L.19

2022-L019-1-EL-01/32

Pre-Leaving Certificate Examination, 2022

Mathematics

Paper 2

Ordinary Level

Time: 2 hours, 30 minutes

300 marks

For examiner	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

CANDIDATE DETAILS

EXAM ID

Optional 4 or 5-digit number
(only if provided by your school)

NAME

SCHOOL

TEACHER

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2022-L019-1-EL-01/32

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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 **any five** questions from Section A and **any three** questions from Section B.

Write your Exam ID, Name, School's Name and Teacher's Name 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 you do not include appropriate units of measurement, where relevant.

You may lose marks if you do not give your answers in simplest form, where relevant.

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

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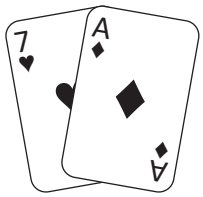
Section A — Concepts and Skills — 150 marks

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

(a) Two cards are drawn at random from the pack of cards.
Find, as a fraction, the probability that:

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

(ii) both cards drawn are 'hearts'

(iii) neither card drawn is an 'ace' (A)

(iv) at least one card drawn is an 'ace' (A).

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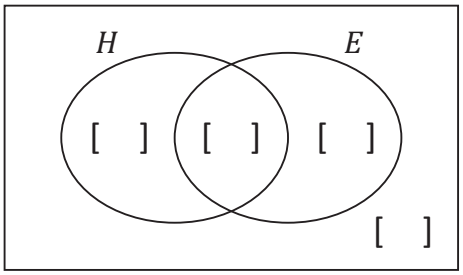
(b) In the Venn diagram below, the universal set is the full pack of cards.
The two sets shown represent 'hearts' (H) and even-numbered cards (E).

(i) Show on the diagram the number of elements in each region.



(ii) Two cards are again drawn at random from the full pack of cards.
Use your answers from the Venn diagram in **part (b)(i)** above to find the probability that the two cards drawn are neither 'hearts' nor even-numbered cards.

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Question 2 **(30 marks)**

l is the line $3x + 2y - 9 = 0$.

(a) l cuts the y-axis at the point P.
Find the co-ordinates of P.

(b) k is the line which contains the point $Q(-3, -4)$ and is perpendicular to the line l.
Show that the equation of k is $2x - 3y - 6 = 0$.

(c) R is the point of intersection of the lines l and k.
Find, using algebra, the co-ordinates of R.

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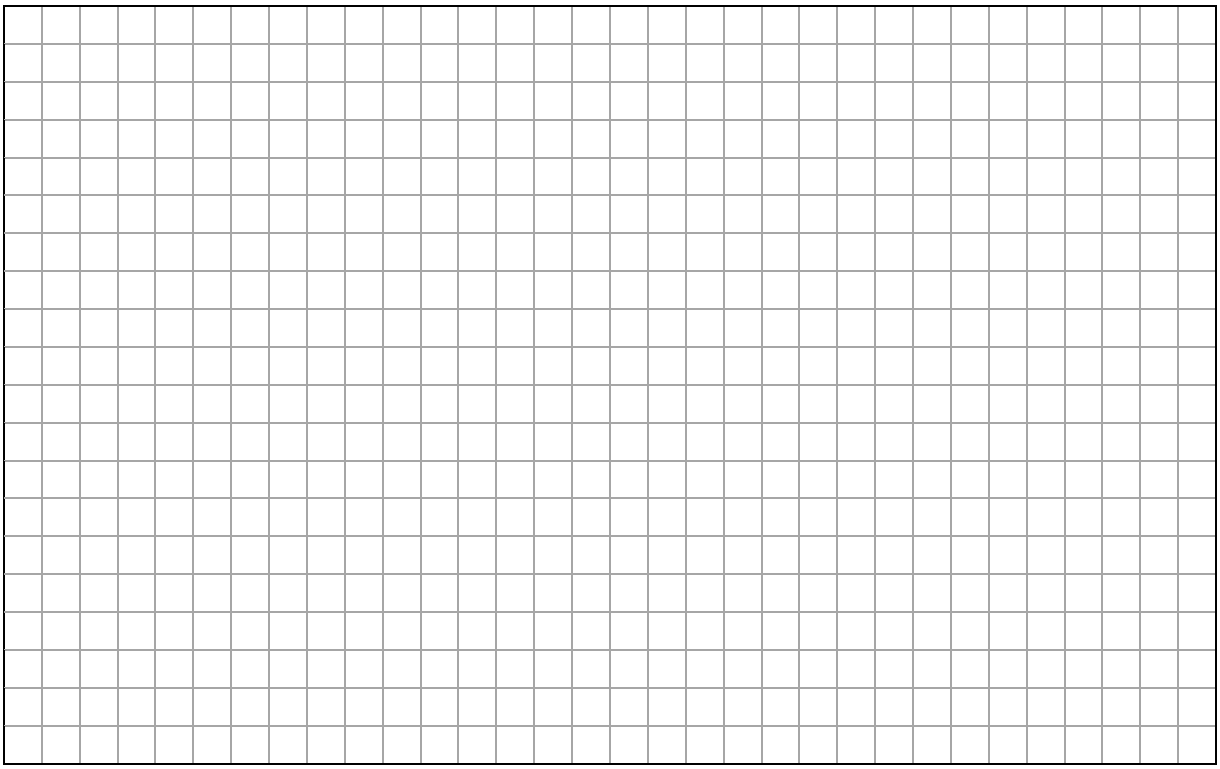
(d) Hence find the area of the triangle PQR.



