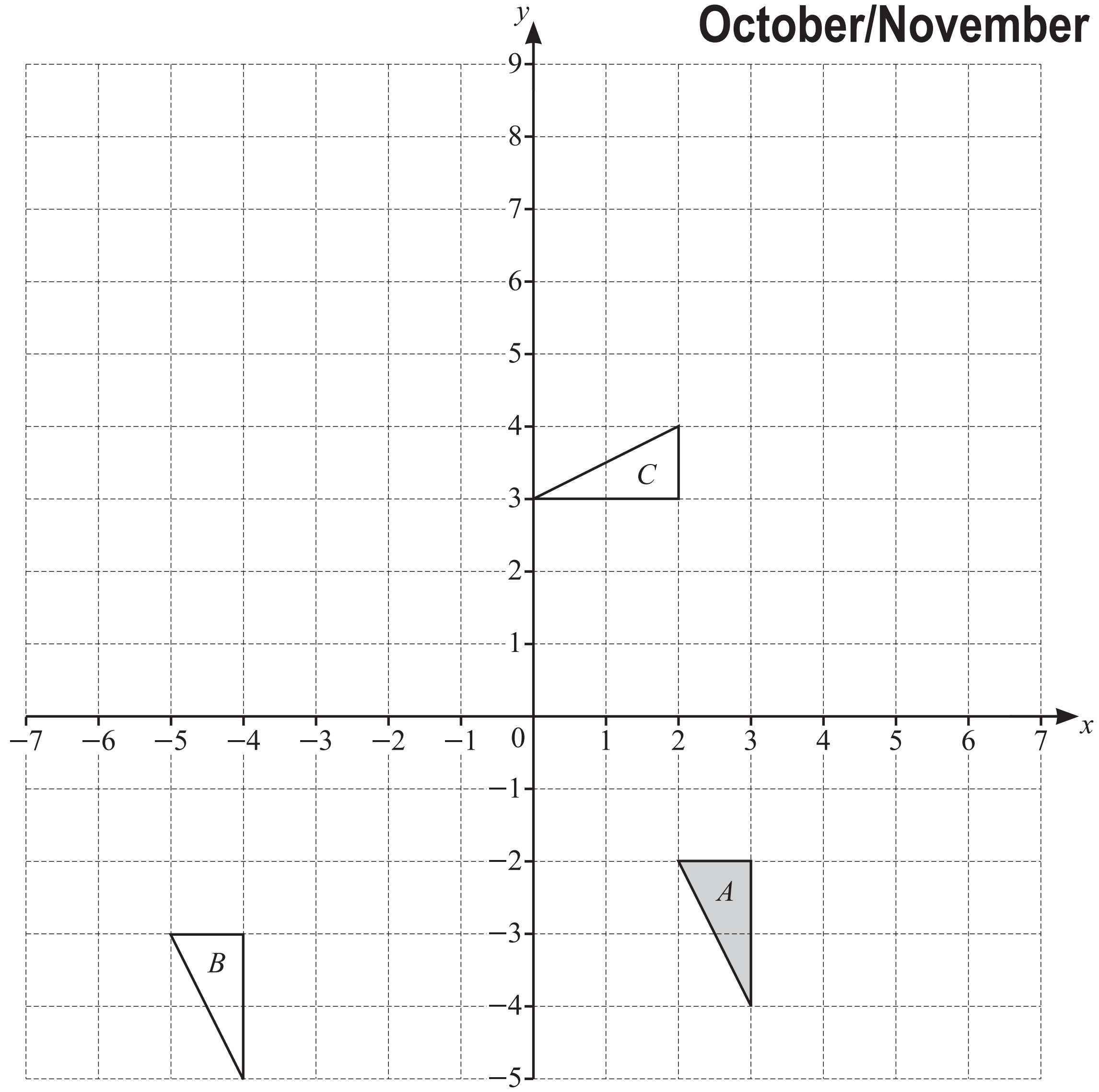
1




**(a)** Describe fully the **single** transformation that maps

**(i)** shape *A* onto shape *B*

.......................................................................................................................

....................................................................................................................... [2]

**(ii)** shape *A* onto shape *C*.

.......................................................................................................................

