L.19

2023-L019-1-EL-01/32

Pre-Leaving Certificate Examination, 2023

Mathematics

Paper 2

Ordinary Level

Time: 2 hours, 30 minutes

300 marks

CANDIDATE DETAILS

DAY and DATE of BIRTH / For example, 3rd February is entered as 03/02

NAME

SCHOOL

TEACHER

School Stamp

For examiner	
Question	Mark
1	
2	
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8	
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10	
Total	

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Instructions

There are **two** sections in this examination paper.

Section A	Concepts and Skills	150 marks	6 questions
Section B	Contexts and Applications	150 marks	4 questions

Answer questions as follows:

- any **five** questions from Section A – Concepts and Skills
- any **three** questions from Section B – Contexts and Applications.

Write your Name and Individual Details in the grid on the front cover.

Write your answers in blue or black pen. You may use pencil in graphs and diagrams only.

This examination booklet will be scanned and your work will be presented to an examiner on screen. Anything that you write outside of the answer areas may not be seen by the examiner.

Write all answers into this booklet. There is space for extra work at the back of the booklet. If you need to use it, label any extra work clearly with the question number and part.

The superintendent will give you a copy of the *Formulae and Tables* booklet. You must return it at the end of the examination. You are not allowed to bring your own copy into the examination.

You will lose marks if your solutions do not include relevant supporting work.

You may lose marks if the appropriate units of measurement are not included, where relevant.

You may lose marks if your answers are not given in simplest form, where relevant.

Write the make and model of your calculator(s) here:

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Section A — Concepts and Skills — 150 marks

Answer **any five** questions from this section.

Question 1 **(30 marks)**

A standard pack of playing cards consists of 52 cards in four suits:

Hearts (♥)	:	2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A
Diamonds (♦)	:	2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A
Clubs (♣)	:	2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A
Spades (♠)	:	2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A

Two cards are drawn at random from the pack of cards and not replaced.

(a) Find, as a fraction, the probability that:

(i) the first card drawn is a 'diamond'

(ii) both cards drawn are 'diamonds'.

(b) Find the probability that the two cards drawn from the pack are in consecutive order (e.g. a 'jack' (J) followed by a 'queen' (Q)).
Give your answer correct to four decimal places.

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(c) Two cards again are drawn at random from the pack of cards and not replaced.
Find, correct to four decimal places, the probability that:

(i) neither card drawn is a 'king' (K)

(ii) at least one card drawn is a 'king' (K).

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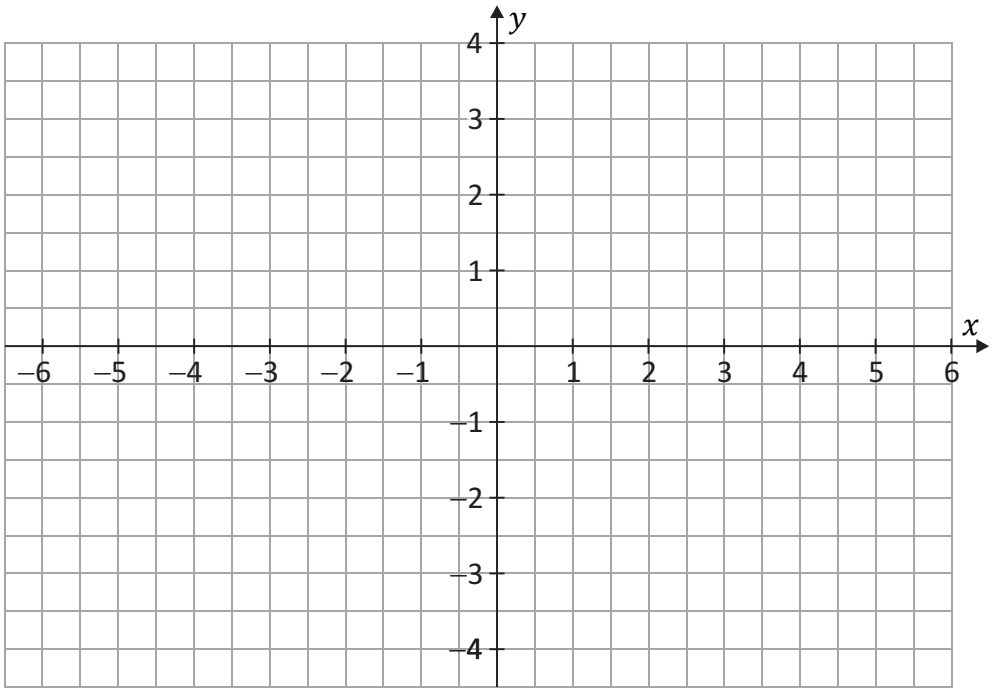
Question 2 **(30 marks)**