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Question 3 **(30 marks)**

(a) A penalty stroke is awarded in hockey for an intentional foul on an attacking player in the penalty circle. The probability that Joanne scores from a penalty stroke is $\frac{5}{7}$.

During a particular match, Joanne takes three penalty strokes.

(i) Find the probability that she scores from the first two but not the third penalty stroke.

(ii) Find the probability that Joanne scores exactly twice.

(b) Jack and Holly take their driving tests on the same day.
The probability that Jack passes his test is 0·7.
The probability that both Jack and Holly pass their tests is 0·56.

(i) Find the probability that Holly passes her driving test.

(ii) Find the probability that both Jack and Holly fail their driving tests.

(iii) Find the probability that only one of them passes his or her driving test.

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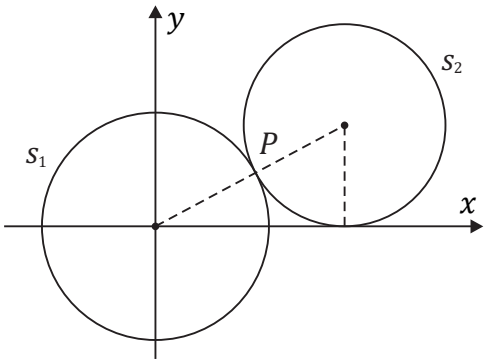
Question 4 **(30 marks)**

Two circles, s_1 and s_2, touch at the point P, as shown in the diagram.
P is on the line joining the two centres.



(a) Circle s_1 has centre $(0, 0)$ and radius 9 units.
Write down the equation of s_1.

(b) **(i)** Circle s_2 has radius 8 units and touches the x-axis.
Use the Theorem of Pythagoras to find the co-ordinates of the centre of circle s_2.

(ii) Hence write down the equation of circle s_2.

(c) The point $(a, 4)$ is on circle s_2.
Find, in surd form, the two possible values of a.

Question 5 **(30 marks)**

The table below shows the numbers of births by sex in Ireland between 2010 and 2019.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Male	38 395	37 898	36 890	35 340	34 681	33 480	32 709	31 779	31 298	30 555
Female	36 779	36 135	34 784	33 614	32 614	32 056	31 132	30 045	29 718	29 241

Source: Central Statistics Office (CSO)

(a) **(i)** Find the mean annual number of **female** births between 2010 and 2019.

(ii) Find the median annual number of **male** births between 2010 and 2019.

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(b) **(i)** Margaret examines the data in the table and comments that:
"A new baby born in Ireland is equally likely to be male or female."

Do you agree with her? Justify your answer by calculation.

Answer:

Justification:

(ii) Ben examines the data in the table and says that:
"It follows that there are more males than females overall in Ireland today."

Do you agree with him? Explain your answer.

Answer:

Explanation:

(c) Find the percentage decrease in the **total** number of births in Ireland between 2010 and 2019. Give your answer correct to one decimal place.

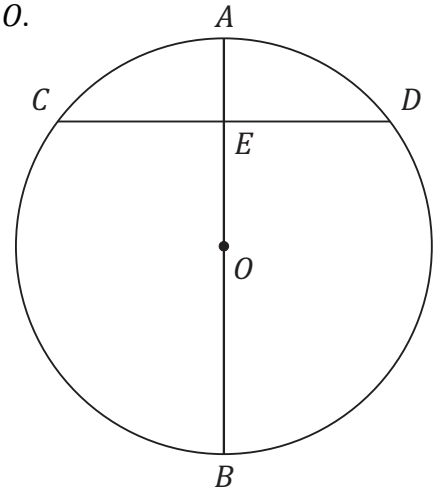
Question 6 **(30 marks)**

(a) **(i)** Construct the triangle PQR, where $|PQ| = 13$ cm, $|PR| = 8$ cm and $|QR| = 10$ cm.
The point P has been marked in for you.
Show all construction lines, arcs and labels clearly.

(ii) Explain what is meant by the *incircle* of a triangle.

(iii) Hence construct the incircle of triangle PQR in **part (a)(i)** above.
Show all construction lines clearly.

(b) In the diagram, $[AB]$ is a diameter of a circle with centre O.
$[AB]$ bisects the chord $[CD]$ at E.
$|AB| = 10$ cm and $|CD| = 8$ cm.



Find, with justification, $|BE|$.

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Section B — Contexts and Applications — 150 marks

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

Question 7 **(50 marks)**

Table A below shows the numbers of **new cars** and the numbers of **imported (used) cars** registered in Ireland between 2010 and 2018.