....................................................................................................................... [3]

**(b)** On the grid, draw the image of

**(i)** shape *A* after a reflection in the line $y = 2$ [2]

**(ii)** shape *A* after an enlargement, scale factor $-2$, centre (0, 0). [2]

**2** **(a)** $s = \frac{1}{2}at^2$

Find the value of $s$ when $a = 9.8$ and $t = 20$.

$s =$ ................................................ [2]

**(b)** Solve.

$$5(4y - 3) = 15$$

$y =$ ................................................ [3]

**(c)** Expand and simplify.

$$3(5x - 8) - 2(3x - 7)$$

................................................ [2]

**(d)** Rearrange $A = 2b^2 - 3c^3$ to make $c$ the subject.

$c =$ ................................................ [3]

**(e)** Factorise completely.

$$6pq - 4q - 3p + 2$$

................................................ [2]

**3** **(a)** The table shows information about some of the planets in the solar system.

| Planet | Diameter (km) | Average distance from the Sun (km) |
|---|---|---|
| Earth | 12 800 | $1.496 \times 10^8$ |
| Mars | 6 800 | $2.279 \times 10^8$ |
| Jupiter | 143 000 | $7.786 \times 10^8$ |
| Saturn | 120 500 | $1.434 \times 10^9$ |
| Neptune | 49 500 | $4.495 \times 10^9$ |

**(i)** The average distance of Mars from the Sun is $2.279 \times 10^8$ km.

Write this distance as an ordinary number.

........................................... km [1]

**(ii)** The planet Uranus has a diameter that is 35.8% of the diameter of Jupiter.

Calculate the diameter of Uranus.

........................................... km [2]

**(iii)** The ratio diameter of Neptune : diameter of Saturn can be written in the form 1 : $n$.

Find the value of $n$.

$n$ = ................................................ [1]

**(iv)** Find the average distance of Neptune from the Sun as a percentage of the average distance of the Earth from the Sun.

................................................ % [2]

**(v)** Distances within the solar system are also measured in astronomical units (AU).
The average distance of Jupiter from the Sun is 5.20 AU.

Calculate the average distance of Mars from the Sun in astronomical units.

........................................... AU [2]

**(vi)** The diameter of Mars is 39.2% greater than the diameter of Mercury.

Calculate the diameter of Mercury.

............................................ km [2]

**(b)** One light year is the distance that light travels in a year of 365.25 days.
The speed of light is $2.9979 \times 10^5$ kilometres per second.

**(i)** Show that one light year is $9.461 \times 10^{12}$ km, correct to 4 significant figures.

[2]

**(ii)** The distance from the Andromeda Galaxy to Earth is $2.40 \times 10^{19}$ km.

Calculate the time taken for light to travel from this galaxy to Earth.
Give your answer in millions of years.

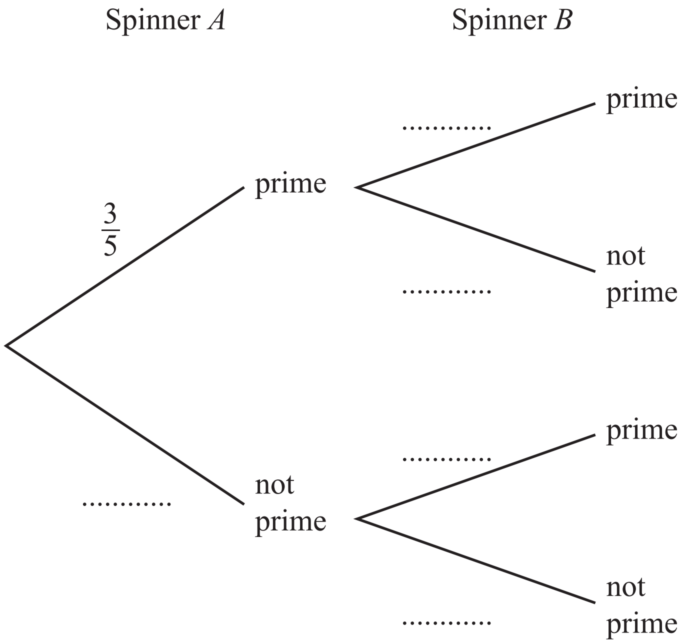
.......................... million years [2]

**4** **(a)** Lucia has two fair spinners.
Spinner $A$ is five-sided and is numbered 1, 2, 3, 4, 5.
Spinner $B$ is nine-sided and is numbered 3, 3, 3, 4, 4, 4, 4, 5, 5.

Lucia spins the two spinners and records whether they land on a prime number.

