



**Coimisiún na Scrúduithe Stáit  
State Examinations Commission**

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**LEAVING CERTIFICATE EXAMINATION, 2009**

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**MATHEMATICS – ORDINARY LEVEL**

**PAPER 2 ( 300 marks )**

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**MONDAY, 8 JUNE – MORNING, 9:30 to 12:00**

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Attempt **FIVE** questions from **Section A** and **ONE** question from **Section B**.  
Each question carries 50 marks.

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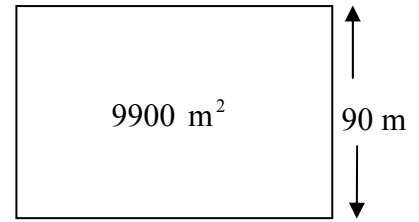
**WARNING: Marks will be lost if all necessary work is not clearly shown.**

**Answers should include the appropriate units of measurement,  
where relevant.**

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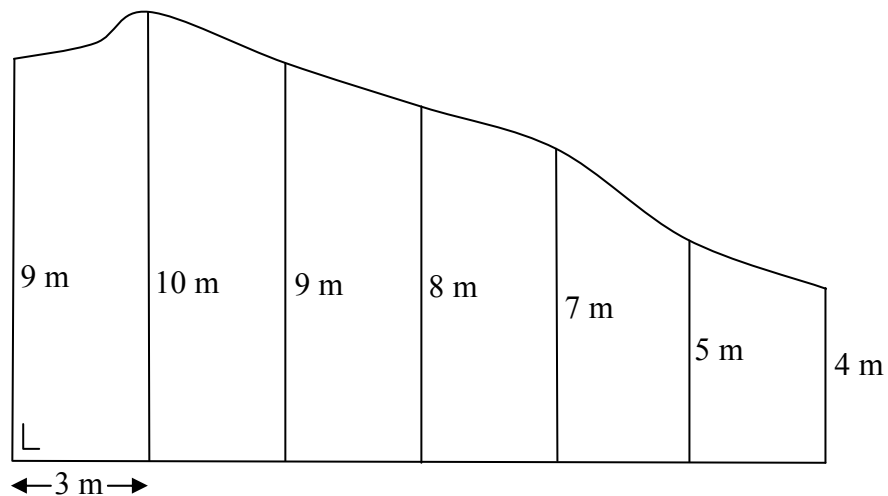
**SECTION A**  
**Attempt FIVE questions from this section.**

1. (a) The area of a rectangular playing pitch is  $9900 \text{ m}^2$ .  
 The width of the playing pitch is  $90 \text{ m}$ .



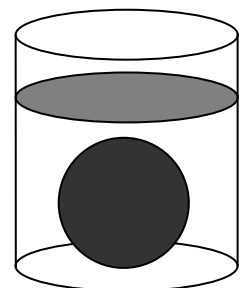
- (i) Find the length of the playing pitch.  
 (ii) Find the perimeter of the playing pitch.

- (b) The sketch shows the garden of a house. At equal intervals of  $3 \text{ m}$  along one side, perpendicular measurements are made to the boundary, as shown on the sketch.



- (i) Use Simpson's rule to estimate the area of the garden.  
 (ii) The owner of the house digs an ornamental pond in the garden. The surface area of the pond is  $7 \text{ m}^2$ .  
 What percentage of the area of the garden is taken up by the pond?  
 Give your answer correct to the nearest percent.

- (c) (i) The volume of a sphere is  $36\pi \text{ cm}^3$ .  
 Find the radius of the sphere.  
 (ii) When the sphere is fully immersed in a cylinder of water, the level of the water rises by  $2.25 \text{ cm}$ .  
 Find the radius of the cylinder.



