

- 1 (a) A library has a total of 10494 fiction and non-fiction books.
The ratio fiction books : non-fiction books = 13 : 5.

Find the number of non-fiction books the library has.

..... [2]

- (b) The library has DVDs on crime, adventure and science fiction.
The ratio crime : adventure : science fiction = 11 : 6 : 10.
The library has 384 **more** science fiction DVDs than adventure DVDs.

Calculate the number of crime DVDs the library has.

..... [2]

- (c) Every Monday, Sima travels by car to the library.
The distance is 20 km and the journey takes 23 minutes.

- (i) Calculate the average speed for the journey in kilometres per hour.

..... km/h [2]

- (ii) One Monday, she is delayed and her average speed is reduced to 32 km/h.

Calculate the percentage increase in the journey time.

.....% [5]



- (d) In Spain, the price of a book is 11.99 euros.
In the USA, the price of the same book is \$12.99 .
The exchange rate is \$1 = 0.9276 euros.

Calculate the difference between these prices.
Give your answer in dollars, correct to the nearest cent.

\$..... [3]

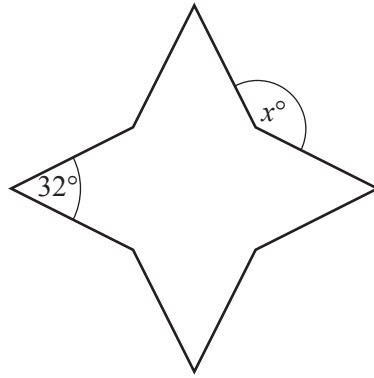
- (e) 7605 books were borrowed from the library in 2016.
This was 22% less than in 2015.

Calculate the number of books borrowed in 2015.

..... [3]



2 (a)



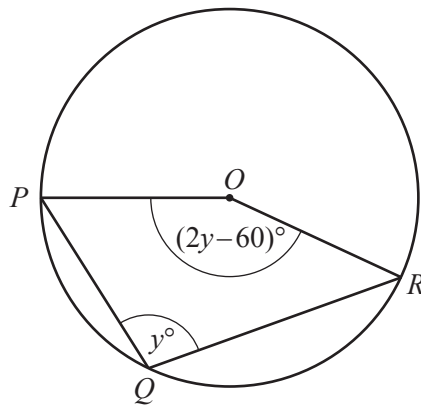
NOT TO SCALE

The diagram shows an octagon.
 All of the sides are the same length.
 Four of the interior angles are each 32° .
 The other four interior angles are equal.

Find the value of x .

$x = \dots\dots\dots$ [4]

(b)



NOT TO SCALE

P , Q and R lie on a circle, centre O .
 Angle $PQR = y^\circ$ and angle $POR = (2y - 60)^\circ$.

Find the value of y .

$y = \dots\dots\dots$ [3]



3 (a) Solve.

$$11x + 15 = 3x - 7$$

$x = \dots\dots\dots$ [2]

(b) (i) Factorise.

$$x^2 + 9x - 22$$

$\dots\dots\dots$ [2]

(ii) Solve.

$$x^2 + 9x - 22 = 0$$

$x = \dots\dots\dots$ or $x = \dots\dots\dots$ [1]

(c) Rearrange $y = \frac{2(x-a)}{x}$ to make x the subject.

$x = \dots\dots\dots$ [4]

(d) Simplify. $\frac{x^2 - 6x}{x^2 - 36}$

$\dots\dots\dots$ [3]