**(i)** Complete the tree diagram.




[2]

**(ii)** Find the probability that

**(a)** the two numbers are both prime

................................................ [2]

**(b)** the two numbers are **not** both prime.

................................................ [1]

**(b)** Lucia spins Spinner *A* 120 times.

Find the expected number of times the spinner lands on a prime number.

................................................ [1]

**(c)** Lucia spins Spinner *B* twice.

Find the probability that the two numbers it lands on add up to 9 or more.

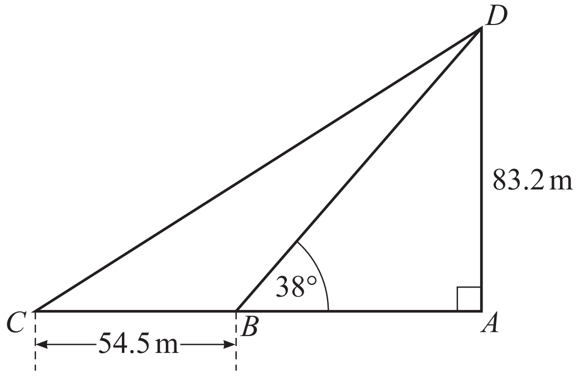
................................................ [3]

**(d)** Lucia keeps spinning Spinner *B* until it lands on a 4.

Find an expression, in terms of $n$, for the probability that this happens on the $n$th spin.

................................................ [2]

**5** **(a)**



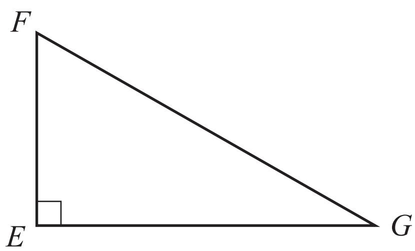

NOT TO SCALE

*ACD* is a right-angled triangle.
*B* is on *AC* and *BC* = 54.5 m.
*AD* = 83.2 m and angle *ABD* = 38°.

Calculate angle *ACD*.

Angle *ACD* = ................................................ [5]

**(b)**



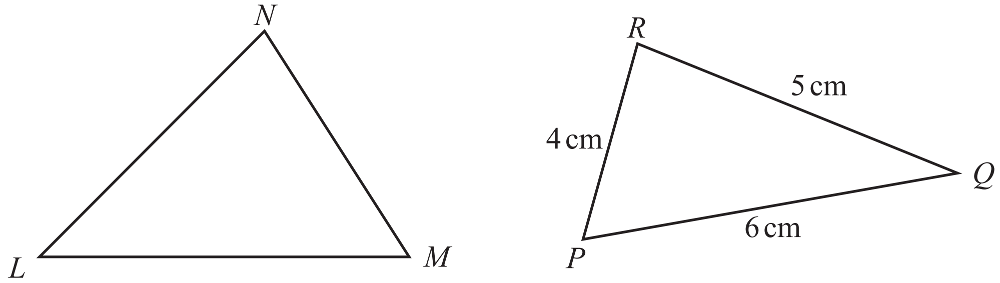

*EFG* is a right-angled triangle.
A circle can be drawn that passes through the three vertices of the triangle.

On the diagram, mark the position of the centre of the circle with a cross.
Explain how you decide.

.......................................................................................................................................

....................................................................................................................................... [2]

**(c)**




NOT TO SCALE

In triangle *LMN*, the ratio angle *L* : angle *M* : angle *N* = 4 : 5 : 6.
In triangle *PQR*, $PQ = 6\,\text{cm}$, $PR = 4\,\text{cm}$ and $QR = 5\,\text{cm}$.

Calculate the difference between the largest angle in triangle *PQR* and the largest angle in triangle *LMN*.

.................................................. [7]

**6** **(a)**

| Sequence | 1st term | 2nd term | 3rd term | 4th term | 5th term | | *n*th term |
|---|---|---|---|---|---|---|---|
| A | −7 | −3 | 1 | 5 | | | |
| B | 7 | 13 | 23 | 37 | | | |
| C | $\frac{2}{27}$ | $\frac{3}{81}$ | $\frac{4}{243}$ | $\frac{5}{729}$ | | | |

Complete the table for the three sequences.

[10]

**(b)** In a sequence, the sum of the first 49 terms is 7644.
The sum of the first 50 terms is 7975.

Find the 50th term of this sequence.

