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**MATHEMATICS GRADE 12**

PAPER 2

Total: 150

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PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 26 pages and a separate formula sheet. Please check that your paper is complete.
2. Read the questions carefully.
3. Answer all the questions.
4. You may use an approved non-programmable and non-graphical calculator, unless otherwise stated.
5. Answers must be rounded off to the first decimal place, unless otherwise stated.
6. All the necessary working details must be clearly shown.
7. It is in your own interest to write legibly and to present your work neatly.

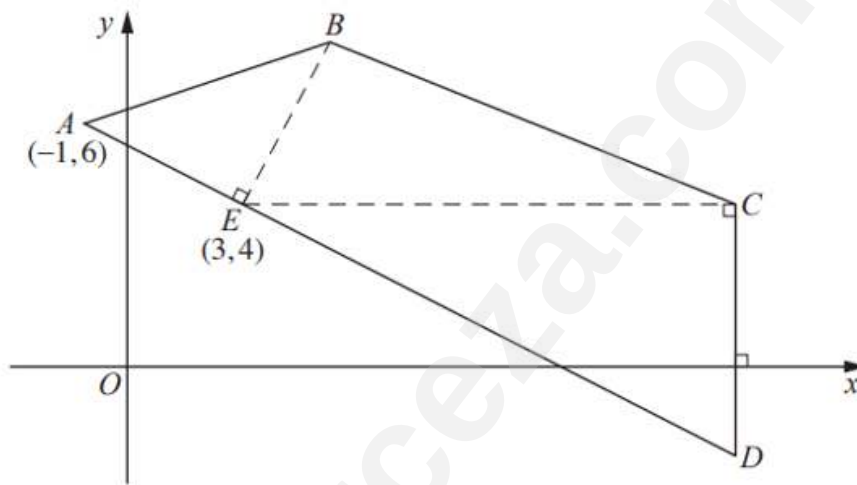
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1 16	2 10	3 13	4 13	5 19	6 15	7 20	8 16	9 6	10 16	11 6	Total 150
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SECTION A

QUESTION 1:

The diagram shows a quadrilateral $ABCD$. The point E lies on AD such that angle $AEB = 90^\circ$. The line EC is parallel to the x -axis and the line CD is parallel to the y -axis. The points A and E are $(-1; 6)$ and $(3; 4)$ respectively.



a) Determine the gradient of AD . (2)

b) Calculate the equation of line EB . (3)

c) Given that the gradient of AB is $\frac{1}{3}$, calculate the coordinates of B . (3)

d) Hence, write down the shortest distance from B to line EC . (2)

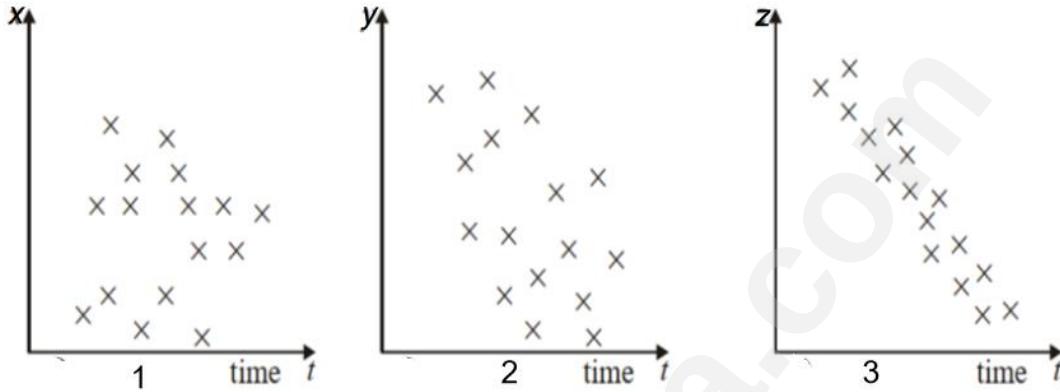
e) Given also that the area of triangle EBC is 24 units^2 , find the coordinates of C . (3)

f) Hence, calculate the coordinates of D . (3)

[16]

QUESTION 2:

The sketches below represent scatter diagrams for the way in which variables x , y and z change over time, t , in each given chemical experiment.



a) State which of the diagrams indicate that the pair of variables.