l is the line $3x + 5y + 15 = 0$.

(a) Find the slope of line l.

(b) k is the line which contains the point $P(-1, 1)$ and is perpendicular to the line l.
Show that the equation of k is $5x - 3y + 8 = 0$.

(c) Draw the lines l and k on the axes below and find Q, the point of intersection of the two lines. Label each line clearly.



(d) Verify, using algebra, the co-ordinates of Q.

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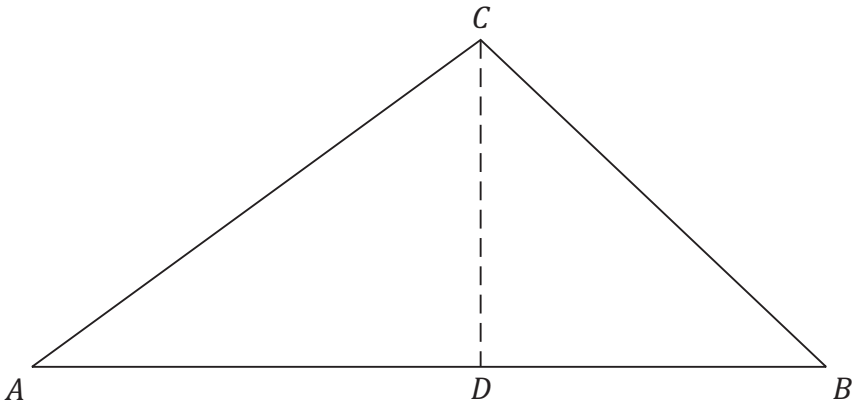
Question 3 **(30 marks)**

The diagram below shows the triangle ABC, where $|AB| = 10$ cm, $|AC| = 7$ cm and $|BC| = 6$ cm. D is a point on AB such that CD is perpendicular to AB.



(a) Use the Cosine Rule to show that $|\angle CAB| = 36{\cdot}18°$, correct to two decimal places.

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(b) Find the area of the triangle ABC.
Give your answers in cm^2, correct to two decimal places.

(c) Using your answer to **part (b)**, or otherwise, find $|CD|$.
Give your answer in cm, correct to one decimal place.

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Question 4 **(30 marks)**

c is the circle $x^2 + y^2 = 25$.

(a) Write down the centre and radius of circle c.

Centre of $c =$ Radius of $c =$

(b) Show that the line l: $3x + 4y = 25$ is a tangent to circle c.