2. (a)  $a(-2, 1)$  and  $b(4, 5)$  are two points.
- Plot the points  $a$  and  $b$  on a co-ordinate diagram.
  - Find the slope of  $ab$ .
  - Find the equation of  $ab$ .
- $K$  is the line  $3x + 2y - 9 = 0$ .
- Show that  $K$  passes through the midpoint of  $[ab]$ .
  - Show that  $K$  is perpendicular to  $ab$ .
- (b)  $p(3, 0)$  is a point.  
 $t$  and  $s$  are two distinct points on the  $y$ -axis and  $|pt| = |ps| = 5$ .
- Find the co-ordinates of  $t$  and the co-ordinates of  $s$ .
  - Find the area of the triangle  $tsp$ .
  - $ptus$  is a parallelogram in which  $[ts]$  is a diagonal.  
 Find the co-ordinates of the point  $u$ .

3. (a) The circle  $C$  has equation  $x^2 + y^2 = 25$ .
- Write down the radius of  $C$ .
  - Verify that the point  $(4, -3)$  is on  $C$ .
  - The line  $T$  is a tangent to  $C$  at the point  $(4, -3)$ . Find the equation of  $T$ .
  - On a co-ordinate diagram, draw the circle  $C$  and the tangent  $T$ .
  - $L$  is a tangent to  $C$  and  $L$  is parallel to the  $x$ -axis.  
 Find the two possible equations of  $L$ .

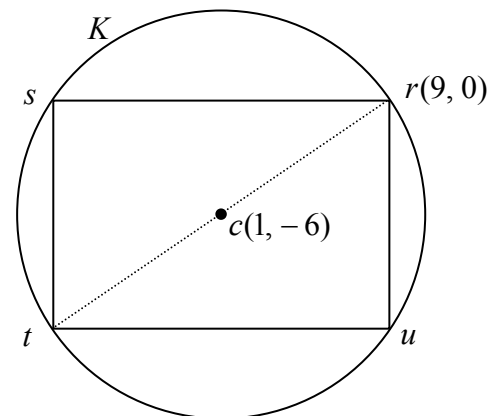
- (b) The point  $c(1, -6)$  is the centre of the circle  $K$ , as shown.

The point  $r(9, 0)$  is on the circle.

- Find the radius of the circle.
- Write down the equation of the circle.

The vertices of the rectangle  $rstu$  are on the circle and  $sr$  is horizontal.

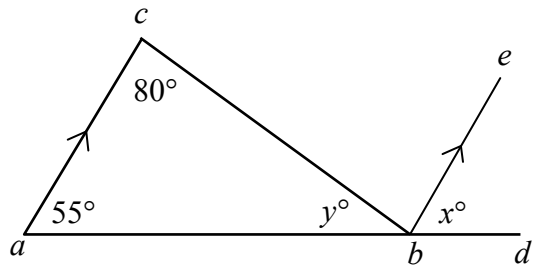
- Find the co-ordinates of  $t$ , the co-ordinates of  $s$  and the co-ordinates of  $u$ .



4. (a) In the diagram,  $ac$  is parallel to  $be$ ,  
 $|\angle bca| = 80^\circ$  and  $|\angle cab| = 55^\circ$ .

(i) Find  $x$ .

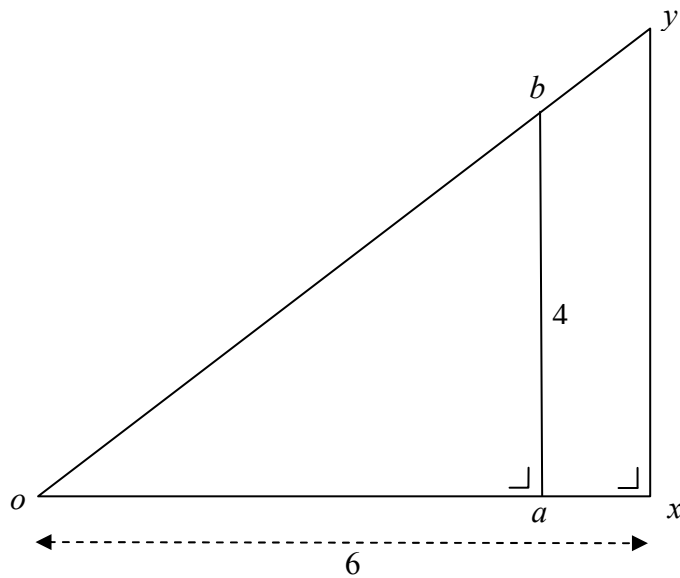
(ii) Find  $y$ .