1) has no correlation. (1)

2) shows strong linear correlation. (1)

b) A student is given a piece of paper with five numbers written on it. She is told that three of these numbers are the correlation coefficients for the three pairs of variables shown above. The five numbers are:

0,9; - 0,85; - 0,20; 0,04; -1,60

1) For each sketch above state which of these five numbers is the most appropriate value for the correlation coefficient. (3)

2) For the two remaining numbers, state why you reject them for this experiment. (2)

- c) If another point close to the origin is added on graph number 3, what effect will it have on:

1) Correlation coefficient. (1)

2) Line of best fit. (2)

[10]

QUESTION 3:

Consider the function $f(x) = 3\sin 6x + 5$ and for $x \in [0^\circ; 90^\circ]$

a) Sketch the graph of $f(x)$. (4)

b) Write down the period of $f(x)$ (1)

c) Write down the range of $f(x)$ (2)

d) Write down the amplitude of $f(x)$. (1)

e) The equation $f(x) = k$ has exactly 2 solutions, write down the possible values of k . (3)

f) For which values of x is $f'(x) > 0$. (2)

[13]

QUESTION 4:

a) Simplify, without the use of a calculator and showing all working:

$$\frac{\tan(180^\circ - x) \cdot \cos(360^\circ - x) + \cos(90^\circ + x)}{\cos(90^\circ - x) \cdot \sin(90^\circ + x)} \quad (6)$$

b) If $\cos 56^\circ = p$, determine the following in terms of p :

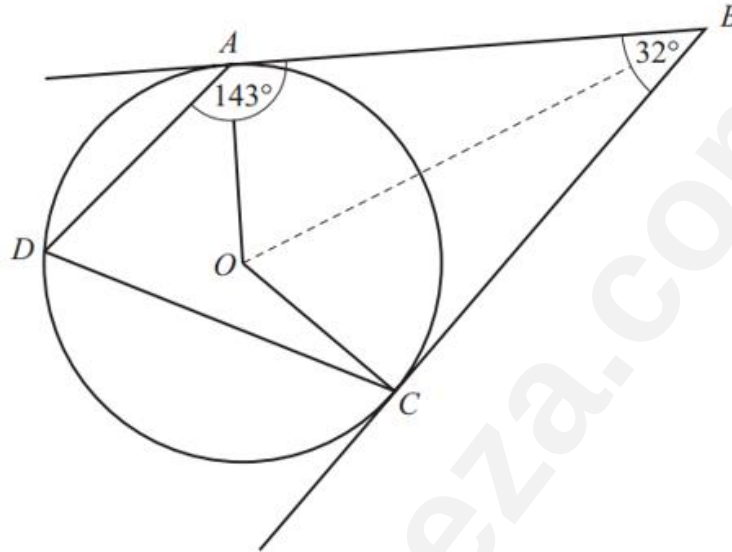
1) $\sin 28^\circ$ (3)

2) $\cos 22^\circ$ (4)

[13]

QUESTION 5:

- a) Points A , C and D lie on a circle centre O . BA and BC are tangents to the circle. $\hat{ABC} = 32^\circ$ and $\hat{DAB} = 143^\circ$.

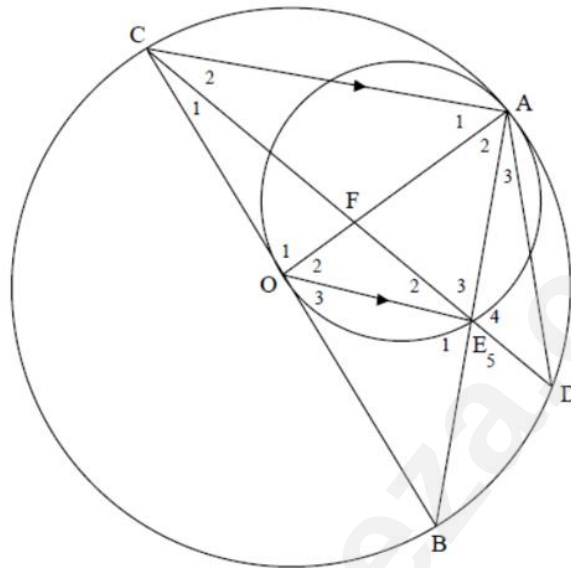


Calculate, with reasons the following:

1) $\hat{AOC}$ (3)

2) $\hat{OCD}$ (3)

- b) Two circles touch each other at point A . The smaller circle passes O , the centre of the larger circle. Point E is on the circumference of the smaller circle. A , D , B and C are points on the circumference of the larger circle.