................................................. [1]

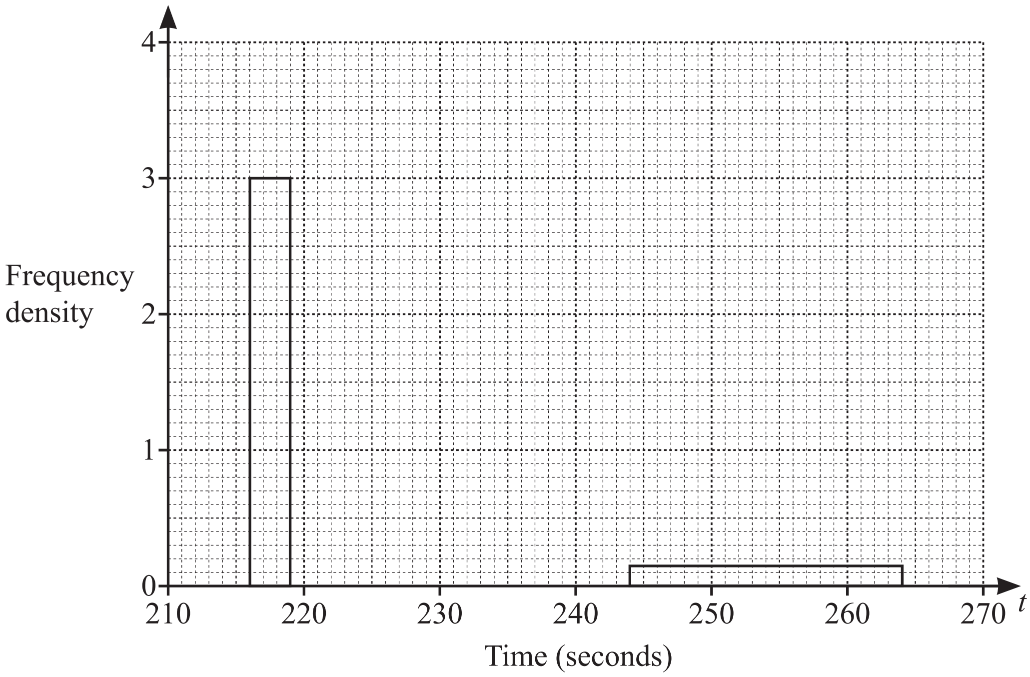
**7** The frequency table shows the time of each of 42 athletes in a race.

| Time ($t$ seconds) | Number of athletes |
|---|---|
| $216 < t \leqslant 219$ | 9 |
| $219 < t \leqslant 224$ | 14 |
| $224 < t \leqslant 234$ | 14 |
| $234 < t \leqslant 244$ | 2 |
| $244 < t \leqslant 264$ | 3 |

**(a)** Calculate an estimate of the mean time.

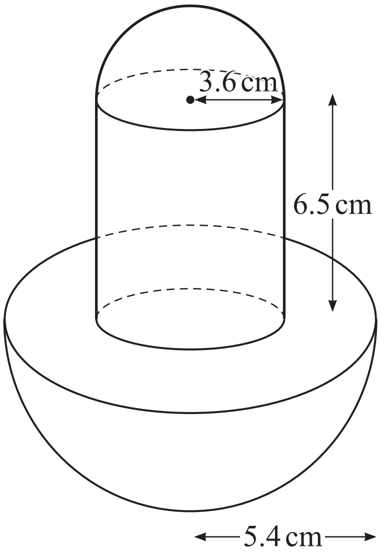
.................................... seconds [4]

**(b)** Complete the histogram to show the information in the frequency table.
Two of the blocks have been drawn for you.




[3]

**8 (a)**




NOT TO SCALE

The diagram shows a solid formed by joining two hemispheres and a cylinder.
The radius of the large hemisphere is 5.4 cm.
The radius of the small hemisphere and the radius of the cylinder are both 3.6 cm.
The height of the cylinder is 6.5 cm.

**(i)** Show that the volume of the solid is 692 $cm^3$, correct to the nearest cubic centimetre.

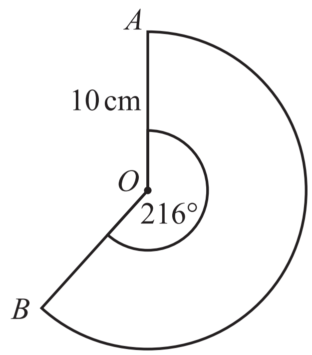
[4]

**(ii)** A mathematically similar solid is made of silver.
In this solid, the cylinder has radius 0.6 cm.
1 $cm^3$ of silver has a mass of 10.49 grams.