4

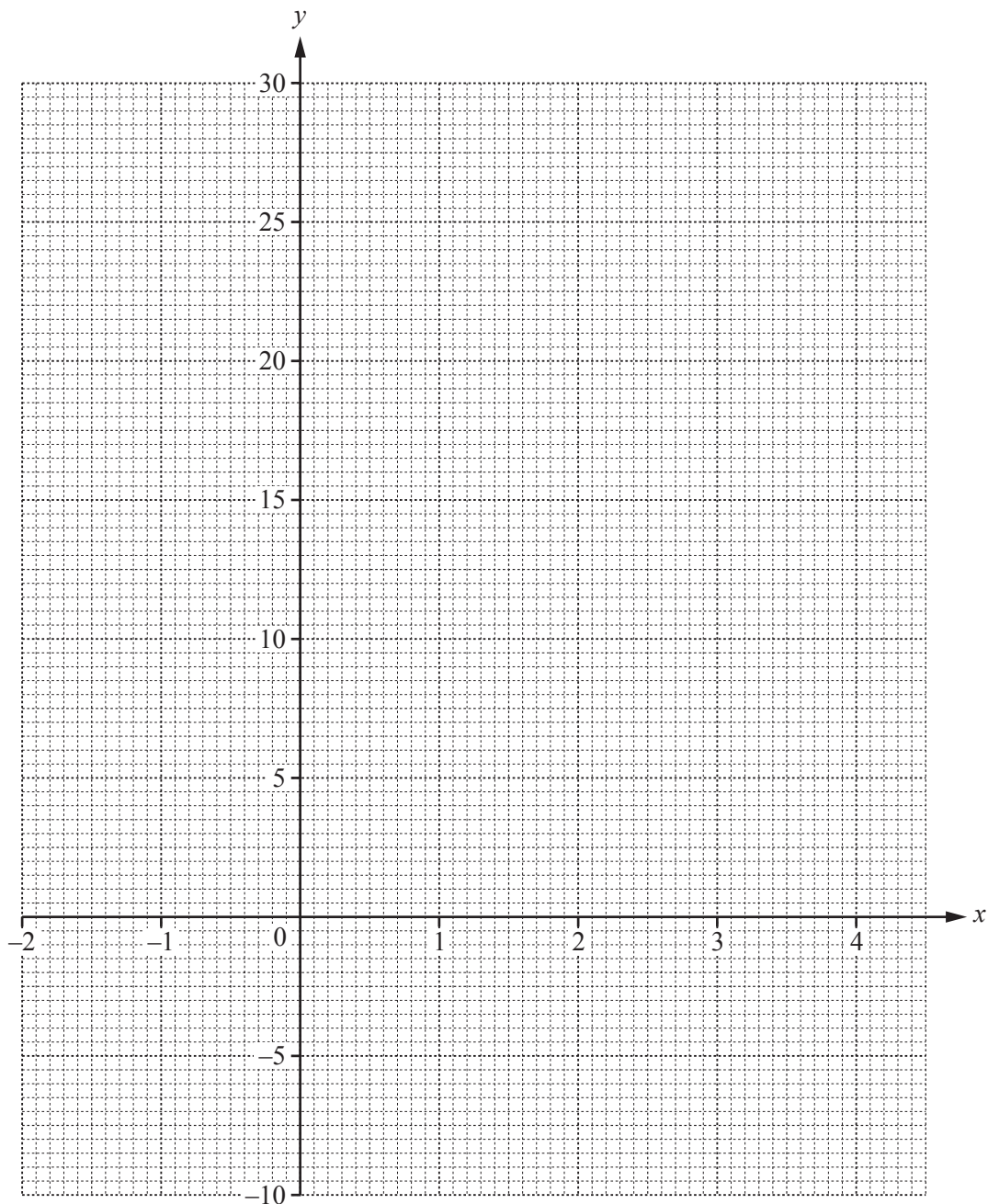
$$f(x) = x^3 - 4x^2 + 15$$

(a) Complete the table of values for $y = f(x)$.

x	-2	-1	-0.5	0	1	2	2.5	3	3.5	4	4.5
y	-9		13.9	15	12		5.6	6	8.9	15	25.1

[2]

(b) On the grid, draw the graph of $y = f(x)$ for $-2 \leq x \leq 4.5$.



[4]



(c) Use your graph to solve the equation $f(x) = 0$.

$x = \dots\dots\dots$ [1]

(d) By drawing a suitable tangent, estimate the gradient of the graph of $y = f(x)$ when $x = 3.5$.