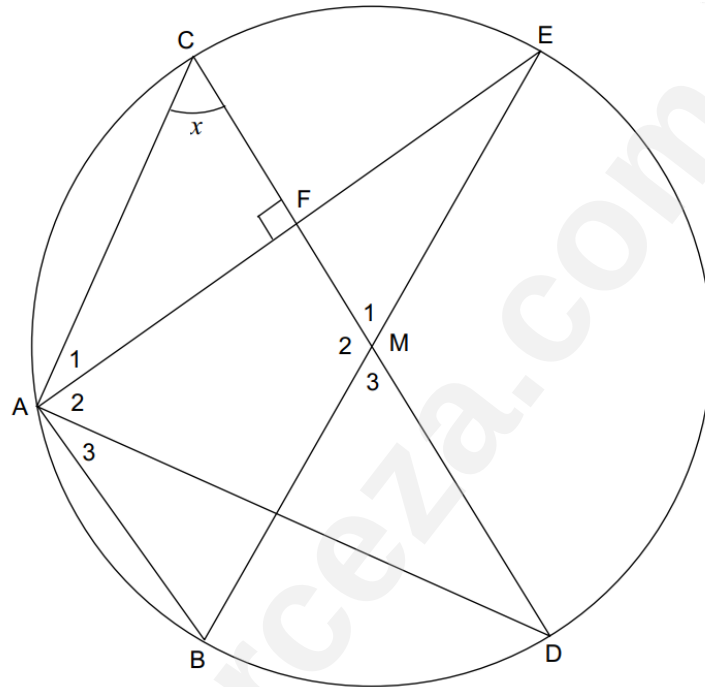
- 1) Prove, with reasons, that $AE = BE$. (2)

- 2) Prove that $\triangle AED \parallel \triangle CEB$ (3)

- 3) Hence, or otherwise, show that $AE^2 = DE \cdot CE$ (2)

- c) In the diagram, BE and CD are diameters of a circle having M as centre. Chord AE is drawn to cut CD at F . $AE \perp CD$.

Let $\hat{C} = x$.



- 1) Determine, giving reasons, the size of $\hat{M}_1$ in terms of x . (3)

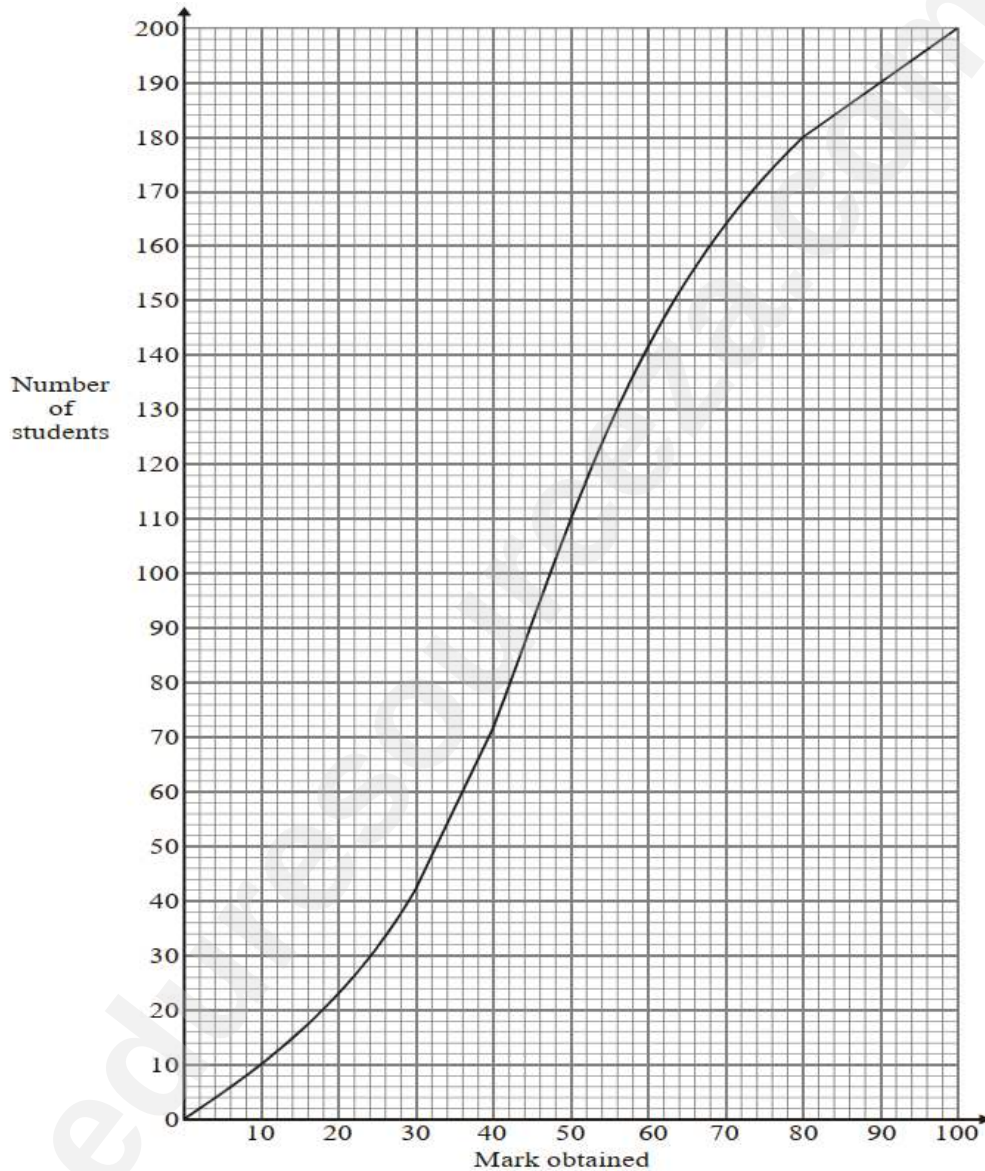
- 2) Prove, giving reasons, that AD is a tangent to the circle passing through A, C and F . (3)

