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GRADE 12

MATHEMATICS PAPER 2

SEPTEMBER 2018

MARKS: 150

TIME: 3 HOURS

This question paper consists of 12 pages, an information sheet and an answer book.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 10 questions.
2. Answer ALL the questions in the ANSWER BOOK provided.
3. Answer ALL the questions.
4. Clearly show ALL calculations, diagrams, graphs, et cetera that you have used in determining your answers.
5. ANSWERS ONLY will not necessarily be awarded full marks.
6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
7. If necessary, round answers off to TWO decimal places, unless stated otherwise.
8. Diagrams are NOT necessarily drawn to scale.
9. Number the answers correctly according to the numbering system used in this question paper.
10. Write legibly and present your work neatly.

QUESTION 1

Fifty learners wrote a National Benchmark Test for admission to university. The test counted out of 50. The results were summarised as follows:

Marks	Frequency	Cumulative Frequency
$0 \leq x < 10$	4	
$10 \leq x < 20$	20	
$20 \leq x < 30$	15	
$30 \leq x < 40$	5	
$40 \leq x < 50$	6	

- 1.1 Use the data in the table to calculate the estimated mean. (2)
 - 1.2 Use the table and complete the cumulative frequency column. (2)
 - 1.3 Draw the ogive on the grid provided. (3)
 - 1.4 Determine the interquartile range, by using the ogive. (3)
- [10]**

QUESTION 2

Ten students trained to take part in the 100m sprint event for the Mayoral Athletics Competition. The following data table shows the number of days each student trained and the time he/she ran.

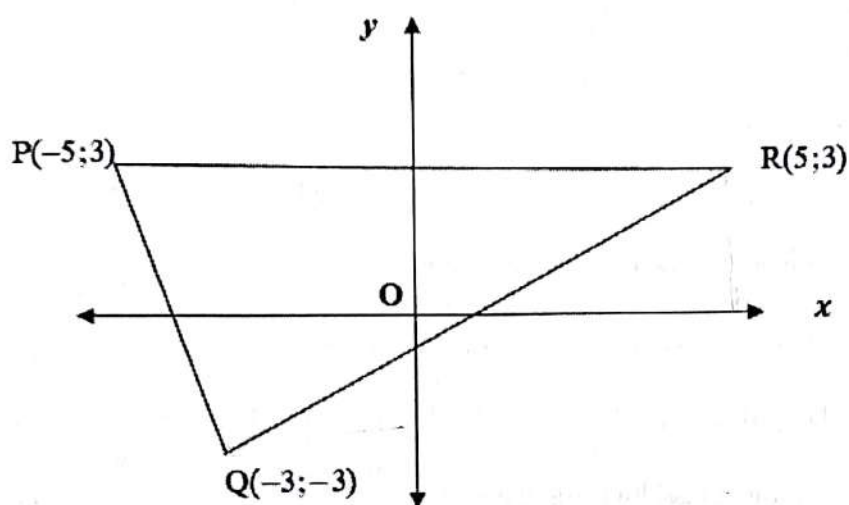
Number of days training	10	70	50	60	20	60	100	30	90	30
Time (in seconds)	17	13	13	11	17	19	10	17	12	14

- 2.1 Calculate the MEAN and STANDARD DEVIATION of the times of the students. (4)
- 2.2 Calculate an equation for the least squares regression line for the data. (3)
- 2.3 Calculate the correlation coefficient. (1)
- 2.4 If Simon trained for 80 days, estimate the time it might take him to finish. (2)

[10]

QUESTION 3

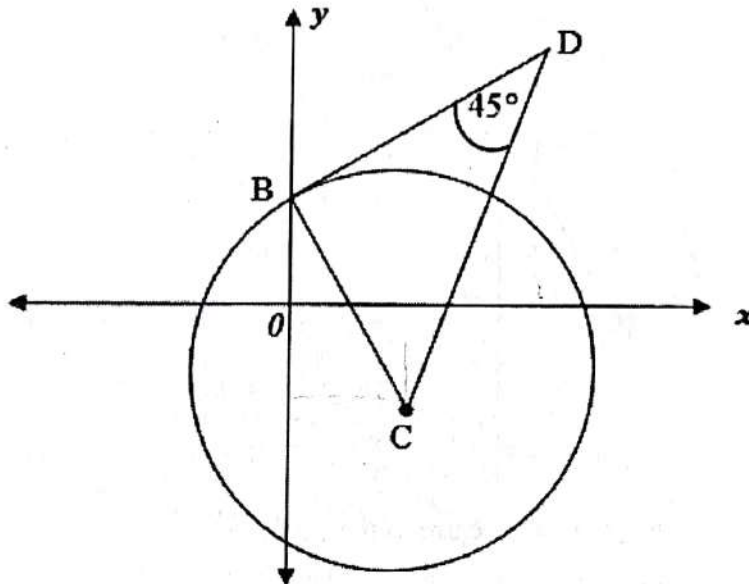
In the diagram PQR is a triangle with vertices $P(-5;3)$, $Q(-3;-3)$ and $R(5;3)$.



