L.19

2020-L019-1-EL-01/28

Pre-Leaving Certificate Examination, 2020

Mathematics

Paper 2

Ordinary Level

Time: 2 hours, 30 minutes

300 marks

CANDIDATE DETAILS

EXAM ID | | | | | | **Optional** 4 or 5-digit number (only if provided by your school)

NAME

SCHOOL

TEACHER

For examiner	
Question	Mark
1	
2	
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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	3 questions

Answer all nine questions.

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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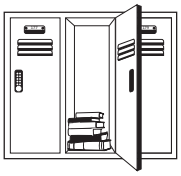
Section A — Concepts and Skills — 150 marks

Answer **all six** questions from this section.

Question 1 **(25 marks)**



Students select a four-digit security code using the numbers 0 to 9 for their school lockers. A code cannot begin with 0, but numbers may be repeated.

(a) **(i)** Write down the smallest possible four-digit code.

(ii) How many different codes are possible?

(iii) How many different codes do **not** contain a zero?

(iv) One code is selected at random from all the possible codes.
Find the probability that this code contains at least one zero.
Give your answer correct to two decimal places.

(b) Liz has forgotten the security code for her school locker.
She knows that she used two prime numbers when selecting the code.
She also knows that no number was repeated in the code.

How many attempts would it take Liz to open her locker if the two prime numbers are next to each other?

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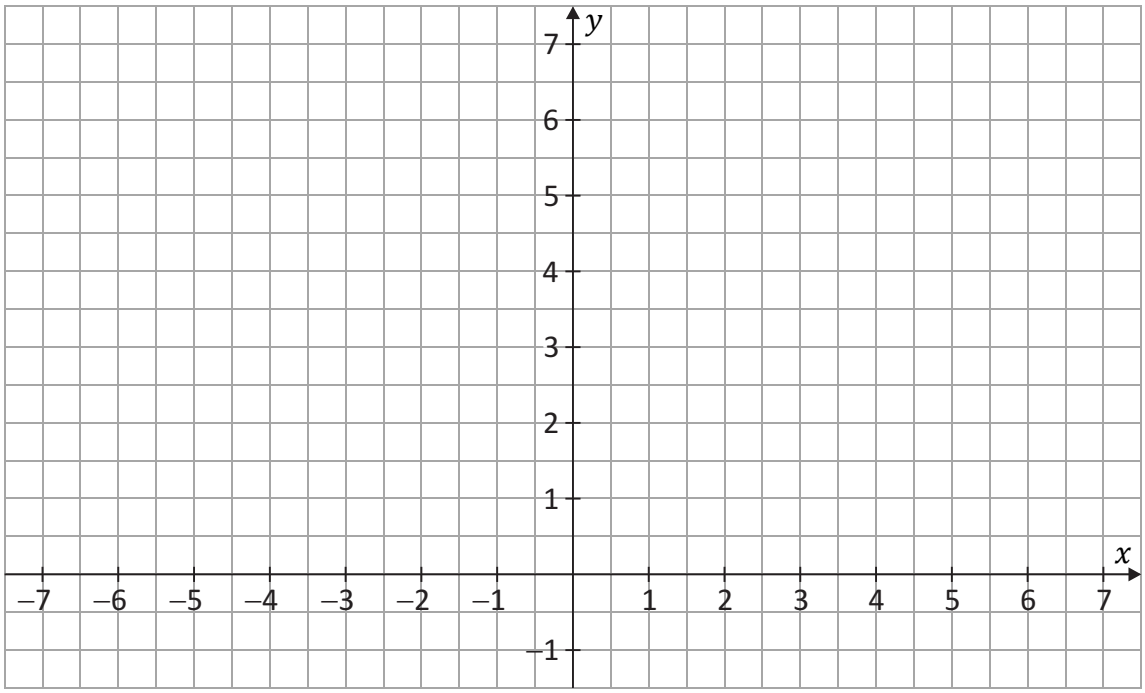
Question 2 **(25 marks)**

The points $A(2, 3)$, $B(-1, 4)$ and $C(3, 6)$ are the vertices of a triangle.

(a) Draw the triangle ABC on the co-ordinate diagram below.
Label each vertex clearly.



(b) **(i)** Show, using slopes, that AB is perpendicular to AC.

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(ii) Find $|AB|$ and $|AC|$.

$|AB| =$

$|AC| =$

(iii) Hence use your answers to **parts (b)(ii)** above to find the area of the triangle ABC.

(c) Use another method to find the area of the triangle ABC.