Table A – Numbers of cars registered									
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
New cars	89 212	90 477	79 874	74 689	96 630	125 211	146 806	131 683	126 280
Imported (used) cars	40 115	40 809	40 512	50 687	54 471	48 398	72 718	94 456	101 879

Source: Central Statistics Office (CSO) / Revenue

(a) Based on the data in **Table A**, write down:

(i) the year with the lowest number of imported (used) cars registered _____

(ii) the year with the largest increase in new cars registered _____

(iii) the smallest difference between the numbers of new cars and imported (used) cars registered in any year during the period shown. _____

(b) **(i)** Write the number of imported (used) cars registered in 2018 as a percentage of the total number of cars registered in that year. Give your answer correct to one decimal place.

(ii) Based on the data in **Table A**, what trend do you observe in cars registered in Ireland in the period shown?
Explain your answer.

Trend:

Explanation:

(c) A pie chart to represent the total numbers of cars registered in Ireland between 2014 and 2018 is to be drawn.

(i) Complete **Table B** below, to show the total number of cars registered each year.
Hence find the angle corresponding to each year in the pie chart.
Give your answers in degrees, correct to one decimal place.

Table B – Total numbers of cars registered		
Year	**Total number**	**Angle (degrees)**
2014		
2015		
2016	219 524	79·1°
2017		
2018		

(ii) Draw a pie chart to represent the data in **Table B**. Label the sector corresponding to each year and write the size of the angle in each sector.

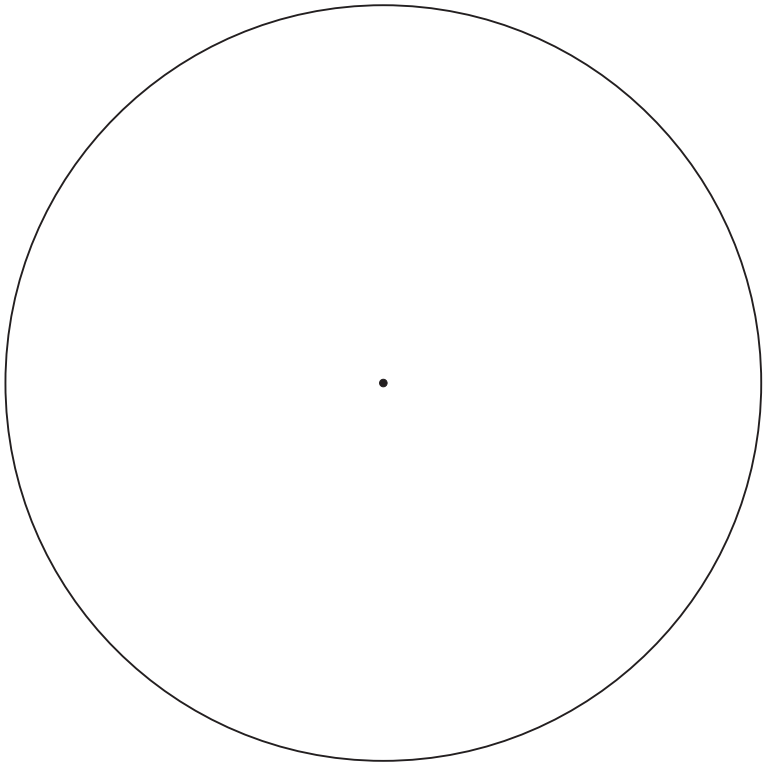

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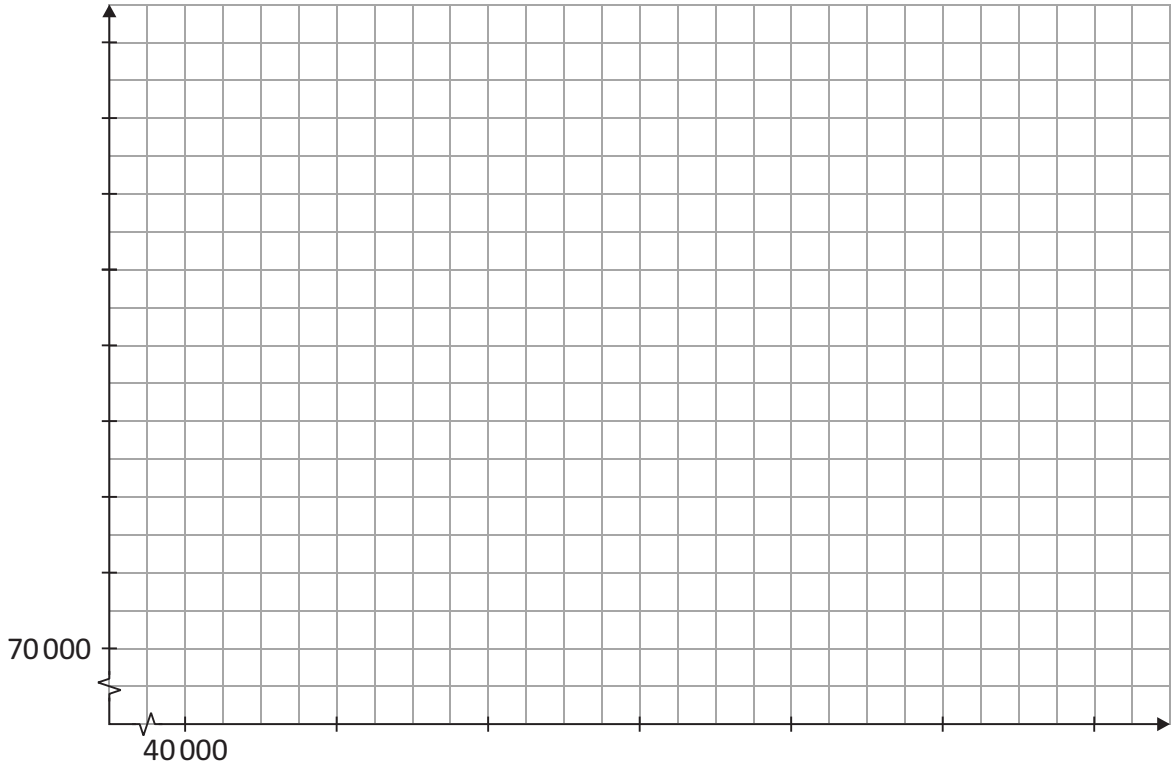
Table A – Numbers of cars registered (Repeat)									
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
New cars	89 212	90 477	79 874	74 689	96 630	125 211	146 806	131 683	126 280
Imported (used) cars	40 115	40 809	40 512	50 687	54 471	48 398	72 718	94 456	101 879