- 3.1 Calculate the length of QR. (2)
 - 3.2 Determine M, the midpoint of QR. (2)
 - 3.3 Determine the equation of the line passing through P and M. (3)
 - 3.4 Determine the equation of the circle which has QR as a diameter. (3)
 - 3.5 Does point P lie inside, or outside the circle in Question 3.4? Motivate your answer with relevant calculations. (3)
 - 3.6 Determine the coordinates of S, if PQRS is a parallelogram, with S in the first quadrant. (2)
 - 3.7 Calculate the size of \hat{QPR} . (4)
- [19]**

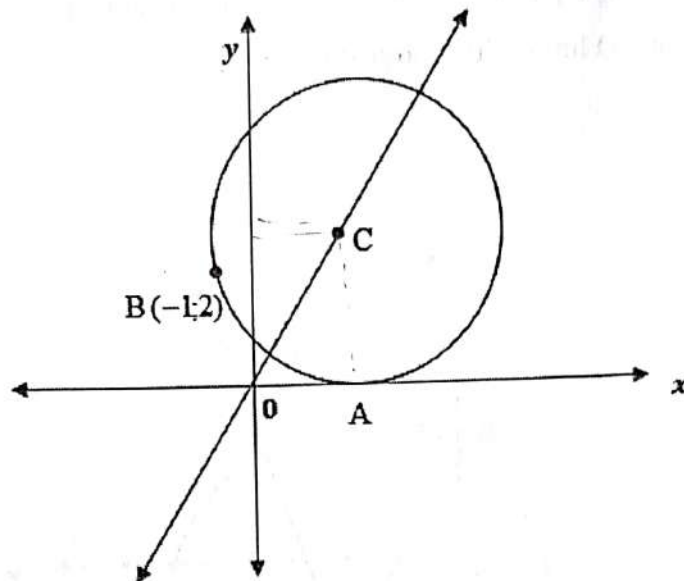
QUESTION 4

- 4.1 A circle with equation $x^2 - 6x + y^2 + 4y = 12$ has centre C. B is the y-intercept of the circle. BD, having equation $3x - 4y + 8 = 0$, is a tangent to the circle at B such that $\hat{BDC} = 45^\circ$ and D lies in the first quadrant.



- 4.1.1 Write down the coordinates of C. (2)
4.1.2 Determine the coordinates of B. (2)
4.1.3 Determine the values of q , if $x = q$ is a tangent to the circle. (4)
4.1.4 Calculate the coordinates of D. (6)

- 4.2 A circle touches the x -axis at A and has its centre C on the line $y = 2x$. The circle passes through the point $B(-1;2)$.



Determine:

- 4.2.1 The coordinates of C , the centre of the circle. (6)
 4.2.2 The radius of the circle. (2)

[22]

QUESTION 5

5.1 Given: $\cos 25^\circ = \sqrt{1 - k^2}$.

Express each of the following in terms of k :

5.1.1 $\sin 25^\circ$ (2)

5.1.2 $\sin 50^\circ$ (2)

- 5.2 Simplify fully without using a calculator:

$$\sqrt{\frac{\tan(-207^\circ)}{\tan 333^\circ} - \frac{\sin^2(x - 360^\circ)}{\sin(x - 90^\circ) \cos x}} \quad (7)$$