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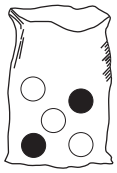
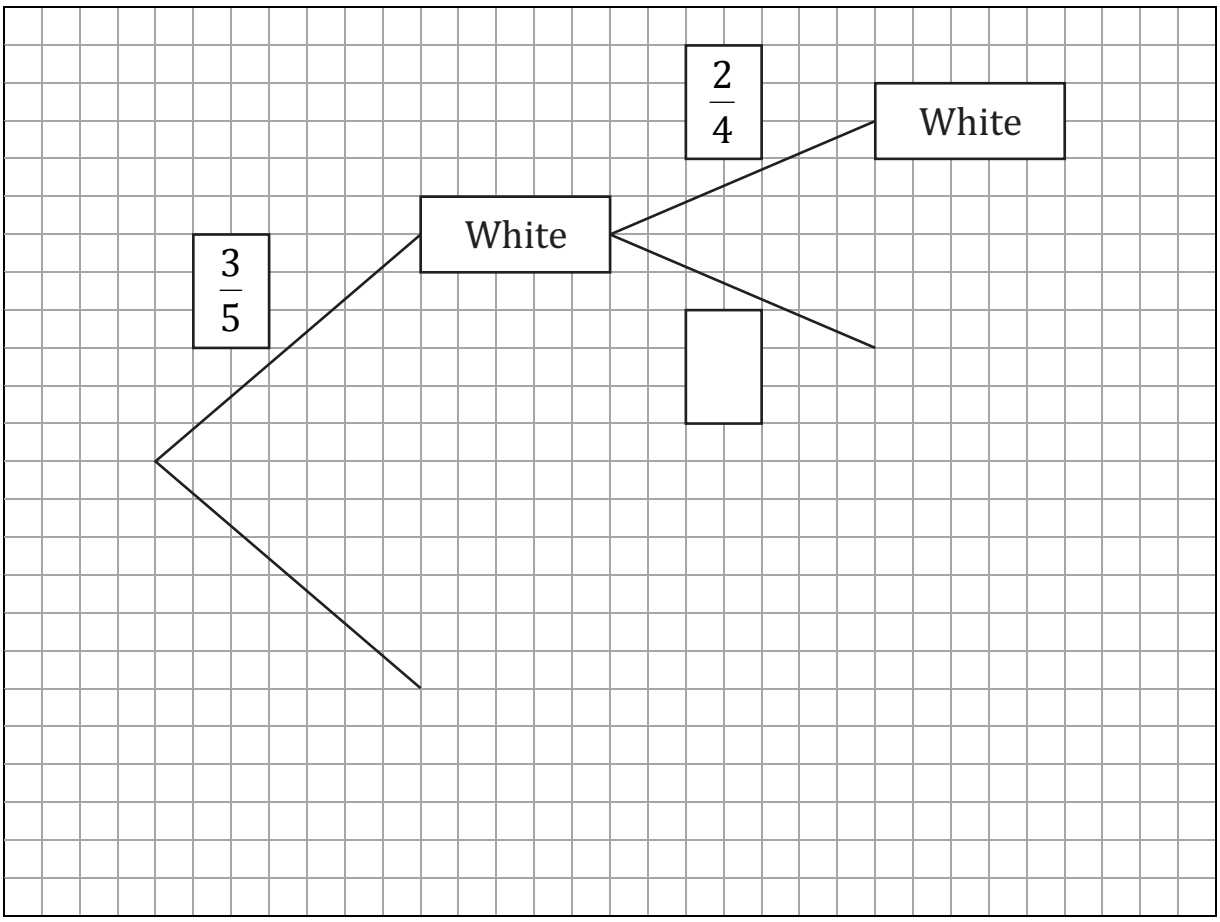
Question 3 **(25 marks)**

A bag contains three white balls and two black balls.
Two balls are picked at random from the bag and not replaced.



(a) Complete the tree diagram below to illustrate all the possible outcomes.
Show clearly the probability associated with each branch.



(b) Using your tree diagram, or otherwise, find the probability that

(i) two white balls are picked

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(ii) one white ball and one black ball are picked

(iii) two balls of the same colour are picked.

(c) All the balls are replaced and one green ball is added to the bag.
Two balls are again picked at random and not replaced.
Find the probability that the two balls are **not** of the same colour.

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Question 4 **(25 marks)**

The table below shows the number of births to women in particular age groups in Ireland in 2016.