(d) A student is interested in the relationship between the sales of new and imported (used) cars. She draws the axes of a scatter plot but only partially completes them.

(i) Complete the axes below and plot the data in **Table A**.



(ii) The correlation coefficient between the two sets of data is one of the numbers below. Write the letter corresponding to the correct answer in the box.

A 0·1
B 0·7
C –0·1
D –0·7

(iii) What can you conclude from the scatter plot and the correlation coefficient?

(e) **Table C** below shows the values, in intervals, of new cars registered in Ireland in 2018.

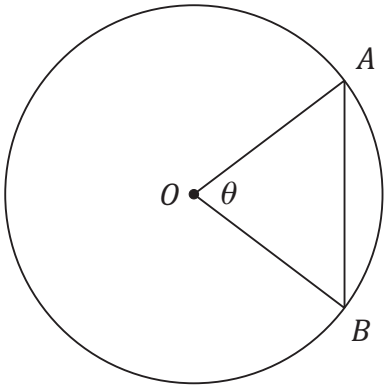
Use mid-interval values of the data in the table below to estimate the total value of new cars registered in Ireland in 2018.
Given that one billion is one thousand million, write your final answer in billions of euro, correct to three significant figures.

Table C – Total value of new cars registered in 2018		
Value of car (€)	**Number**	**Value of cars registered (€)**
0 – 15 000	7278	
15 000 – 20 000	20 364	
20 000 – 25 000	25 218	
25 000 – 30 000	30 837	
30 000 – 40 000	27 048	
40 000 – 50 000	8337	
50 000 – 60 000	4017	
60 000 – 70 000	1078	70 070 000
70 000 – 80 000	892	66 900 000
80 000 – 90 000	419	35 615 000
90 000 – 100 000	237	22 515 000
100 000 – 150 000	460	57 500 000
150 000 – 200 000	72	12 600 000
200 000 – 250 000	14	3 150 000
250 000 – 500 000	9	3 375 000
Total	126 280	

Question 8 **(50 marks)**

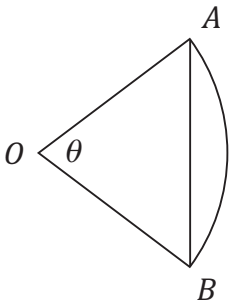
A sector of a circle, AOB, where O is the centre of the circle, is shown in **Figure 1**.
The radius of the circle is 7·5 cm and the angle at the centre of the sector, θ, is 74°.