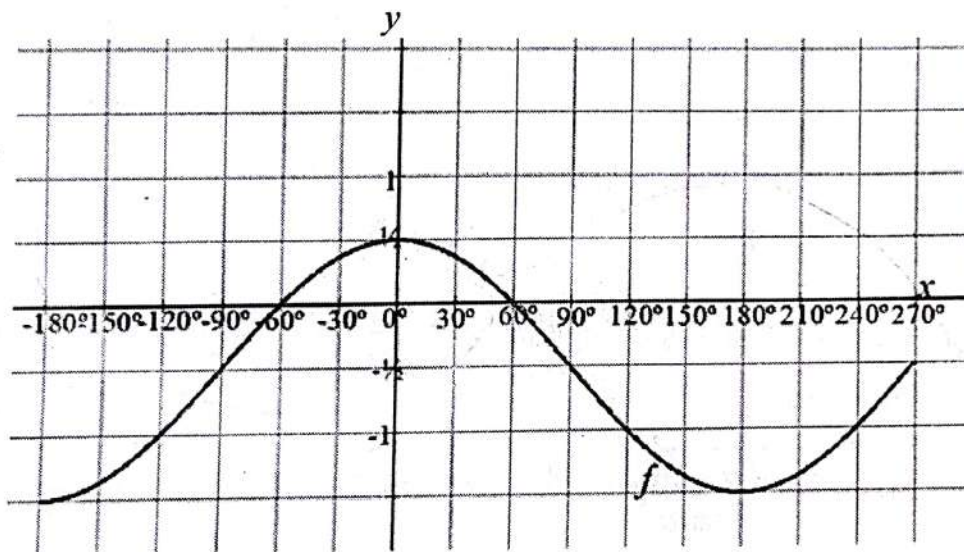
5.3 Prove that $\frac{1 + \cos 2A}{\cos 2A} = \frac{\tan 2A}{\tan A}$ (5)

5.4 Determine the general solution of $2 \sin 2x = -\cos 2x$ (5)

[21]

QUESTION 6

Given: $f(x) = \cos x - \frac{1}{2}$ for $x \in [-180^\circ; 270^\circ]$.



6.1 Draw a sketch graph of $g(x) = \sin(x + 30^\circ)$ on the same set of axes for $x \in [-180^\circ; 270^\circ]$ on the grid provided. Show all the intercepts with the axes and the turning points and endpoints. (3)

6.2 Use your graph and determine for which x -values, $x \in [-180^\circ; 270^\circ]$ is:

6.2.1 $f(x) > g(x)$. (3)

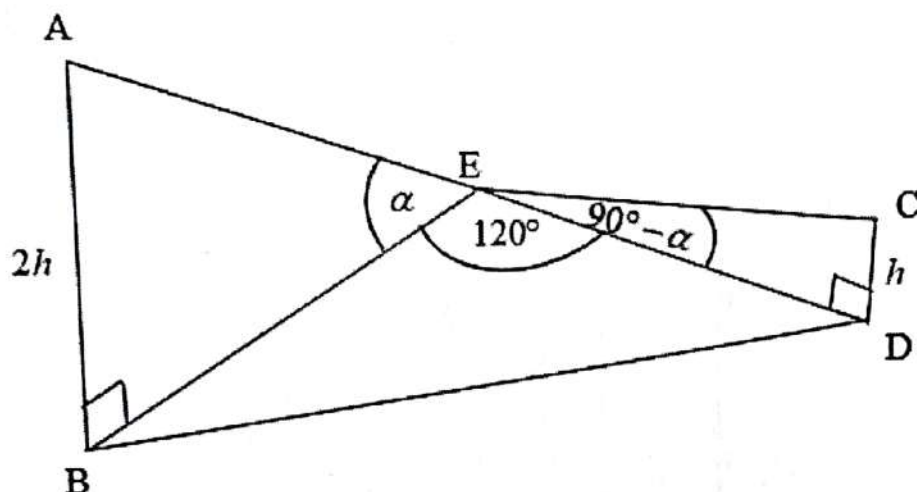
6.2.2 $f(x) \cdot g(x) \geq 0$. (3)

6.3 The graph of g is shifted 120° to the right to form h . Determine the equation of h in its simplest form. (2)

[11]

QUESTION 7

In this diagram the points B, D and E lie in the same horizontal plane, with $\hat{BED} = 120^\circ$. AB and CD are two vertical towers. $AB = 2CD = 2h$ metres. The angle of elevation of A from E is α . The angle of elevation of C from E is $(90^\circ - \alpha)$.