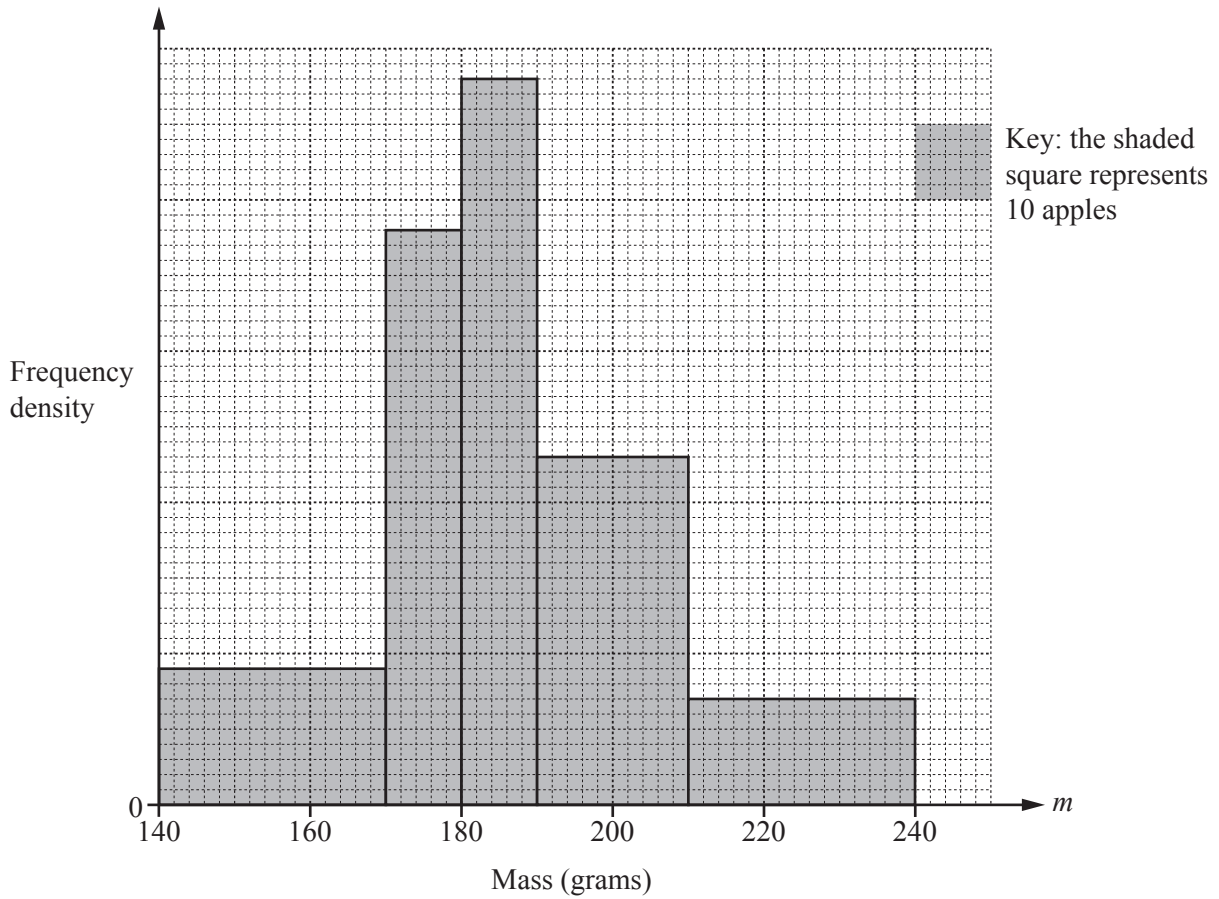
$\dots\dots\dots$ [3]

(e) By drawing a suitable straight line on the grid, solve the equation $x^3 - 4x^2 - 2x + 5 = 0$.

$x = \dots\dots\dots$ or $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [4]



5 The histogram shows the distribution of the masses, m grams, of 360 apples.



(a) Use the histogram to complete the frequency table.