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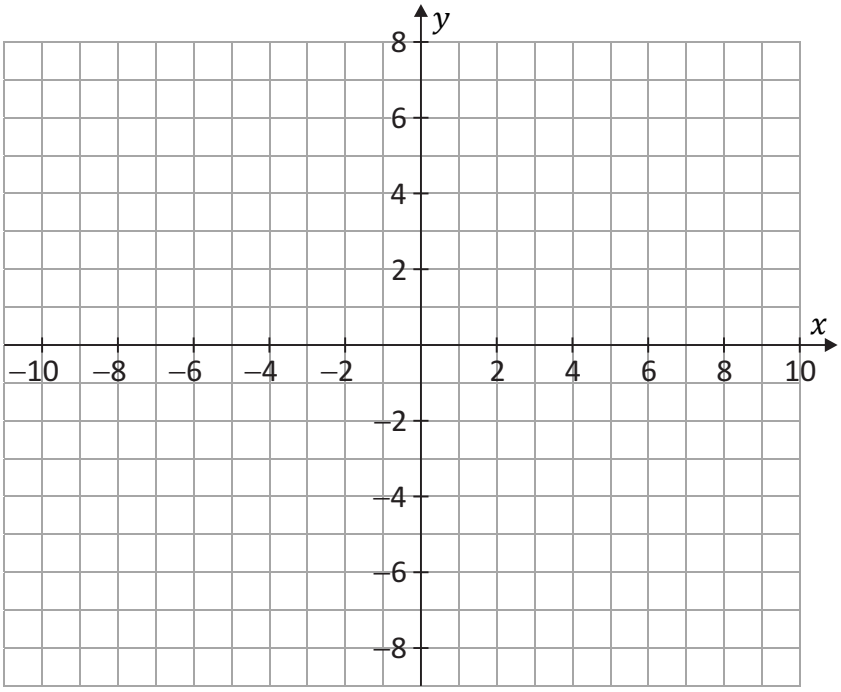
(c) Draw the circle c and the line l on the axes below.



(d) k is second tangent to circle c and is parallel to line l.
Find the equation of k.

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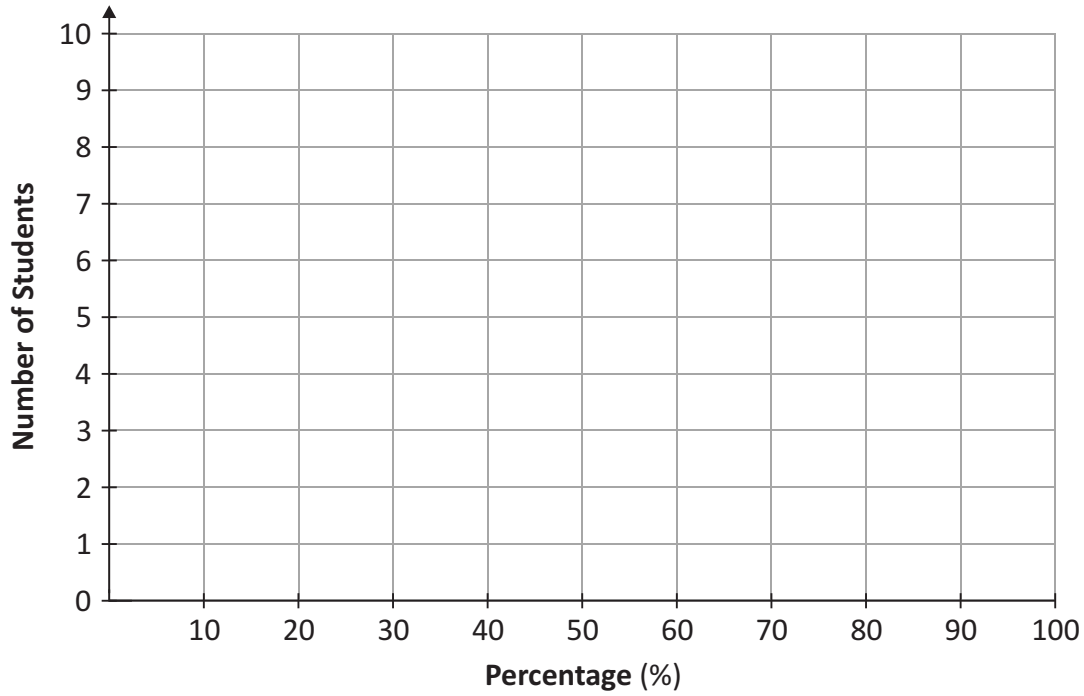
Question 5 **(30 marks)**

The table below shows the percentages that students in a class were awarded in a maths exam.

Percentage (%)	0–10	10–20	20–30	30–40	40–50	50–60	60–70	70–80	80–90	90–100
Number of students	0	1	1	1	2	5	7	5	5	3

Note: 20–30 means 20% and over but less than 30%.

(a) **(i)** Draw a **histogram** to represent the data.



(ii) Describe the distribution of results in the class.