7.1 Determine the length of BE in terms of h and α . (2)

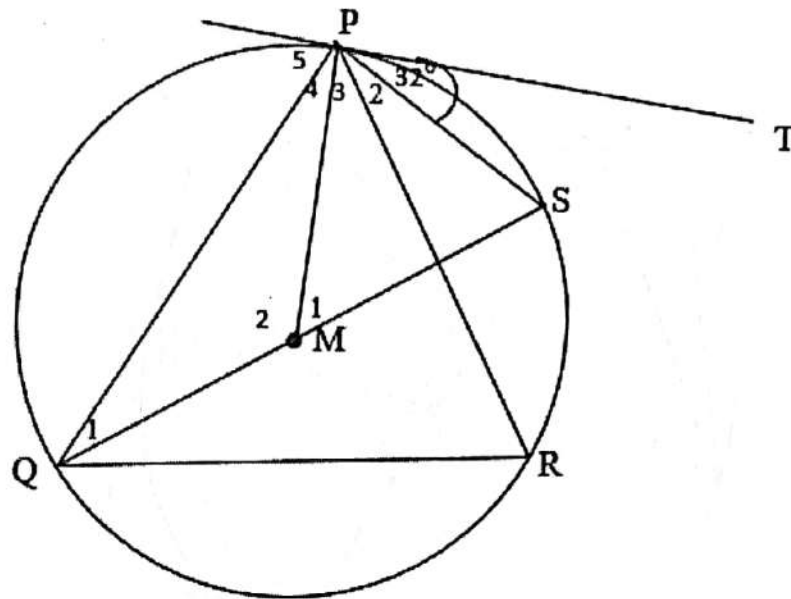
7.2 Show that $ED = h \tan \alpha$. (2)

7.3 Prove that $BD = \frac{h\sqrt{\tan^4 \alpha + 2 \tan^2 \alpha + 4}}{\tan \alpha}$. (5)

[9]

QUESTION 8

In the diagram below, TP is a tangent to the circle with centre M at P. QS is a diameter of the circle and R is on the circumference of the circle. $\hat{TPS} = 32^\circ$



Calculate the following, giving reasons:

8.1 \hat{Q}_1 (2)

8.2 \hat{P}_4 (2)

8.3 \hat{M}_1 (2)

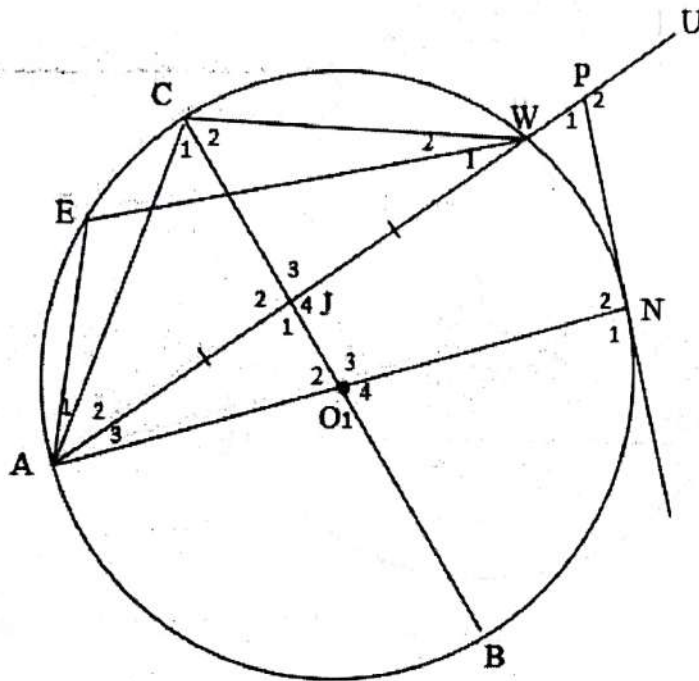
8.3 \hat{R} (4)

[10]

QUESTION 9

O is the centre of circle AECWN. BOC bisects \hat{ACW} and $AJ = JW$. AN is a diameter of the circle. AW is produced to U. P is a point on AU such that PN is a tangent to the circle at N.

Let $\hat{C}_1 = x$.