Age (years)	15 – 20	20 – 25	25 – 30	30 – 35	35 – 40	40 – 45
Number of births	1101	5217	11 357	23 012	18 775	4079

Source: Central Statistics Office (CSO)

[25 – 30 means 25 years old or more but less than 30 years old, etc.]

(a) **(i)** Use mid-interval values of the data in the table to estimate the mean age of women who gave birth in Ireland in 2016. Give your answer correct to one decimal place.

(ii) What percentage of women who gave birth were in their thirties? Give your answer correct to the nearest percent.

(b) The total number of births in Ireland in 2016 was 63 841, of which 32 709 were boys. The table below shows the number of births on each day of the week.

Day of week	Mon	Tues	Wed	Thurs	Fri	Sat	Sun
Number of births	8998	10 219	10 245	10 665	10 355		6154

Source: Central Statistics Office (CSO)

(i) Find the **total** number of births on Saturday or Sunday and hence find the probability of a birth being on either of those days. Give your answer correct to two decimal places.

(ii) Find the number of girls **expected** to have been born on either Saturday or Sunday of that year.

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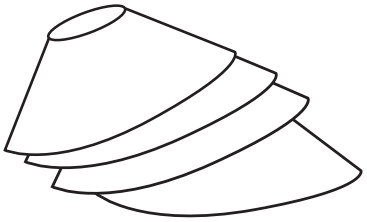
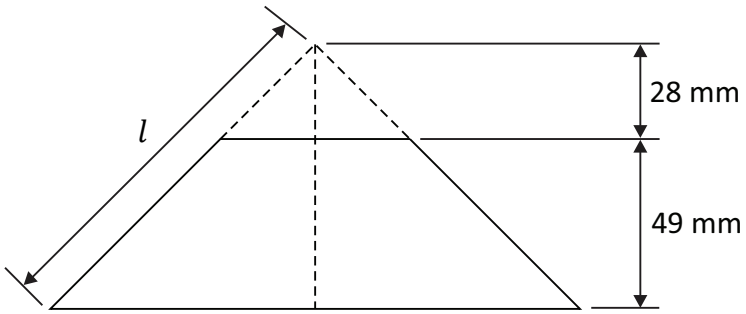
Question 5 **(25 marks)**



Marker cones are used in many games and sports to set out drills and to indicate playing areas.

A marker cone is produced in the shape of a truncated right cone, which is a cone with its top cut off. The height of the truncated cone is 49 mm and the height of the cone that is cut off is 28 mm, as shown. The bottom diameter of the marker cone is 176 mm.



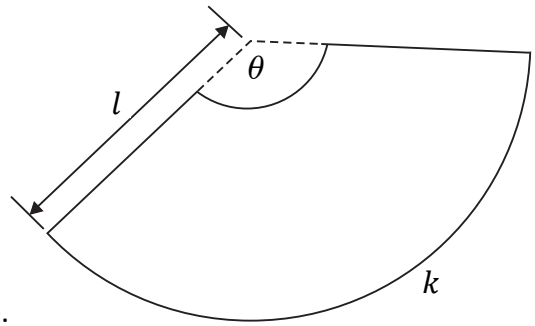
(a) **(i)** Write down r_b, the bottom radius of the marker cone.

(ii) Show that the slant height of the cone, l, before its top is cut off is 116·9 mm, correct to one decimal place.

(iii) Using similar triangles, or otherwise, find the top radius of the marker cone, r_t.

(b) **(i)** Find k, the bottom circumference of the marker cone.
Give your answer in mm, correct to nearest whole number.

(ii) The diagram (not to scale) shows the net of the outer surface of the marker cone. It is a sector of a circle of radius length l with arc length k and angle θ at the centre, as shown.



Find θ, the angle at the centre of the sector.
Give your answer correct to the nearest degree.

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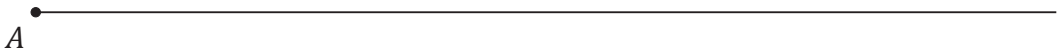
Question 6 **(25 marks)**

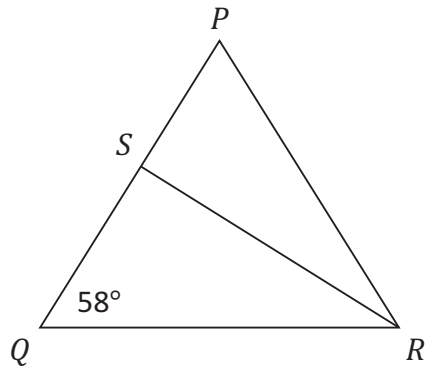
(a) **(i)** Construct an isosceles triangle ABC, where $|AB| = |AC| = 12$ cm, $|BC| = 7$ cm.
The point A is given to you.
Show all your construction lines, arcs and labels clearly.