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(b) Find the modal interval and the median interval of the data.

Modal interval =

Median interval =

(c) Use mid-interval values to estimate the mean result of the class.
Give your answer correct to one decimal place.

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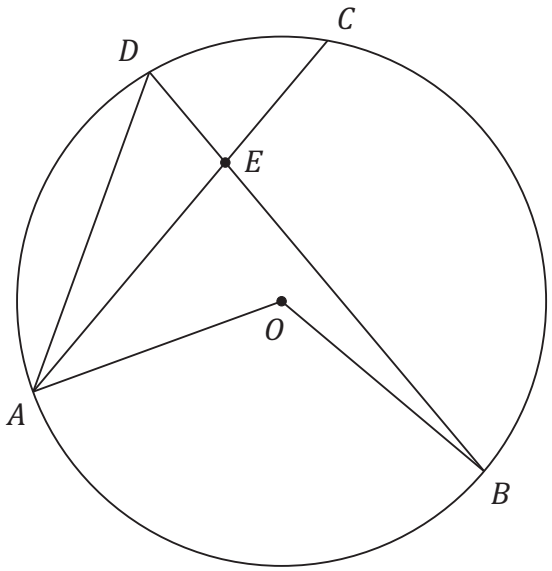
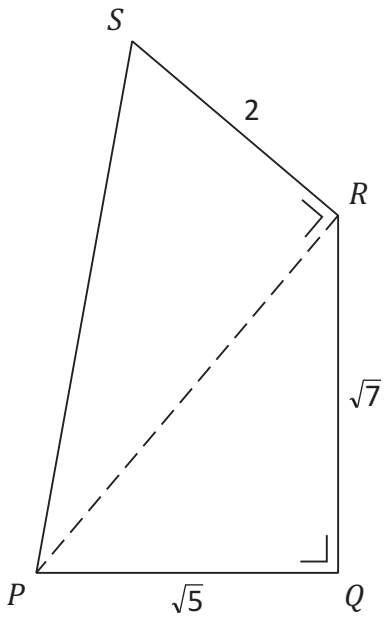
Question 6 **(30 marks)**

(a) A, B, C and D are points on a circle, with centre O, as shown.
The chords $[AC]$ and $[BD]$ intersect at the point E.
$|\angle BEA| = 80°$ and $|\angle DAE| = 20°$.



Find, with justification, $|\angle BOA|$.

(b) In the quadrilateral $PQRS$,
$|\angle PQR| = 90°$, $|PQ| = \sqrt{5}$, $|QR| = \sqrt{7}$, $|\angle PRS| = 90°$ and $|RS| = 2$.



(i) Find $|PS|$.

(ii) Find the area of the quadrilateral $PQRS$.
Give your answer correct to one decimal place.

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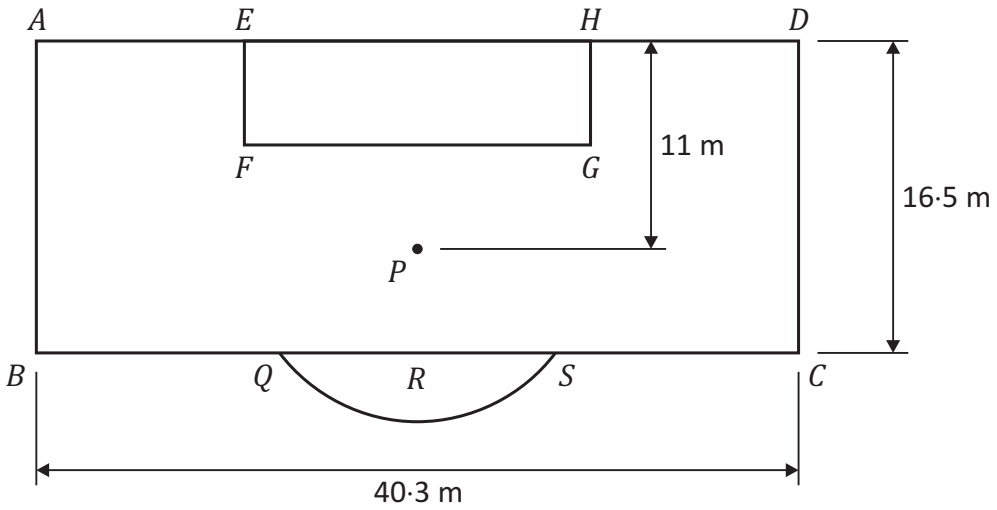
Section B — Contexts and Applications — 150 marks

Answer **any three** questions from this section.