[19]

SECTION B

QUESTION 6:

- a) The cumulative frequency curve below shows the marks obtained in an examination by a group of 200 students.



- 1) Use the cumulative frequency curve to complete the frequency table below. (3)

Mark (x)	$0 \leq x < 20$	$20 \leq x < 40$	$40 \leq x < 60$	$60 \leq x < 80$	$80 \leq x < 100$
Number of students	22				20

2) 35% of the students pass. Find the failure mark. (2)

3) Calculate the mean and median mark. Hence, comment on the distribution of marks (3)

- b) 40 families are reviewed for the number of pets they own. Part of the results is shown below:

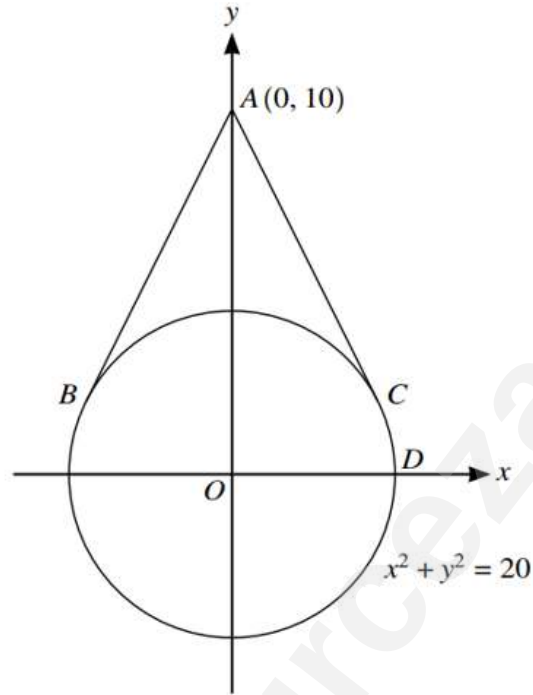
Number of pets	Number of families
0	14
1	a
2	b
3	c
more than 3	none

Given that the mean is 1,1 and the variance is 1,04. Calculate the values of a , b and c . (7)

[15]

QUESTION 7:

- a) The diagram shows the circle with equation $x^2 + y^2 = 20$. Tangents touching the circle at points B and C pass through the point $A(0; 10)$.