- (b) Prove that the sum of the lengths of any two sides of a triangle is greater than that of the third side.

- (c) The right-angled triangle  $oxy$  is the image of the triangle  $oab$  under the enlargement of centre  $o$  and scale factor  $1.2$ .

$|ab| = 4$  and  $|ox| = 6$ .



(i) Find  $|xy|$ .

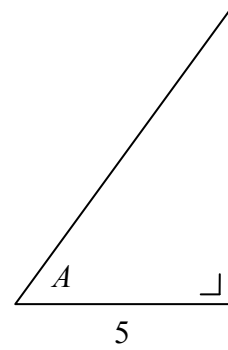
(ii) Find  $|oa|$ .

(iii) Find the area of the triangle  $oab$ .

(iv) Find the area of the figure  $axyb$ .

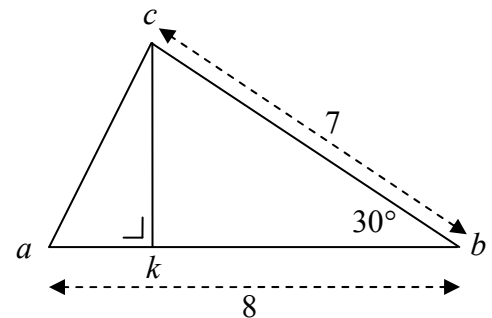
5. (a) The length, 5, of a side of the right-angled triangle is shown and  $A$  is the angle indicated, where  $\tan A = \frac{7}{5}$ .

- (i) Copy the diagram into your answer book and on it mark the side of length 7.
- (ii) Find the length of the third side.

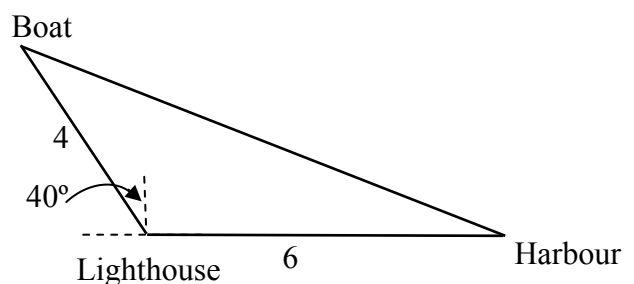


- (b) In the triangle  $abc$ ,  
 $|ab| = 8$  cm,  $|bc| = 7$  cm  
 and  $|\angle abc| = 30^\circ$ .

- (i) Find the area of the triangle  $abc$ .
- (ii) Given that  $ck \perp ab$ , find  $|ck|$ .
- (iii) Given that  $|ac| = 4$  cm, find  $|\angle kca|$  correct to the nearest degree.



- (c) A harbour is 6 km due East of a lighthouse.  
 A boat is 4 km from the lighthouse.  
 The bearing of the boat from the lighthouse is  $N 40^\circ W$ .



- (i) How far is the boat from the harbour?  
 Give your answer correct to one decimal place.
- (ii) Find the bearing of the boat from the harbour.  
 Give your answer correct to the nearest degree.

6. (a) (i) Evaluate  $\binom{7}{2}$ .
- (ii) Evaluate  $\binom{7}{2} + \binom{7}{5}$ .

- (b) There are 210 boys and 240 girls in a school. The school has a junior cycle and a senior cycle. The number of boys and the number of girls in each cycle is shown in the table.

|              | Boys | Girls |
|--------------|------|-------|
| Junior cycle | 120  | 130   |
| Senior cycle | 90   | 110   |

- (i) A student is picked at random.  
What is the probability that the student is a boy?
- (ii) A student is picked at random.  
What is the probability that the student is in the senior cycle?
- (iii) A junior cycle student is picked at random.  
What is the probability that the student is a girl?
- (iv) A boy is picked at random.  
What is the probability that he is in the senior cycle?
- (c) Three boys and two girls are seated in a row as a group.  
In how many different ways can the group be seated if
- (i) there are no restrictions on the order of seating
- (ii) there must be a boy at the beginning of the row
- (iii) there must be a boy at the beginning of the row and a boy at the end of the row
- (iv) the two girls must be seated beside each other?