Mass (m grams)	Number of apples
$140 < m \leq 170$	
$170 < m \leq 180$	
$180 < m \leq 190$	
$190 < m \leq 210$	92
$210 < m \leq 240$	42

[3]

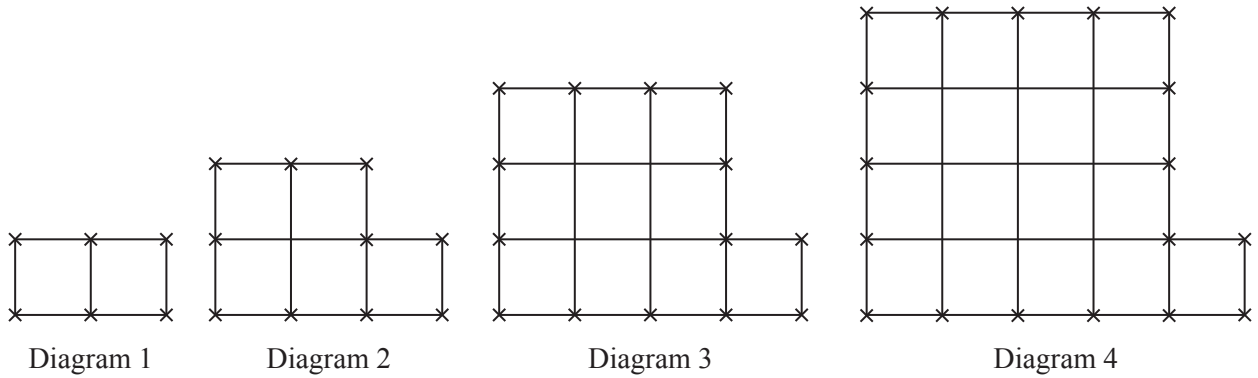


(b) Calculate an estimate of the mean mass of the 360 apples.

..... g [4]



6



These are the first four diagrams in a sequence.
Each diagram is made from small squares and crosses.

(a) Complete the table.

Diagram	1	2	3	4	5		n
Number of crosses	6	10	14				
Number of small squares	2	5	10				

[6]

(b) Find the number of crosses in Diagram 60.

..... [1]

(c) Which diagram has 226 squares?

Diagram [1]

(d) The side of each small square has length 1 cm.
The number of lines of length 1 cm in Diagram n is $2n^2 + 2n + q$.

Find the value of q .

$q =$ [2]



7 $f(x) = 3 - 2x$ $g(x) = \frac{4}{x}, x \neq 0$ $h(x) = 4^x$

(a) Find $f(5)$.

..... [1]

(b) Find $gh(3)$.

..... [2]

(c) Find $f^{-1}(x)$.

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

(d) Show that $hf(x) = \frac{64}{16^x}$.

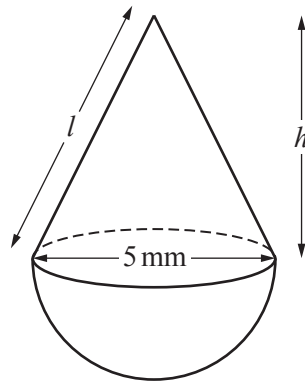
[3]

(e) Find the value of x when $h(x) = g(0.5)$.

$x =$ [2]



8



NOT TO SCALE

The diagram shows a solid made from a hemisphere and a cone.
The base diameter of the cone and the diameter of the hemisphere are each 5 mm.

- (a) The total surface area of the solid is $\frac{115\pi}{4}$ mm².

Show that the slant height, l , is 6.5 mm.

[The curved surface area, A , of a cone with radius r and slant height l is $A = \pi rl$.]

[The surface area, A , of a sphere with radius r is $A = 4\pi r^2$.]

[4]

- (b) Calculate the height, h , of the cone.

$h = \dots\dots\dots$ mm [3]



(c) Calculate the volume of the solid.

[The volume, V , of a cone with radius r and height h is $V = \frac{1}{3}\pi r^2 h$.]

[The volume, V , of a sphere with radius r is $V = \frac{4}{3}\pi r^3$.]

.....mm³ [4]

(d) The solid is made from gold.

1 **cubic centimetre** of gold has a mass of 19.3 grams.

The value of 1 gram of gold is \$38.62 .

Calculate the value of the gold used to make the solid.