(ii) Measure $|\angle ABC|$, and give your answer correct to the nearest degree.

(iii) Explain how you could use the measurement in **part (a)(ii)** to check the accuracy of your construction.

(b) The diagram shows an isosceles triangle PQR in which $|PQ| = |PR|$ and $|\angle PQR| = 58°$. $[RS]$ is perpendicular to $[PQ]$ at S.



(i) Verify that $|\angle RPQ| = 2|\angle QRS|$.

(ii) Hence, or otherwise, find $|\angle SRP|$.

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Section B — Contexts and Applications — 150 marks

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

Question 7 **(60 marks)**

Table A below shows the total numbers of learner drivers and qualified drivers in Ireland – both male and female – between 2012 and 2017.

Table A – Total numbers of drivers in Ireland						
Year	2012	2013	2014	2015	2016	2017
Learner (Male)	134 295	109 727	116 143	119 675	124 570	122 786
Learner (Female)	123 039	117 470	119 735	120 767	125 087	123 362
Total (Learner)						246 148
Qualified (Male)	1 300 385	1 295 289	1 324 507	1 337 991	1 370 954	1 394 693
Qualified (Female)	1 113 551	1 119 094	1 150 279	1 175 636	1 199 917	1 225 321
Total (Qualified)	2 413 936	2 414 383	2 474 786	2 523 627	2 570 871	2 620 014

Source: Central Statistics Office (CSO)

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

(i) the year with the lowest number of male learner drivers _____

(ii) the year with the largest increase in female qualified drivers _____

(iii) the smallest difference between male and female learner drivers in any year during the period shown. _____

(b) Write the total number of learner drivers as a percentage of the total number of all drivers in 2017. Give your answer correct to one decimal place.

(c) **(i)** Complete **Table B** below to show the total numbers of learner drivers in Ireland between 2012 and 2017.

Table B – Total numbers of learner drivers in Ireland						
Year	2012	2013	2014	2015	2016	2017
Total (Learner)						246 148

(ii) Write the data for the total numbers of learner drivers in increasing order and hence find the median number of learner drivers during the period shown.

(d) **(i)** Find the mean number of learner drivers in Ireland between 2012 and 2017.

(ii) For what year(s) was the total numbers of learner drivers not within 5% of the **mean** number of learner drivers in Ireland during the period shown?

(e) **Table C** below shows the total numbers and percentages of learner drivers – both male and female – in Ireland between 2012 and 2017.

Table C – Total numbers and percentages of learner drivers in Ireland						
Year	2012	2013	2014	2015	2016	2017
Learner (Male)	134 295	109 727	116 143	119 675	124 570	122 786
Learner (Male), %	9·4	7·8	8·1	8·2	8·3	8·1
Learner (Female)	123 039	117 470	119 735	120 767	125 087	123 362
Learner (Female), %	9·9	9·5	9·4	9·3	9·4	9·1

Source: Central Statistics Office (CSO)

(i) Draw a suitable chart or charts to represent the percentage data for male and female learner drivers in **Table C**.

(ii) Adam examines the data in **Table C** and the chart(s) in **part (e)(i)** and comments that:
"There was no significant increase in the **total** number of female drivers between 2012 and 2017."
Do you agree with Adam? Explain your answer.

Answer:

Explanation:

(f) **Table D** below shows the numbers of learner drivers who passed the driving test in 2017.

Table D – Numbers who passed the driving test in 2017			
Gender	Male	Female	All
All Driving Tests	70 552	55 315	125 867
Driving Tests Passed	39 476	27 111	66 587

Source: Central Statistics Office (CSO)

A survey was carried out of female learner drivers who completed their driving tests in 2017 **for the first time** to investigate if their pass rate was in accordance with the overall statistics.