Calculate the total mass of this silver solid.

................................................ g [4]

**(b)**




NOT TO SCALE

*AOB* is a sector of a circle, centre *O*.
$AO = 10$ cm and the sector angle is 216°.

**(i)** Calculate the length of the arc of this sector.
Give your answer as a multiple of π.

.............................................cm [2]

**(ii)** A cone is made from this sector by joining *OA* to *OB*.

Calculate the volume of the cone.

......................................... $cm^3$ [4]

**9** $f(x) = (3x+1)(x+5)(x-4)$ $g(x) = 2x-3$ $h(x) = 4^{2x-1}$

**(a)** Find

**(i)** $f(0)$

................................................ [1]

**(ii)** $g^{-1}(x)$

$g^{-1}(x) =$ ................................................ [2]

**(iii)** gh(2).

................................................ [2]

**(b)** $g(2x) = 7$

Find the value of $x$.

$x =$ ................................................ [2]

**(c)** Simplify $g(x^2) + gg(x) + 1$.

................................................ [3]

**(d)** Find $h^{-1}(16)$.

................................................ [2]

**(e)** $f(x) = (3x+1)(x+5)(x-4)$

This can be written in the form $f(x) = ax^3 + bx^2 + cx + d$.

Find the value of each of $a$, $b$, $c$ and $d$.

$a =$ ................ $b =$ ................ $c =$ ................ $d =$ ................ [3]

**10** **(a)** $ABC$ is a triangle.

$B$ is the point $(1, -10)$, $A$ is the point $(4, 14)$ and $\overrightarrow{CA} = \begin{pmatrix} -11 \\ 8 \end{pmatrix}$.

**(i)** Find the coordinates of $C$.

(................. , ..................) [2]

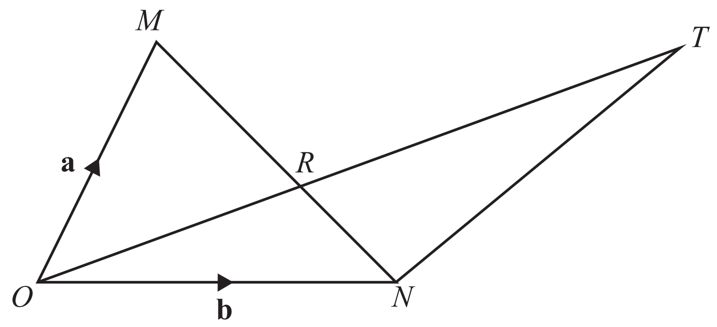
**(ii)** Find $\overrightarrow{BA}$.

$\overrightarrow{BA} = \begin{pmatrix} \quad \\ \quad \end{pmatrix}$ [1]

**(iii)** Find $|\overrightarrow{CA}|$.

................................................. [2]

**(b)**




NOT TO SCALE

*OMN* is a triangle.
$\overrightarrow{OM} = \mathbf{a}$ and $\overrightarrow{ON} = \mathbf{b}$.
*R* is a point on *MN* such that *MR* : *RN* = 3 : 2.
*ORT* is a straight line.

**(i)** Show that $\overrightarrow{OR} = \frac{2}{5}\mathbf{a} + \frac{3}{5}\mathbf{b}$.

[3]

**(ii)** **(a)** $\overrightarrow{NT} = 4\mathbf{a} + k\mathbf{b}$ and $\overrightarrow{OT} = c\overrightarrow{OR}$ .

Find the value of *k* and the value of *c*.

$k =$ .......................... $c =$ .......................... [4]

**(b)** Find $\overrightarrow{MT}$ .

$\overrightarrow{MT} =$ ................................................ [1]

**11** **(a)** Differentiate $x^3 - 4x^2 - 3x$ .

.................................................. [2]

**(b)** A curve has equation $y = x^3 - 4x^2 - 3x$ .

Work out the coordinates of the two stationary points.
Show all your working.

(........................ , ........................)

(........................ , ........................) [5]

**(c)** Determine whether each stationary point is a maximum or a minimum.
Show all your working.

[3]