7. (a) Find the median of the numbers

3, 9, 2, 1, 13, 5, 8.

(b) A car-park opens at 07:30. The number of cars entering the car-park during 15 minute intervals on a particular morning is recorded in the following table:

|                |                  |                  |                  |                  |                  |                  |
|----------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Time           | 07:30 -<br>07:45 | 07:45 -<br>08:00 | 08:00 -<br>08:15 | 08:15 -<br>08:30 | 08:30 -<br>08:45 | 08:45 -<br>09:00 |
| Number of cars | 20               | 40               | 100              | 165              | 105              | 50               |

[Note: 07:30 - 07:45 means 07:30 or later, but not including 07:45 etc.]

(i) How many cars entered the car-park from 07:45 to 08:30?

(ii) What was the maximum number of cars that could have entered the car park by 08:20?

(iii) Copy and complete the following cumulative frequency table:

|                |                 |                 |                 |                 |                 |                 |
|----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Time           | Before<br>07:45 | Before<br>08:00 | Before<br>08:15 | Before<br>08:30 | Before<br>08:45 | Before<br>09:00 |
| Number of cars |                 |                 |                 |                 |                 |                 |

(iv) Draw the cumulative frequency curve (ogive).

Use your curve to estimate

(v) the median time

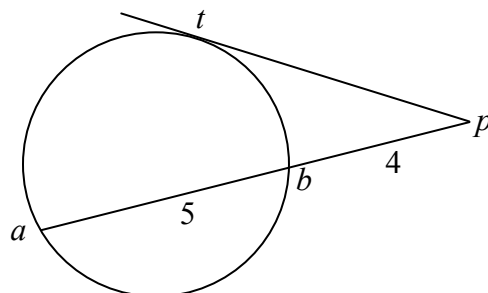
(vi) the number of cars that had entered the car-park by 08:10

(vii) the time by which 75% of the cars had entered the car-park.

**SECTION B**

**Attempt ONE question from this section.**

8. (a)  $pt$  is a tangent to the circle at  $t$ .  
 $pa$  intersects the circle at  $b$ .  
 $|ab| = 5$  and  $|bp| = 4$ .

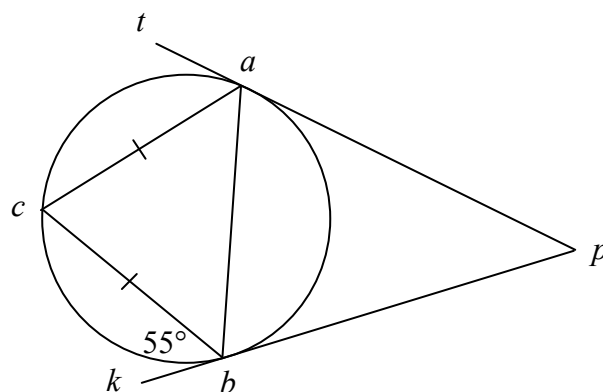


- (i) Find  $|pa|$ .  
 (ii) Find  $|pt|$ .

- (b) Prove that an angle between a tangent  $ak$  and a chord  $[ab]$  of a circle has degree-measure equal to that of any angle in the alternate segment.

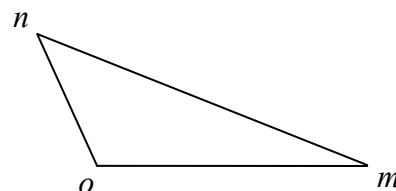
- (c)  $pt$  and  $pk$  are tangents to the circle at  $a$  and  $b$ , respectively.

$c$  is a point on the circle such that  
 $|ca| = |cb|$  and  $|\angle kbc| = 55^\circ$ .



