



UNIVERSITY of LIMERICK

OLLSCOIL LUIMNIGH

Faculty of Science and Engineering
Department of Mathematics & Statistics

Special Mathematics Entrance Examination Ordinary Level

DATE: Thursday 20 August 2015

TIME: 14.30-17.30 (3 HOURS)

INSTRUCTIONS TO CANDIDATES:

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

Section A: 6 questions, 25 marks each.

Section B: 3 questions, 50 marks each.

ANSWER ALL QUESTIONS

The invigilator will provide answer books, graph paper and 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 all necessary work is not clearly shown.

Answers should include appropriate units of measurement, where relevant.

Answers should be given in simplest form, where relevant.

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

SECTION A (6 questions, 25 marks each)

1. A manufacturer of steel ball bearings buys the raw material in the form of solid cylindrical rods of radius 10cm and length 20m . These rods are melted to produce solid spherical ball bearings. Assume that no steel is wasted in the process.
 - (i) Find the volume of steel in one cylindrical rod in terms of π .
 - (ii) How many ball bearings of diameter 4cm can be made from one steel rod.
 - (iii) A different sized ball bearing resulted in 200,000 being produced from one steel rod. Find the radius of these ball bearings.

2. The function f is defined as

$$f : x \rightarrow x^3 - 6x^2 + 9x + 4$$

- (i) Find the coordinates of the point where the graph of f cuts the y -axis.
- (ii) Find the coordinates of the local maximum and the local minimum turning points.
- (iii) Sketch the graph of f

3. (a) Solve the following equations for x and y :

$$x + y = 16$$

$$xy = 63$$

- (b) A rectangular classroom has a perimeter of $32m$ and an area of $63m^2$.

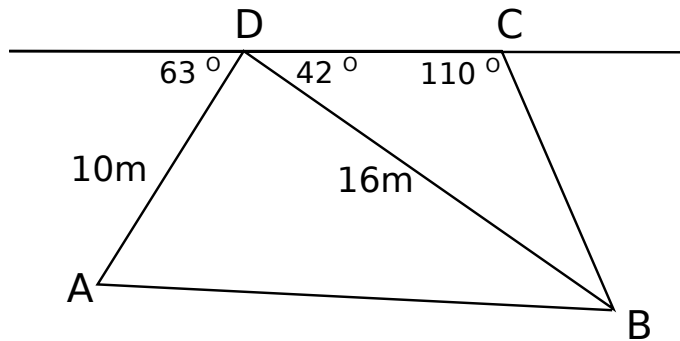
- (i) Letting x and y be the length and breadth of the classroom in meters (m), write down two equations in x and y .
- (ii) Solve the equations in (i) to determine the dimensions of the classroom.

4. The equations of two lines are:

$$l : x + 2y + 2 = 0 \text{ and } k : 2x - y + 9 = 0$$

- (i) Verify that $P(4, -3)$ is a point on l .
- (ii) Prove that l and k are perpendicular.
- (iii) Find the coordinates of Q , the point of intersection of l and k .
- (iv) Find the coordinates of R , the point where k cuts the y -axis.
- (v) Prove that $|PQ| = |QR|$.
- (vi) Calculate the area of the triangle PQR .

5. $ABCD$ represents the shape of a vegetable garden (not drawn to scale), with some measurements shown.



- (i) Find $|BC|$, correct to two decimal places.
- (ii) Find the area of the triangle BCD , correct to two decimal places.
- (iii) Find $|AB|$, correct to two decimal places.
6. (a) (i) In how many different ways can a committee of four people be selected from ten people?
- (ii) If one particular person must be on the committee, in how many ways can the committee be selected?
- (b) Tickets for a raffle are placed in a box. The box contains 15 blue tickets and 10 red tickets. Tickets are drawn at random from the box and they are not replaced. What is the probability that
- (i) the first ticket drawn is red?
- (ii) the first ticket drawn and the second ticket drawn are both red?
- (iii) the first ticket drawn is red and the second ticket drawn is blue?
- (iv) the first two tickets drawn are different in colour?

SECTION B (3 questions, 50 marks each)

7. (a) A company bought a new spherical tank with a diameter of $12m$.
- (i) What is the radius of the tank?
 - (ii) Calculate the volume of the tank, correct to the nearest m^3 .
- (b) In order to protect the tank, the company decides to paint the external curved surface with a special paint.
- (i) Calculate the curved surface area, correct to the nearest m^2 .
 - (ii) If one litre of this special paint will cover $3.5m^2$, how many litres of paint will be needed, correct to the nearest litre.
 - (iii) The paint is sold in 10 litre cans, each costing €85. Calculate the total cost of the paint.
- (c) As the company expands its business, it orders a similar spherical tank but with double the volume.
- (i) Calculate the radius of the new tank, correct to one decimal place.
 - (ii) Calculate the cost of painting the curved surface area of the new tank if the cost per litre of the special paint has increased by 7.5%.

8. (a) The volume of liquid (in cm^3) that remains in a leaking tank after t seconds is given by

$$V = 45,000 - 300t + 0.5t^2$$

- (i) What is the initial volume of liquid in the tank?
 - (ii) How long will it take for the tank to empty?
 - (iii) Find the rate of change of the volume with respect to t after 40 seconds.
- (b) Niamh invests €5,000 in a savings account with an AER of 4%.
- (i) What will the investment be worth in 10 years?
 - (ii) How long will it take for her investment to double, to the nearest year?
 - (iii) At what rate would her investment double in 25 years, to the nearest decimal place?

9. The manager of a store selling men's clothing carries out a survey on a randomly selected sample of 10 customers with the following results:

Men's Age (x years)	18	21	36	45	23	53	25	37	30	32
Annual expenditure on clothes (€y)	330	300	180	120	310	200	200	150	250	190

- (i) Calculate the mean age of the 10 customers.
- (ii) Calculate the mean annual expenditure of the 10 customers.
- (iii) Plot the data as a scatter diagram on graph paper, showing clearly the scales used.
- (iv) Comment on the type of correlation.
- (v) Plot the mean age and the mean expenditure point (\bar{x}, \bar{y}) and label it K .
- (vi) Draw a line of best fit through the point K .
- (vii) Use your line of best fit to estimate
 - (a) the age of a man with annual expenditure of €225.
 - (b) the expected amount of annual expenditure on clothes of a 40-year-old man.