Figure 1



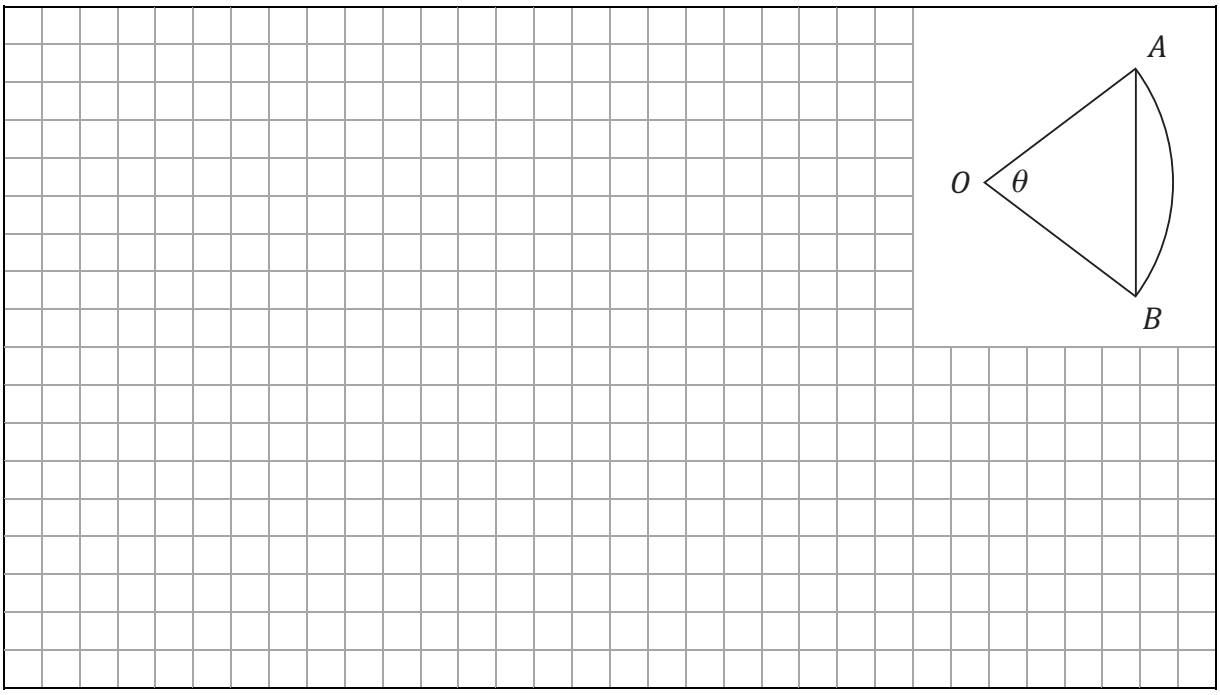
(a) **(i)** The sector AOB taken from **Figure 1** is shown in **Figure 2**.
Find $|\angle OBA|$.

Figure 2

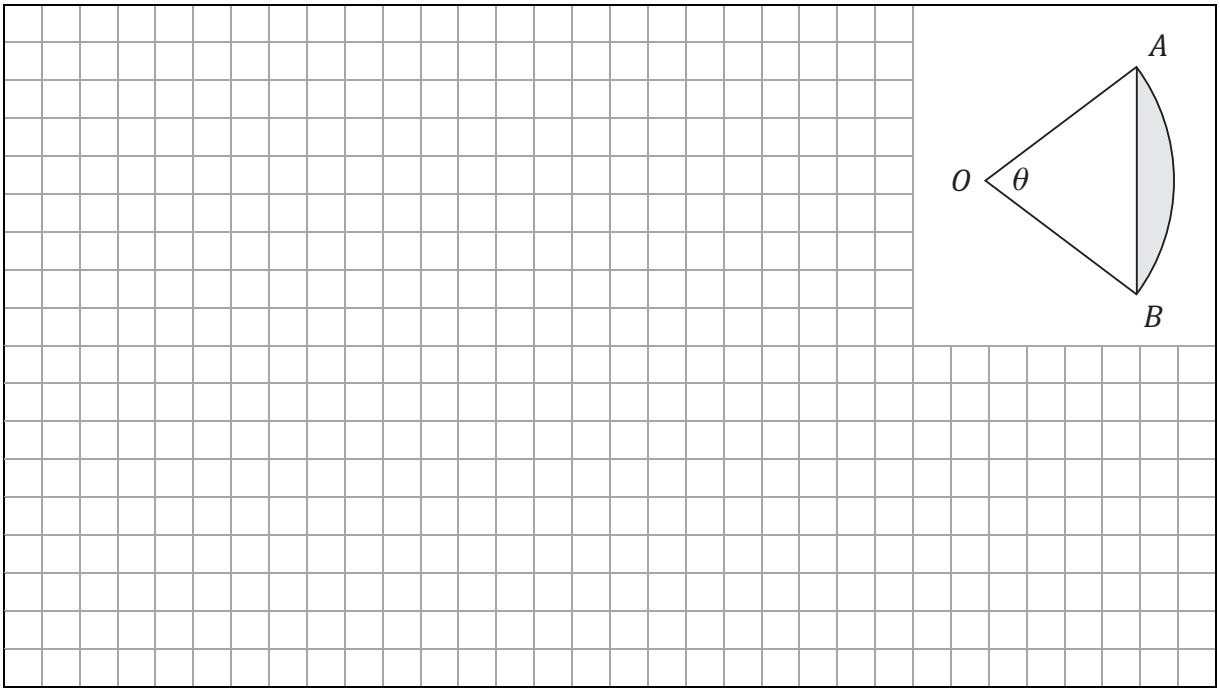


(ii) Use the Sine Rule to find the length of the chord AB.
Give your answer correct to two decimal places.

(iii) Find the area of the sector AOB.
Give your answer in cm², correct to two decimal places.



(iv) Find the area of the triangle AOB and hence find the area of the shaded region.
Give your answers in cm², correct to two decimal places.