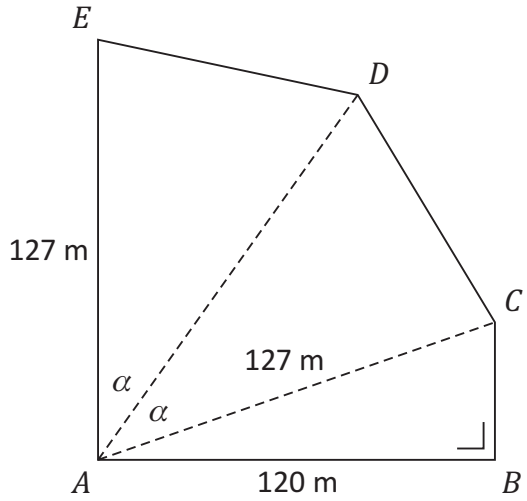
(i) A random sample of 850 female drivers who completed the driving test were surveyed. Find the margin of error of the survey.
Give your answer as a **percentage**, correct to two decimal places.

(ii) In the survey, 382 of those surveyed said that they passed the test on the first attempt. Use your answer to **part (f)(i)** above to create a 95% confidence interval for the percentage of female drivers who passed the test on the first attempt.

(iii) A spokesperson for the driver testing authority claimed that the survey results were in line with the overall statistics. Use your answer to **part (f)(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.

Question 8 **(45 marks)**

The diagram shows the outline of a field divided into three parts.
In the diagram, $|AB| = 120$ m,
$|AC| = |AE| = 127$ m,
$|\angle EAB| = |\angle ABC| = 90°$,
$|\angle EAD| = |\angle DAC| = \alpha$.



(a) **(i)** Use the theorem of Pythagoras to find $|BC|$.
Give your answer in metres, correct to one decimal place.

(ii) Show that $|\angle CAB| = 19{\cdot}1°$, correct to one decimal place.

(iii) Hence find the value of α.

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(b) **(i)** Use trigonometry to find the area of triangle ABC.
Give your answer in square metres, correct to one decimal place.

(ii) The area of triangle ACD is twice the area of triangle ABC.
Use your answer from **part (b)(i)** to show that $|AD| = 135{\cdot}4$ m,
correct to one decimal place.

(iii) Hence use the Cosine Rule to find the length of [CD].
Give your answer in metres, correct to one decimal place.

(c) **(i)** Show that triangles ACD and ADE are congruent.

(ii) Hence find, in m^2, the area of the field $ABCDE$.

(d) A farmer has agreed to rent the field for €550 per acre annually.
Find the amount of money that he will have to pay over five years.
Give your answer correct to the nearest euro.
[1 hectare = 10 000 m^2 and 1 acre = 0·404686 hectares]

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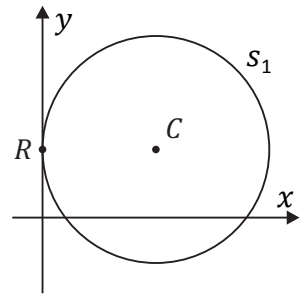
Question 9 **(45 marks)**

The circle s_1 has centre $C(5, 3)$ and radius 5.

(a) Find the equation of the circle s_1.

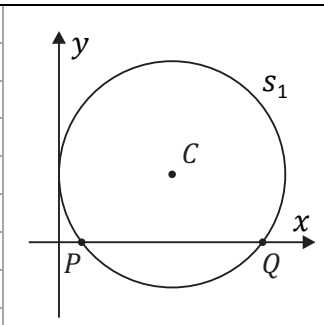
(b) **(i)** The circle s_1 touches the y-axis at the point R.
Find the co-ordinates of R.



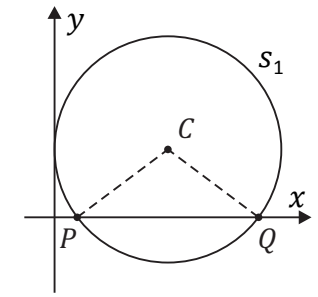
(ii) The circle s_2 is an enlargement of the circle s_1. The scale factor of the enlargement is 2.
Find the area of circle s_2.
Give your answer in terms of π.

(iii) Circles s_1 and s_2 touch at R.
Find the co-ordinates of the two possible centres of s_2.

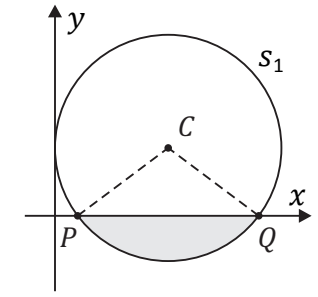
(c) The circle s_1 cuts the x-axis at the points P and Q.
Find the co-ordinates of P and Q.



(d) **(i)** Use trigonometry to find the measure of the obtuse angle PCQ shown in the diagram. Give your answer correct to the nearest degree.



(ii) Find the area of the shaded region, in square units, correct to two decimal places.



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Q. & part	

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Q. & part	

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