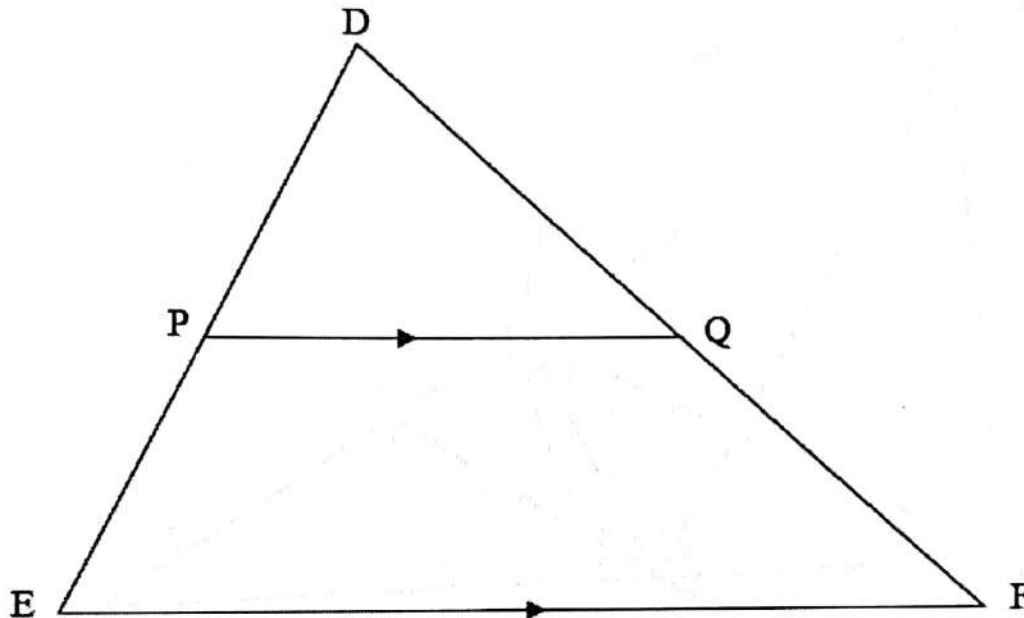
9.1 Prove that ONPJ is a cyclic quadrilateral. (6)

9.2 Express \hat{P}_1 in terms of x . (6)

[12]

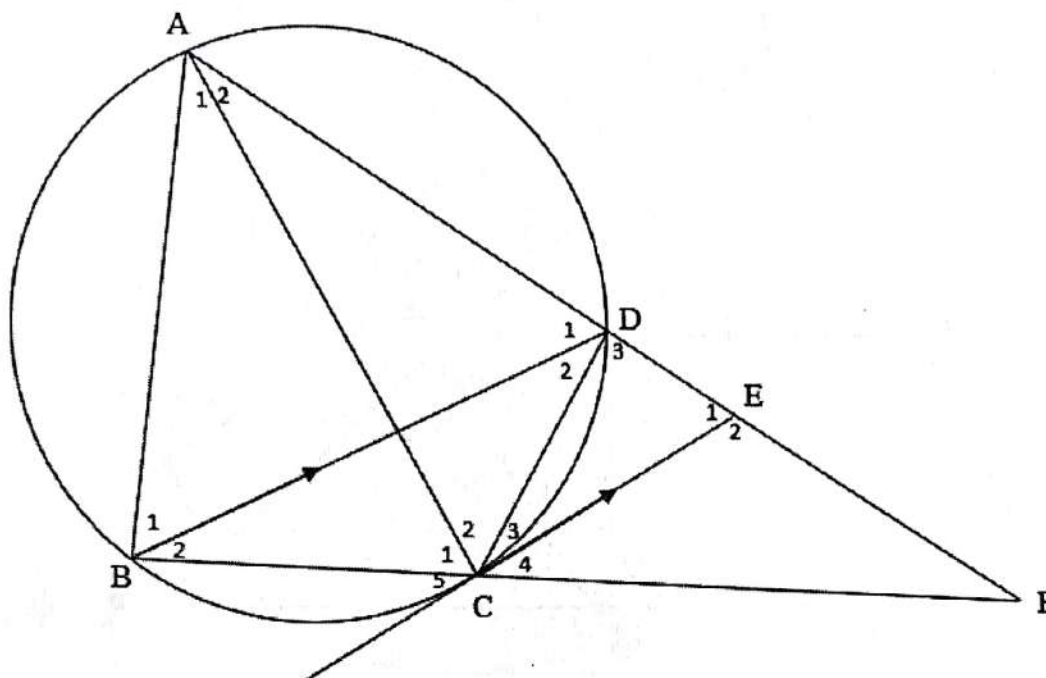
QUESTION 10

10.1 In $\triangle DEF$ P is a point on DE and Q is a point on DF such that $PQ \parallel EF$.



Prove the theorem which states that if $PQ \parallel EF$, then $\frac{DP}{PE} = \frac{DQ}{QF}$. (6)

- 10.2 In the diagram chords AD and BC of circle ABCD are produced to meet at F. E is a point on AF such that EC is a tangent to the circle at C and $BD \parallel CE$. AC and DC are joined.



Prove that:

10.2.1 $BC = DC$ (4)

10.2.2 $\triangle BAF \parallel \triangle DCF$ (4)

10.2.3 $\frac{BA}{AF} = \frac{DE}{EF}$ (5)

10.2.4 $\triangle ECD \parallel \triangle EAC$ (4)

10.2.5 $CE^2 = \frac{AE \cdot BA \cdot EF}{AF}$ (3)

[26]

TOTAL: 150