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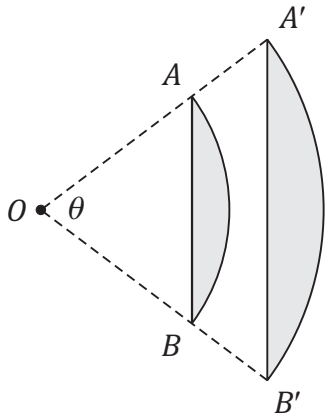
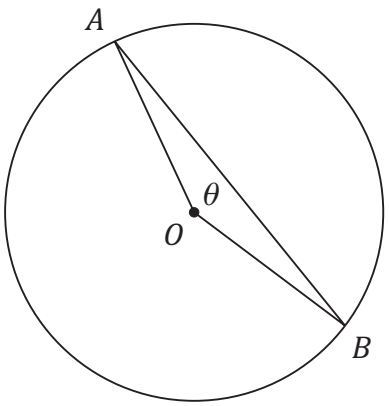
(b) The sector is used in the design of a company logo.
The sector is enlarged with the centre of the circle, O, as the centre of enlargement, as shown in the diagram.
The length of the minor arc $A'B'$ in the resultant shaded image is 14·55 cm.



(i) Find the length of the minor arc AB, correct to one decimal place.
Hence show that the scale factor of the enlargement is 1·5.

(ii) Hence use the scale factor to find the area of the resultant shaded image.

(c) Consider again the sector AOB.
The angle at the centre of the sector, θ, is increased such that the length of the **chord** AB is equal to 14·55 cm.



Use the Cosine Rule to find the value of θ, correct to the nearest degree.

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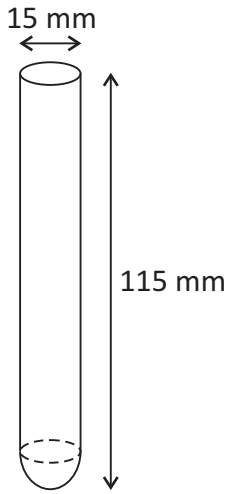
Question 9 **(50 marks)**

(a) A test tube consists of a cylindrical section with a hemispherical end. The test tube has an internal diameter of 15 mm and an overall internal length of 115 mm, as shown.



(i) Find the internal radius of the hemispherical end.

(ii) Find the internal volume of the hemispherical end in terms of π.

(iii) Hence show that the capacity (volume) of the test tube is 19 880 mm^3, correct to the nearest whole number.

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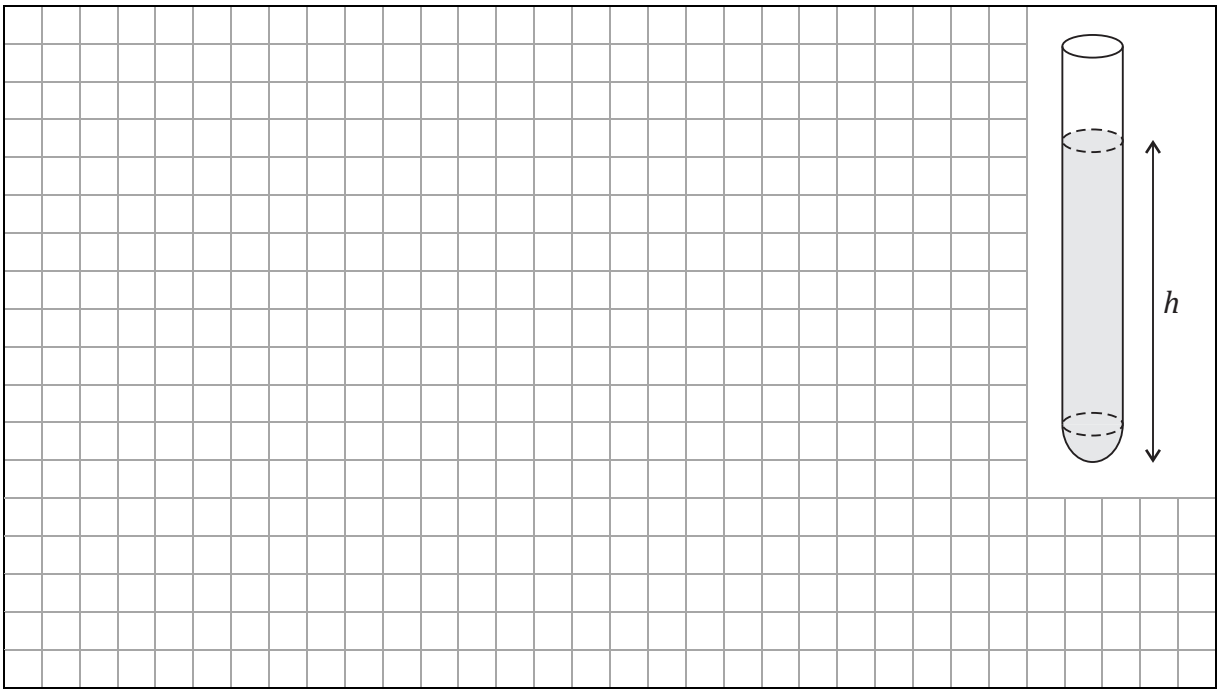
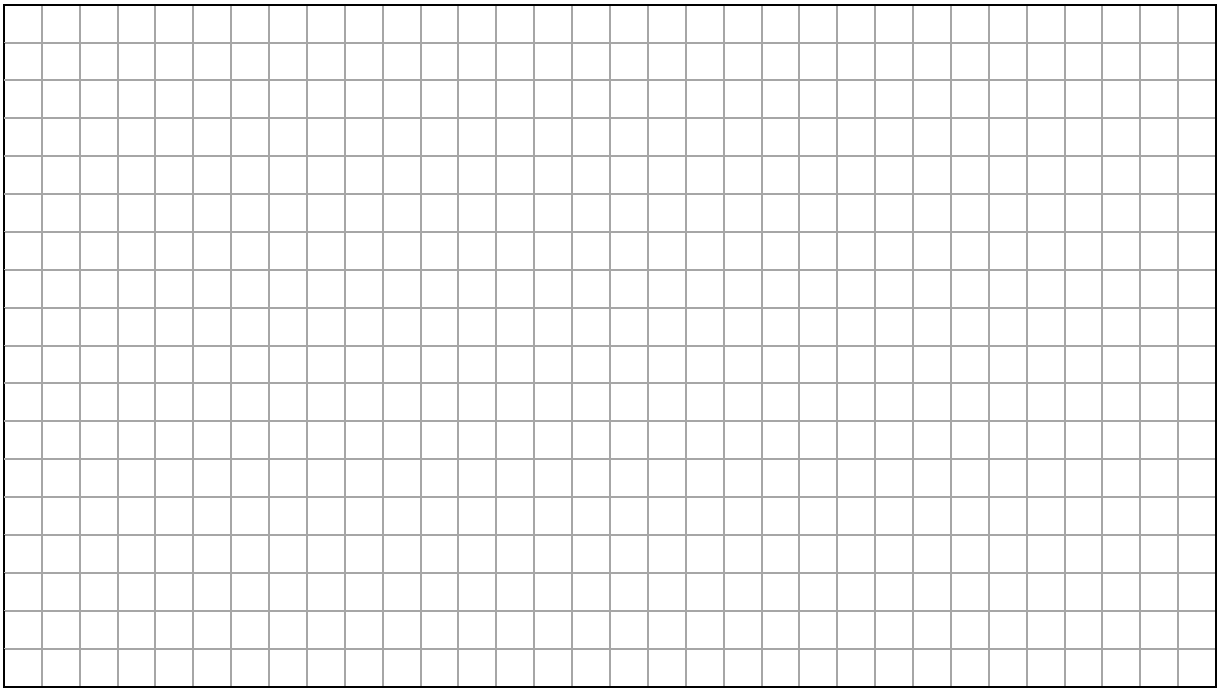
(iv) The test tube is filled to 75% of its capacity with water.

