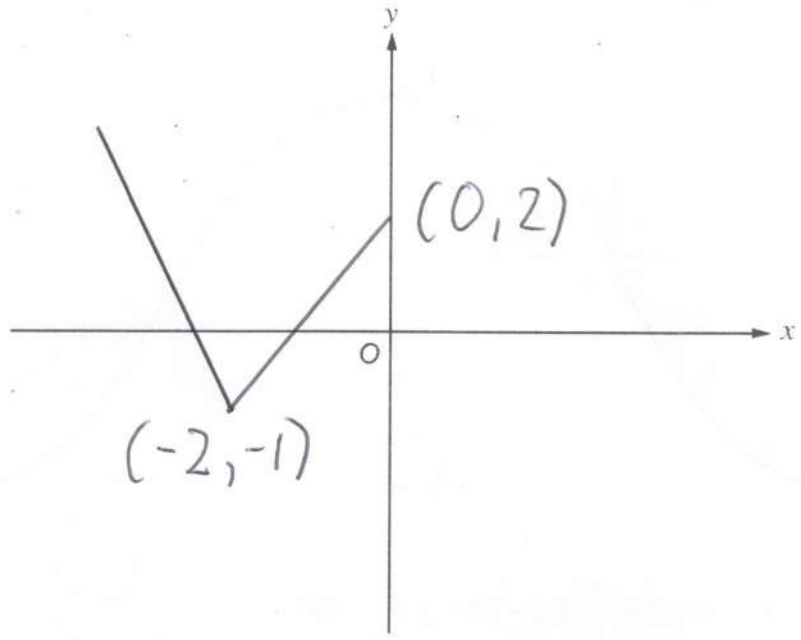
$\cos^{-1}\left(\frac{\sqrt{3}}{2}\right) = 30, -30$ ✓ ✓

(b) The diagram shows a sketch of the graph of $y = f(x)$.
The point A has coordinates $(-2,0)$ and the point B has coordinates $(0,3)$.



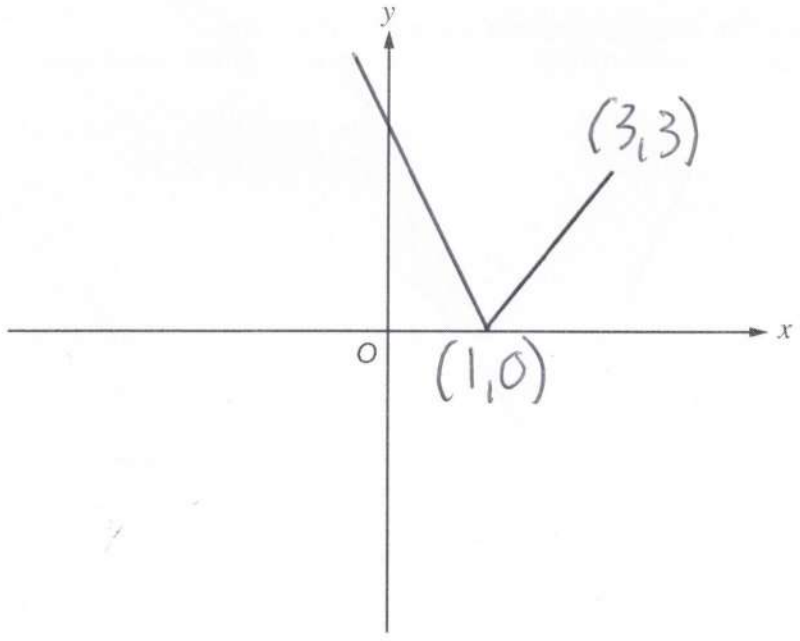
Examiner only

↓1 (i) Sketch the graph of $y = f(x) - 1$ on the axes below.
You must indicate the coordinates of the new positions of the points *A* and *B*. [2]



(ii) Sketch the graph of $y = f(x - 3)$ on the axes below.
You must indicate the coordinates of the new positions of the points *A* and *B*. [2]

→3



Examiner only

22. A game of chance at a school fete is played with the following rules.

- There are five identical balls numbered from 1 to 5 in a bag.
- A player takes two balls from the bag at random.
- A player wins a prize when their two balls are numbered 2 and 4.
- At the end of each game, both balls are put back in the bag.

(a) Olivia plays the game once.

What is the probability that she wins a prize? [2]

$\frac{2}{5} \times \frac{1}{4} = \frac{2}{20}$

✓ ✓ OE

(b) Alex plays the game and stops playing when he wins.

What is the probability that he only plays the game twice? [2]

$LW = \frac{18}{20} \times \frac{2}{20} = \frac{36}{400}$ ✓

✓

23. (a) Write $7\sqrt{3}(5\sqrt{3}-4)+\sqrt{27}$ in the form $a+b\sqrt{3}$, where a and b are integers. [3]

$35\sqrt{9} - 4\times 7\sqrt{3} + \sqrt{9}\sqrt{3}$ ✓✓

$= 105 - 25\sqrt{3}$ ✓

Examiner only

(b) In this question all lengths are in centimetres.