Question 7 (50 marks)

The grounds-person of a local soccer club wishes to mark out a pitch for an upcoming game.
He uses different lengths of string to mark out the **penalty area**, as shown in the diagram.
The penalty spot, marked P, is centred in the penalty area and is 11 m from the goal line.



(a) PQS is a sector of a circle whose centre is P.
R is the midpoint of $[QS]$.
$|QS| = 14{\cdot}6$ m.

(i) Find $|PR|$.

(ii) Show that $|\angle SPQ| = 106°$, correct to the nearest degree.

(iii) Find $|PQ|$, the radius of the sector SPQ.
Give your answer in metres, correct to two decimal places.

(iv) Find the length of the arc QS.
Give your answer in metres, correct to one decimal place.

(b) The inner box of the penalty area measures 18·3 m × 5·5 m.

(i) Find the total length of string required to mark out all the lines in the **penalty area**.

(ii) The line marking machine applies a line of paint of width 12 cm to the ground.
Find the total area of all the lines (including the arc of the sector) in the **penalty area**.
Give your answer in m^2, correct to one decimal place.

This question continues on the next page.

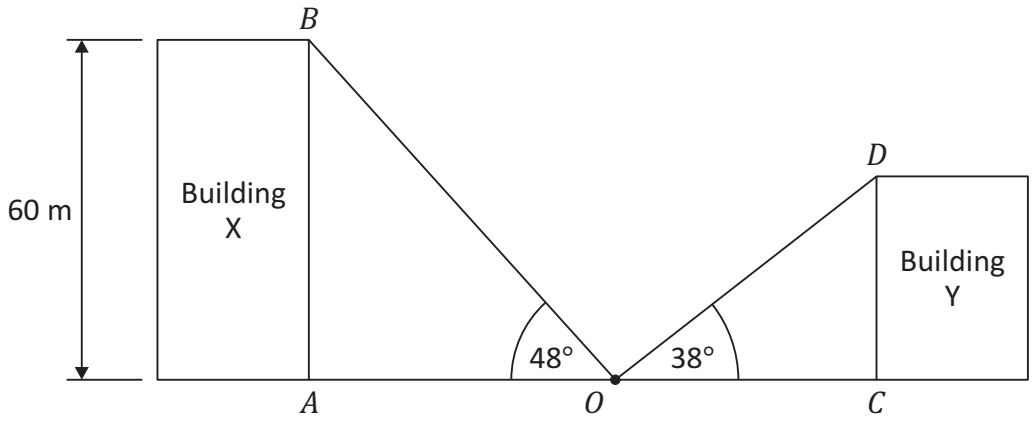
(c) For international competitions, such as the recent FIFA World Cup in Qatar, the length of a soccer pitch must be at least 100 m long and no longer than 110 m. The width of the pitch must be at least 64 m in length and no wider than 75 m.

(i) Write down the dimensions of the smallest allowable pitch **and** the largest allowable pitch for international competition.

(ii) Find the area of the smallest allowable pitch as a percentage of the area of the largest allowable pitch. Give your answer correct to one decimal place.

Question 8 **(50 marks)**

(a) Two buildings, X and Y, are 100 m apart on level ground.
The height of building X is 60 m.
From a point O between the two buildings, the angle of elevation to the top of building X is 48°. From the same point, the angle of elevation to the top of building Y is 38°.