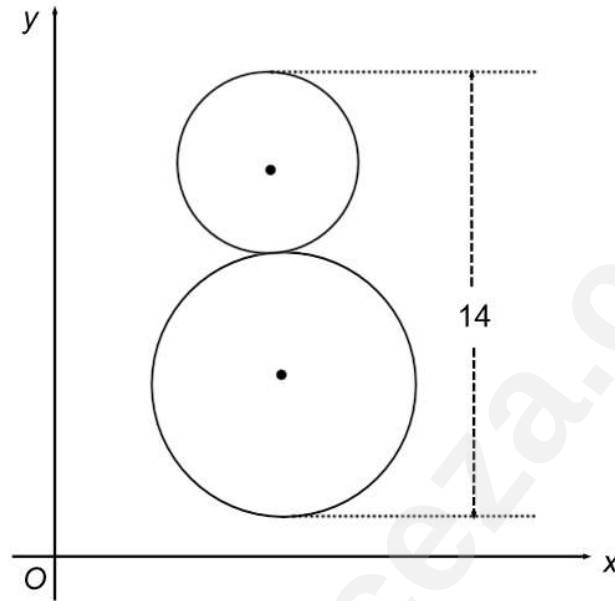


- 1) By letting the equation of the tangent be $y = mx + 10$, find the possible values of m . (5)

- 2) Calculate the coordinates of B and C . (4)

- 3) The point D is where the circle crosses the positive x -axis. Find the angle BDC . (4)

- b) A bakery firm makes gingerbread men each 14 cm high with a circular “head” and “body”.
The equation of the “body” is $x^2 + y^2 - 10x - 12y + 45 = 0$ and the line of centres is parallel to the y -axis.



- 1) Calculate the equation of the “head”. (6)

- 2) Write down the equation of the line that connects the two centres. (1)

[20]

QUESTION 8:

a) Prove the identity $\sin^2 x \cdot \cos^2 x = \frac{1}{8}(1 - \cos 4x)$ (5)

- b) Determine the general solution of $\cos(x - 30^\circ) = 2\sin(x + 30^\circ)$. (5)

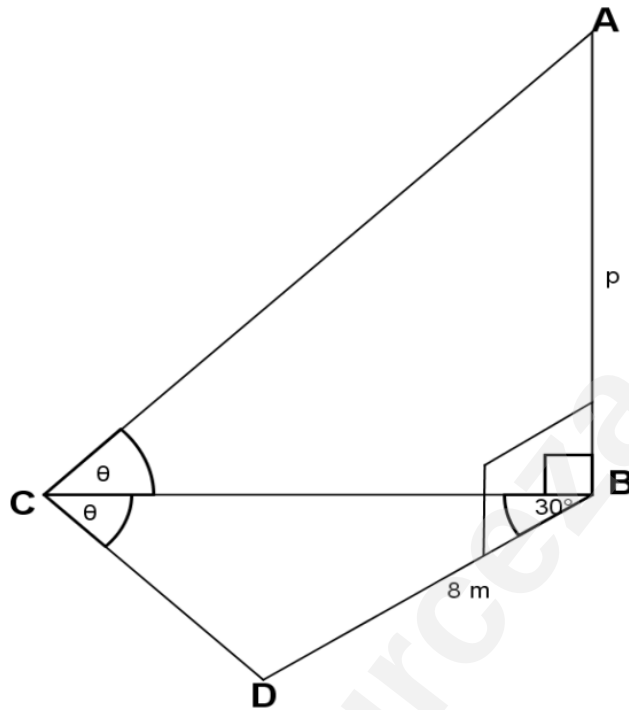
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- c) Let θ be an angle for which $\cos\theta - \sin\theta = \frac{1}{2}$. Find the value of $\cos 4\theta$. (6)

[16]

QUESTION 9:

In the figure below, B, C and D are points on the same horizontal plane and AB is a vertical pole of length p metres. The angle of elevation of A from C is θ .