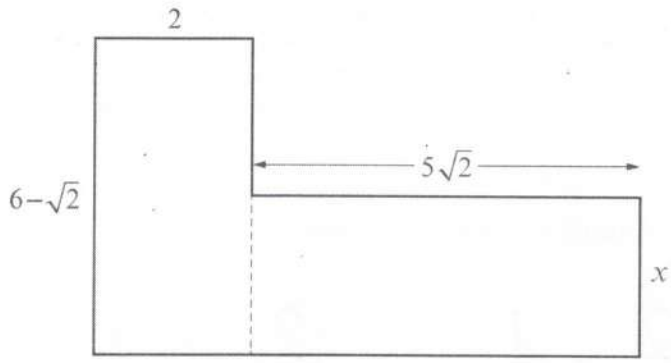


Diagram not drawn to scale

This shape is made from two rectangles.
The area of this shape is $33\sqrt{2}-18$.

Showing all your working, find the value of x.
Give your answer in the form $c+d\sqrt{2}$, where c and d are integers. [5]

$2(6-\sqrt{2}) + x \times 5\sqrt{2} = 33\sqrt{2} - 18$

$12 - 2\sqrt{2} + 5x\sqrt{2} = 33\sqrt{2} - 18$

$5x\sqrt{2} = 35\sqrt{2} - 30$

$x = \dfrac{7\sqrt{2} - 6}{\sqrt{2}}$

$\dfrac{6}{\sqrt{2}} \times \dfrac{\sqrt{2}}{\sqrt{2}}$

$= \dfrac{6\sqrt{2}}{2}$

$= 3\sqrt{2}$

$x = 7 - \dfrac{6}{\sqrt{2}}$

$x = 7 - 3\sqrt{2}$

Examiner only

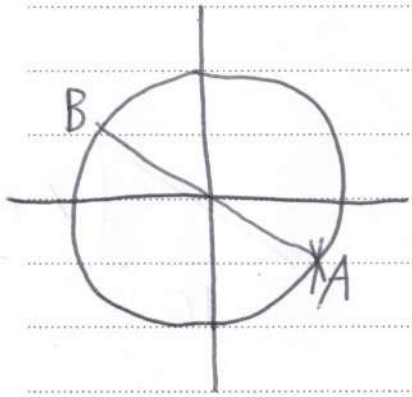
24. A circle has equation $x^2 + y^2 = 400$.

(a) Write down the length of the radius. [1]

$r = \sqrt{400} = 20$ ✓

(b) The points $A(12, -16)$ and B lie on the circle.
AB is a diameter of the circle.

Find the coordinates of B. [2]

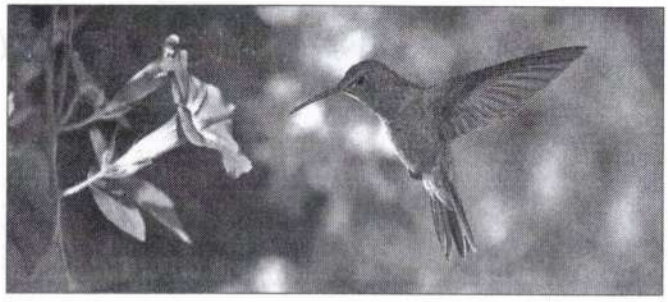


✓ ✓

B(−12, 16)

Examiner only

25. A hummingbird flies at a speed of v metres per second for t seconds after it has finished feeding from a flower.



The diagram shows the speed of the hummingbird for $5 \leqslant t \leqslant 15$.

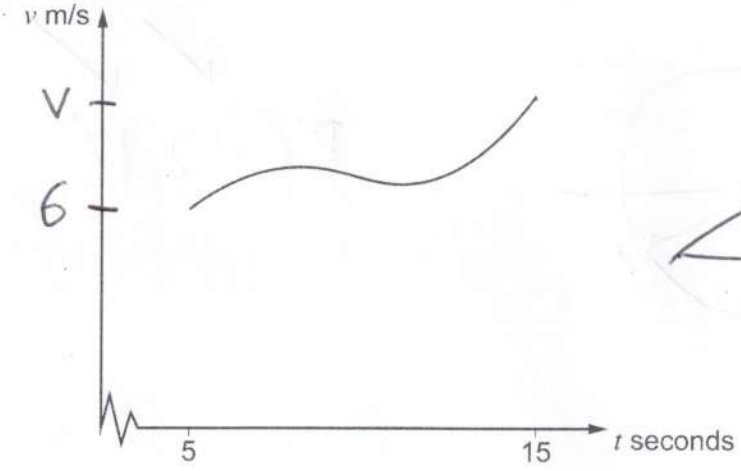


Diagram not drawn to scale

When $t = 5$, $v = 6$.
The average acceleration of the hummingbird for $5 \leqslant t \leqslant 15$ is $0{\cdot}5\,m/s^2$.

Calculate the speed of the hummingbird when $t = 15$.
You must show all your working. [3]

OR $\frac{V-6}{10} = 0.5$ ✓

$V = u + at$

✓ $V = 6 + 0.5 \times 10$

✓ $V = 6 + 5$

✓ $V = 11$

$V - 6 = 5$ ✓

$V = 11$ ✓

END OF PAPER