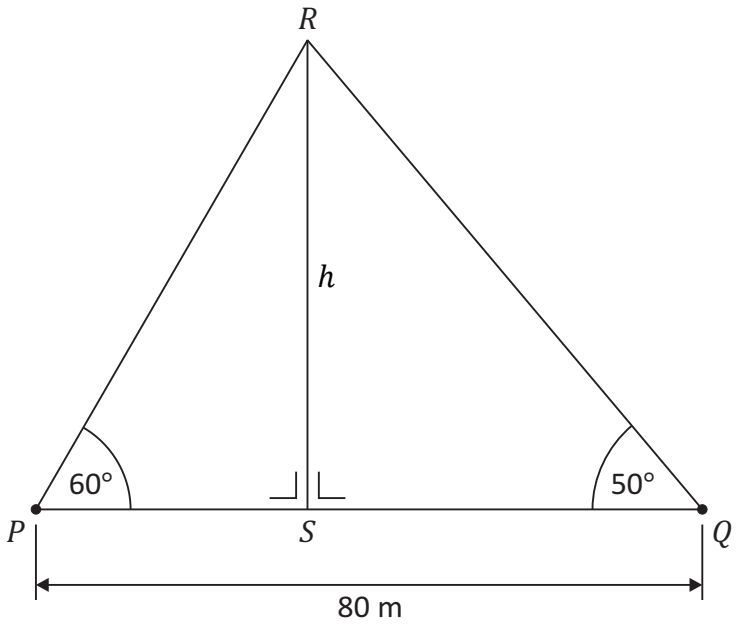
(i) Find $|AO|$, the distance from the base of building X to point O.
Give your answer in metres, correct to the nearest whole number.

(ii) Find $|OC|$, the distance from point O to the base of building Y.

(iii) Hence, find $|CD|$, the height of building Y.
Give your answer in metres, correct to one decimal place.

This question continues on the next page.

(b) The diagram below shows a vertical television mast, $[RS]$, of height h m, which is secured by two cables, $[PR]$ and $[QR]$, anchored to the ground at the points P and Q.
The angle of elevation to the top of the mast from P is 60° and from Q is 50°.



(i) Find $|\angle QRP|$.

(ii) The horizontal distance from P to Q is 80 m.
Use the Sine Rule to find the length of the cable $[PR]$.
Give your answer correct to one decimal place.

(iii) Using your answer to **part (b)(ii)**, or otherwise, find the value of h.
Give your answer in metres, correct to one decimal place.

(iv) Hence, find $|PS|$ and $|QS|$, the distances from the anchor points, P and Q, to the base of the television mast S.
Give your answers in metres, correct to one decimal place.

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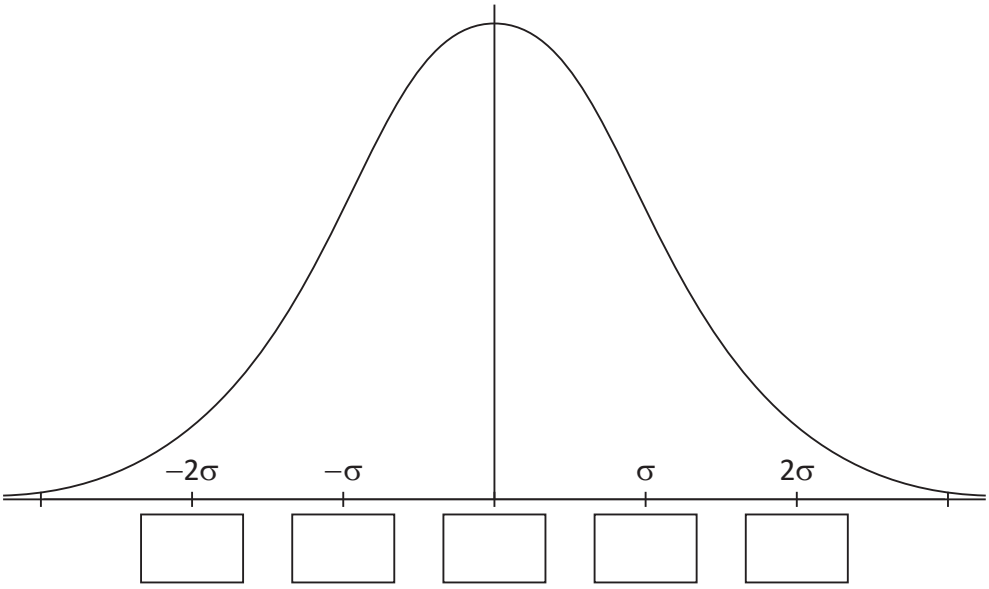
Question 9 **(50 marks)**

A survey was carried out on behalf of a supermarket chain to investigate the shopping habits of people for groceries. A random sample of 800 shoppers took part in the survey.