Find h, the height of the water in the test tube.
Give your answer correct to the nearest mm.



(b) **(i)** Find the curved surface area of the interior of the test tube.
Give your answer in mm^2, correct to two decimal places.



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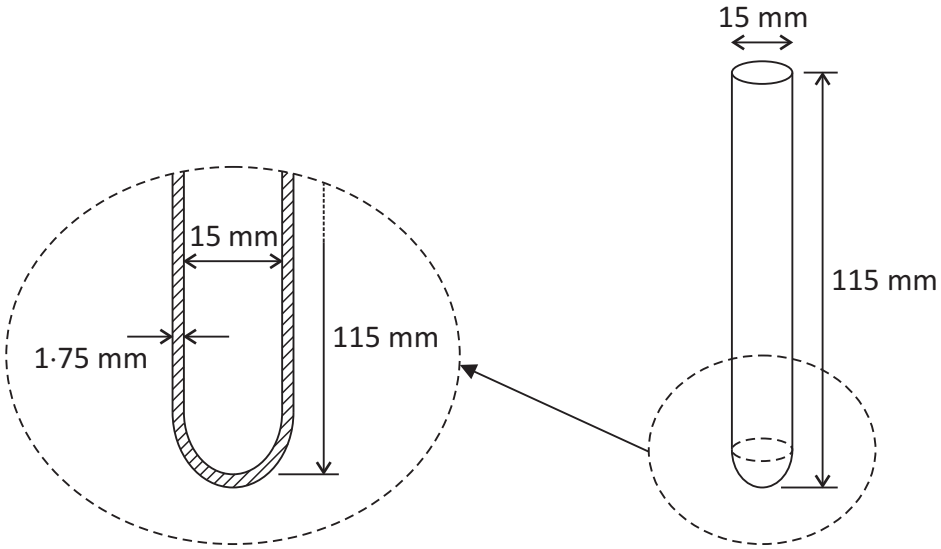
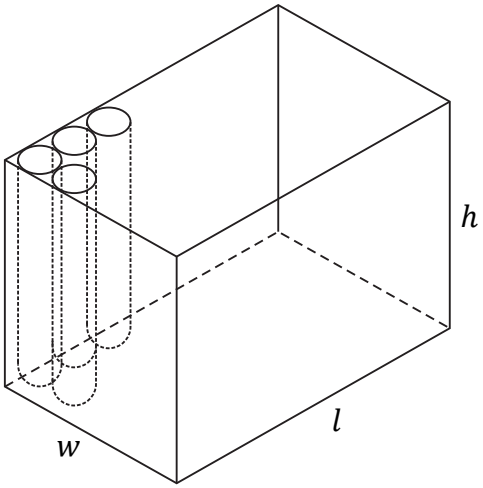
(ii) The test tube is made of glass. The thickness of the glass is 1·75 mm.
The approximate volume of glass in the test tube is equal to the curved surface area of the interior of the test tube by the thickness of the glass.
Each **cm³** of glass weighs 2·7 grams.