- (i) Find  $|\angle bac|$ .  
 (ii) Find  $|\angle cba|$ .  
 (iii) Find  $|\angle acb|$ .  
 (iv) Find  $|\angle bpa|$ .

9. (a) The diagram shows the triangle  $omn$ , where  $o$  is the origin. Copy the diagram into your answerbook and on it show



- (i) the point  $r$  such that  $\vec{r} = -\vec{n}$   
 (ii) the point  $s$  such that  $\vec{s} = \vec{m} + \vec{n}$ .

- (b) Let  $\vec{a} = 7\vec{i} + \vec{j}$  and  $\vec{b} = 5\vec{i} - 5\vec{j}$ .

- (i) Express  $\vec{a} + \vec{b}$  in terms of  $\vec{i}$  and  $\vec{j}$ .  
 (ii) Express  $\vec{a}\vec{b}$  in terms of  $\vec{i}$  and  $\vec{j}$ .  
 (iii) Hence, or otherwise, calculate  $(\vec{a} + \vec{b}) \cdot \vec{a}\vec{b}$ , the dot product of  $\vec{a} + \vec{b}$  and  $\vec{a}\vec{b}$ .  
 (iv) Is  $(\vec{a} + \vec{b}) \perp \vec{a}\vec{b}$ ? Give a reason for your answer.

- (c) Let  $\vec{p} = 2\vec{i} + 5\vec{j}$  and  $\vec{q} = \vec{i} - \vec{j}$ .

- (i) Find the scalars  $k$  and  $t$  such that  $k\vec{p} + t\vec{q} = 14\vec{j}$ .  
 (ii) Show that  $|\vec{p} + \vec{q}| < |k\vec{p} + t\vec{q}|$ .



10. (a) €6000 is invested at 5% per annum compound interest.  
Find the value of the investment at the end of 10 years, correct to the nearest euro.

(b) (i) Expand  $(1+x)^5$  fully.

(ii) Simplify  $(1+x)^5 - (1-x)^5$ .

(iii) Hence, find the value of  $(1+\sqrt{2})^5 - (1-\sqrt{2})^5$ .

Give your answer in the form  $k\sqrt{2}$ , where  $k \in \mathbf{N}$ .

(c) The first two terms of a geometric series are  $6 + \frac{18}{4} + \dots$

(i) Find  $S_{20}$ , the sum of the first 20 terms of the series, correct to one decimal place.

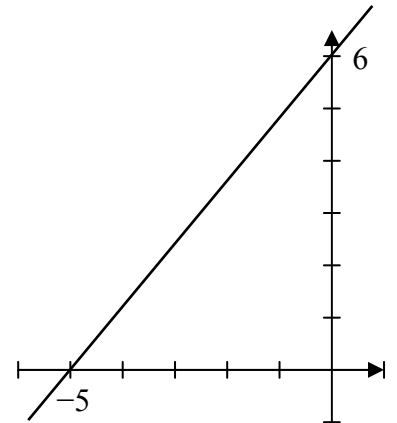
(ii) Find  $S_{\infty}$ , the sum to infinity of the series.

(iii) Find  $S_{\infty} - S_{20}$ .

11. (a) The diagram shows the line  $6x - 5y + 30 = 0$ .

(i) Copy the diagram into your answer book and on it show the set of points which satisfy the inequality  $6x - 5y + 30 \leq 0$ .

(ii) Using the same diagram, illustrate the inequality  $y \geq 2$ .



(b) A person is setting up a new taxi firm. The firm will use medium-sized cars and large cars.

Each medium-sized car costs €20 000 and each large car costs €30 000.

The person has at most €300 000 to purchase the cars.

At any given time there are at most 13 drivers available to operate the taxis.

(i) Taking  $x$  as the number of medium-sized cars and  $y$  as the number of large cars, write down two inequalities in  $x$  and  $y$  and illustrate these inequalities on graph paper.

(ii) The estimate of the monthly profit on a medium-sized car is €800 and on a large car is €900. How many of each type of car should the person buy to maximise profit?

(iii) On your graph, show the region where the monthly profit is at most €7200.

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