(a) Shoppers were asked how much time they spend on average shopping for groceries per month. The results were normally distributed with a mean time of 6 hours and a standard deviation of 1·5 hours.

(i) The diagram below shows the distribution of shopping times.
Fill in the missing numbers on the horizontal axis.



Average Shopping Times per Month

(ii) Use the Empirical Rule to find an interval that contains the shopping times for groceries of approximately 95% of the shoppers surveyed.

(iii) Use the Empirical Rule to estimate the approximate number of shoppers surveyed who spend between 4·5 and 7·5 hours per month shopping for groceries.

(iv) A shopper is chosen at random from those surveyed.
Use the Empirical Rule to find the probability that this person spends less than 3 hours per month shopping for groceries.

(v) Use the Empirical Rule to estimate the number of shoppers surveyed who spend more than 7·5 hours per month shopping for groceries.

This question continues on the next page.

(b) In the survey, shoppers were also asked if they preferred the supermarket chain's own brand of breakfast cereals over premium brands.
A random sample of 800 shoppers took part in the survey.

(i) Show that the margin of error for the survey is 3·54%, correct to two decimal places.

(ii) In the survey 528 people agreed that they preferred the supermarket chain's own brand of breakfast cereals.
Use your answer to **part (b)(i)** above to create a 95% confidence interval for the percentage of the population who preferred the supermarket chain's own brand of breakfast cereals.

(iii) After the survey, a marketing executive claimed that 70% of people preferred the supermarket chain's own brand of breakfast cereals over premium brands.
Use your answer to **part (b)(ii)** above to conduct a hypothesis test, at the 5% level of significance, to test this claim. State clearly your null hypothesis, your alternative hypothesis and give your conclusion in the context of the question.

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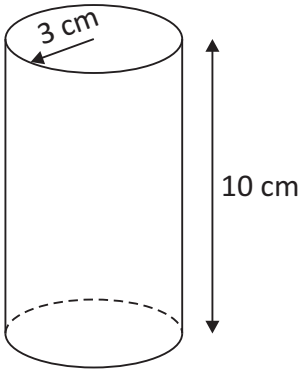
Question 10 **(50 marks)**

(a) Cylinder P has a radius of 3 cm and a height of 10 cm, as shown.



(i) Find the curved surface area of cylinder P.
Give your answer in terms of π.

(ii) Another cylinder Q is an enlargement of cylinder P.
The curved surface area of cylinder Q is 375π cm^2.
Find the scale factor of the enlargement.

(iii) Hence, find the radius and height of cylinder Q.

This question continues on the next page.

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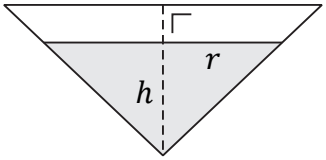
(b) The reservoir tank in a water tower is in the shape of an inverted right cone.
The cone has a diameter of 24 m and a height of 9 m.

(i) Write down the radius of the reservoir tank.

(ii) Find the capacity (volume) of the reservoir tank, in terms of π.

(c) Water used from the reservoir tank during the day is replaced at night. The volume of the tank is refilled to 90% of its capacity.



The diagram (not to scale) shows h, the height of the water, and r, the surface radius of the water, in the tank after it is refilled.

(i) Using similar triangles, or otherwise, show that $r = \frac{4h}{3}$.

(ii) Hence, find h, the height of the water in the tank after it is refilled.
Give your answer in metres, correct to one decimal place.

You may use this page for extra work.
Label any extra work clearly with the question number and part.

Q. & part	

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