How much does each empty test tube weigh?
Give your answer in grams, correct to one decimal place.

(iii) Test tubes are shipped in rectangular cases of 40, as shown.
The width of the case can fit 5 test tubes and the length can fit 8 test tubes.

Find the dimensions of a rectangular case.



$w =$ $l =$ $h =$

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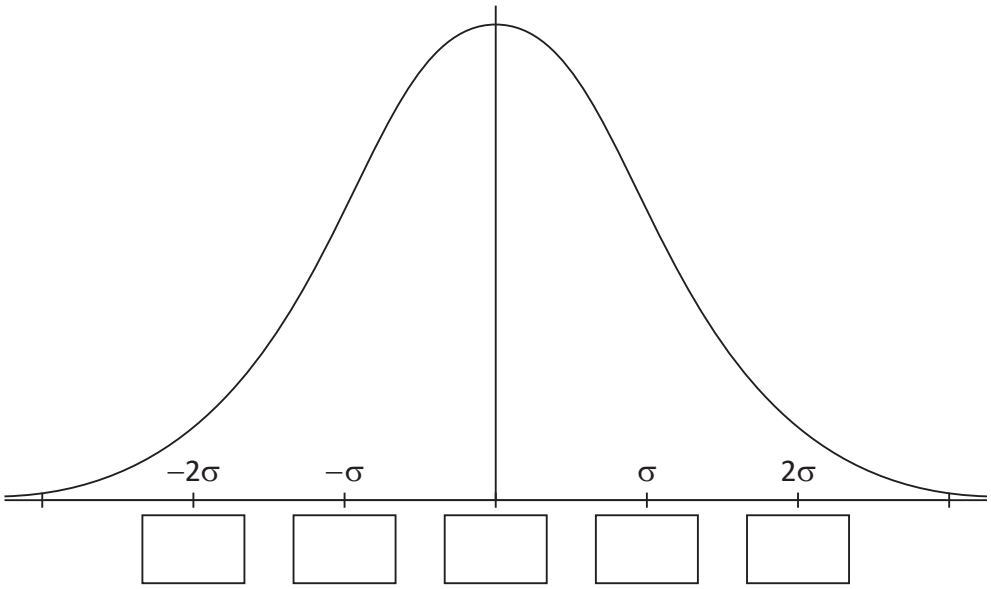
Question 10 **(50 marks)**

(a) The lengths of babies are recorded when they are born. In a sample of 800 newborn babies, the mean length is 51·5 cm and the standard deviation is 5 cm. Assuming that these lengths are normally distributed, the diagram below shows the expected distribution of the lengths of these babies.

(i) Fill in the missing numbers on the horizontal axis.



Lengths of Newborn Babies

(ii) Use the Empirical Rule to find an interval that will contain the lengths of approximately 95% of the babies.

(iii) Find the approximate number of babies in the sample with lengths of between 46·5 cm and 56·5 cm.

(iv) A baby is chosen at random from the sample.
Using the Empirical Rule, or otherwise, find the probability that this baby has a length of between 56·5 cm and 61·5 cm.

(v) Find the approximate number of babies in the sample with lengths of less than 41·5 cm.

(vi) A newborn baby has a length of 66·8 cm.
The midwife states that the baby's length is in the top 1% of newborn babies.
Do you agree with her? Explain your answer.

This question continues on the next page.

(b) In 2013, an advisory group consisting of citizens and politicians voted by a small majority in favour of changing the Irish Constitution to reduce the voting age to 16.
To date, no referendum on this issue has been held.

A Transition Year class carried out a survey to find out people's current views on this proposal.

(i) A random sample of 1024 people was surveyed. Find the margin of error of the survey. Give your answer as a **percentage**, correct to two decimal places.

(ii) In the survey, 605 people agreed that a referendum should be held on this issue. Use your answer to **part (b)(i)** above to create a 95% confidence interval for the percentage of the population who were in favour of a referendum on this issue.

(iii) After the survey, a political activist claimed that 65% of Irish people were in favour of a referendum to reduce the voting age to 16.
Use your answer to **part (b)(ii)** above to conduct a hypothesis test, at the 5% level of significance, to test this claim. State your null hypothesis, your alternative hypothesis and give your conclusion in the context of the question.

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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Pre-Leaving Certificate Examination, 2022 – Ordinary Level

Mathematics – Paper 2

Time: 2 hours, 30 minutes

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