\$..... [3]



- 9 (a) A bag contains red beads and green beads.
There are 80 beads altogether.
The probability that a bead chosen at random is green is 0.35 .

(i) Find the number of red beads in the bag.

..... [2]

- (ii) Marcos chooses a bead at random and replaces it in the bag.
He does this 240 times.

Find the number of times he would expect to choose a green bead.

..... [1]

- (b) A different bag contains 2 blue marbles, 3 yellow marbles and 4 white marbles.
Huma chooses a marble at random, notes the colour, then replaces it in the bag.
She does this three times.

Find the probability that

(i) all three marbles are yellow,

..... [2]

- (ii) all three marbles are different colours.

..... [3]



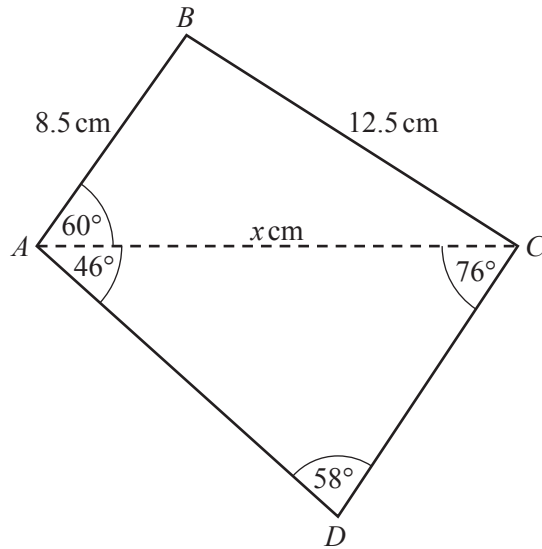
- (c) Another bag contains 2 green counters and 3 pink counters.
Teresa chooses three counters at random **without** replacement.

Find the probability that she chooses more pink counters than green counters.

..... [4]



10



NOT TO SCALE

The diagram shows a quadrilateral $ABCD$.

(a) The length of AC is x cm.

Use the cosine rule in triangle ABC to show that $2x^2 - 17x - 168 = 0$.

[4]

(b) Solve the equation $2x^2 - 17x - 168 = 0$.

Show all your working and give your answers correct to 2 decimal places.

$x = \dots\dots\dots$ or $x = \dots\dots\dots$ [4]



(c) Use the sine rule to calculate the length of CD .

$CD = \dots\dots\dots$ cm [3]

(d) Calculate the area of the quadrilateral $ABCD$.

$\dots\dots\dots$ cm² [3]



11 (a) $A = \begin{pmatrix} 2 & -3 \\ 1 & 4 \end{pmatrix}$

Find

(i) A^2 ,

$\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(ii) A^{-1} , the inverse of A .

$\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Describe fully the **single** transformation represented by the matrix $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$.

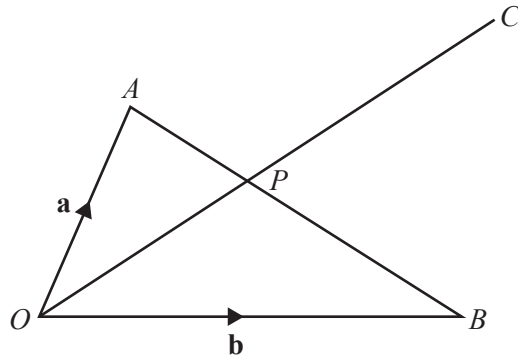
.....
..... [2]

(c) Find the matrix that represents a clockwise rotation of 90° about the origin.

$\begin{pmatrix} & \\ & \end{pmatrix}$ [2]



(d)



NOT TO SCALE

In the diagram, O is the origin and P lies on AB such that $AP : PB = 3 : 4$.
 $\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$.

(i) Find \vec{OP} , in terms of \mathbf{a} and \mathbf{b} , in its simplest form.

$\vec{OP} = \dots\dots\dots [3]$

(ii) The line OP is extended to C such that $\vec{OC} = m\vec{OP}$ and $\vec{BC} = k\mathbf{a}$.

Find the value of m and the value of k .

$m = \dots\dots\dots$

$k = \dots\dots\dots [2]$