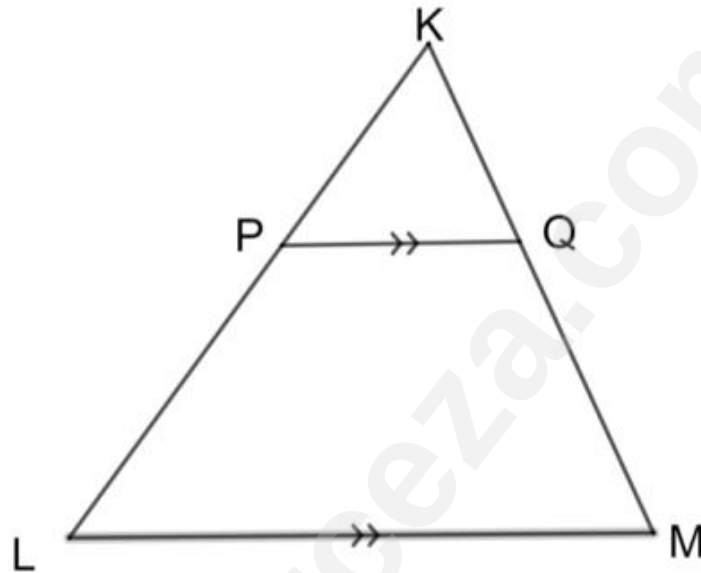
- a) Express BC in terms of p and a trigonometric function of θ . (2)

b) Hence, show that $p = 4(1 + \sqrt{3}\tan\theta)$ (4)

[6]

QUESTION 10:

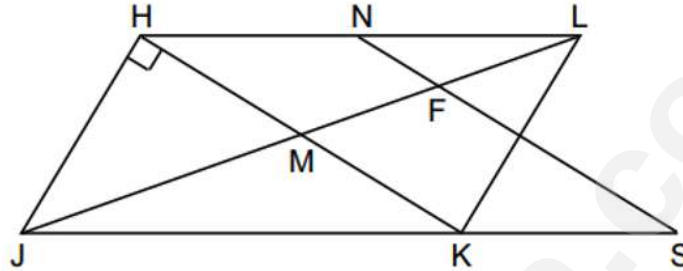
- a) Use the diagram below to prove the theorem which states: A line drawn parallel to one side of a triangle cuts the other two sides in the same proportion. (6)



- b) In the diagram below $HJKL$ is a parallelogram, with the diagonals intersecting at M . $\angle HJK = 90^\circ$. JK is produced to S . N is a point on HL .

NS intersects JL at F . $NS \parallel HK$.

$HJ = 6$ units, $HK = 8$ units, $KS = 5$ units, $FL = \sqrt{13}$ units.



Determine, with reasons, the following ratios in simplified form:

1) $JK : KS$ (3)

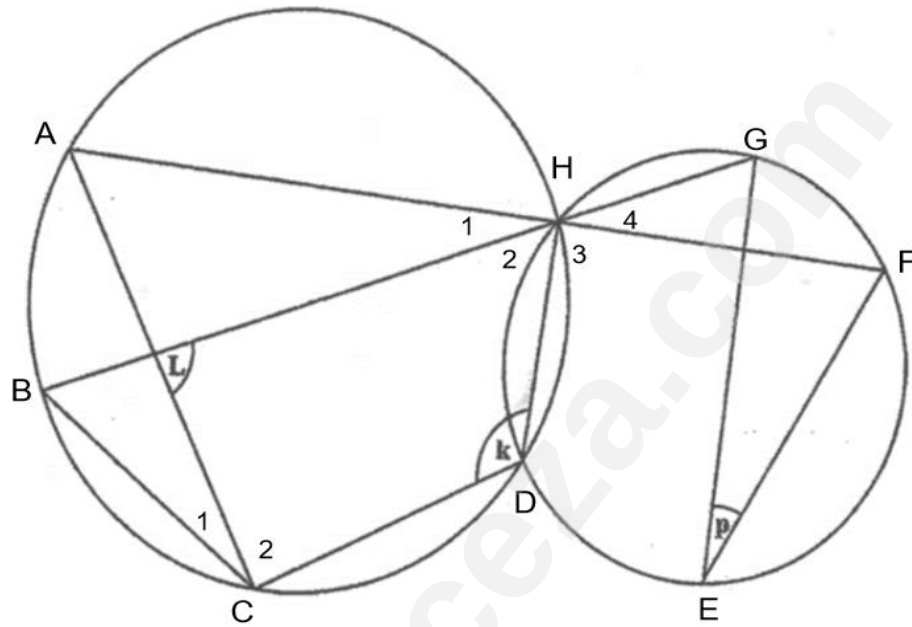
2) $JM : MF$ (3)

3) $\frac{\text{Area of } \triangle LNF}{\text{Area of } \triangle JMK}$ (4)

[16]

QUESTION 11:

Consider the diagram below. Determine, in terms of p and k , the size of the angle marked at L .



[6]