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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
MAY 2024

MATHEMATICS: PAPER II

EXAMINATION NUMBER

Time: 3 hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 25 pages and an Information Sheet of 2 pages (i–ii). Please check that your question paper is complete.
2. Read the questions carefully.
3. **Answer ALL the questions on the question paper and hand it in at the end of the examination. Remember to write your examination number in the space provided.**
4. Diagrams are not necessarily drawn to scale.
5. You may use an approved non-programmable and non-graphical calculator, unless otherwise stated.
6. Ensure that your calculator is in **DEGREE** mode.
7. Clearly show **ALL** calculations, diagrams, graphs, etc. that you have used in determining your answers. **Answers only will NOT necessarily be awarded full marks.**
8. Round off to **ONE DECIMAL PLACE** unless otherwise stated.
9. It is in your own interest to write legibly and to present your work neatly.
10. ONE blank page (page 25) is included at the end of the paper. If you run out of space for a question, use this page. Clearly indicate the question number of your answer should you use this extra space.

FOR OFFICE USE ONLY: MARKER TO ENTER MARKS

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	TOTAL
11	13	7	12	11	21	13	11	16	12	8	5	10	/150

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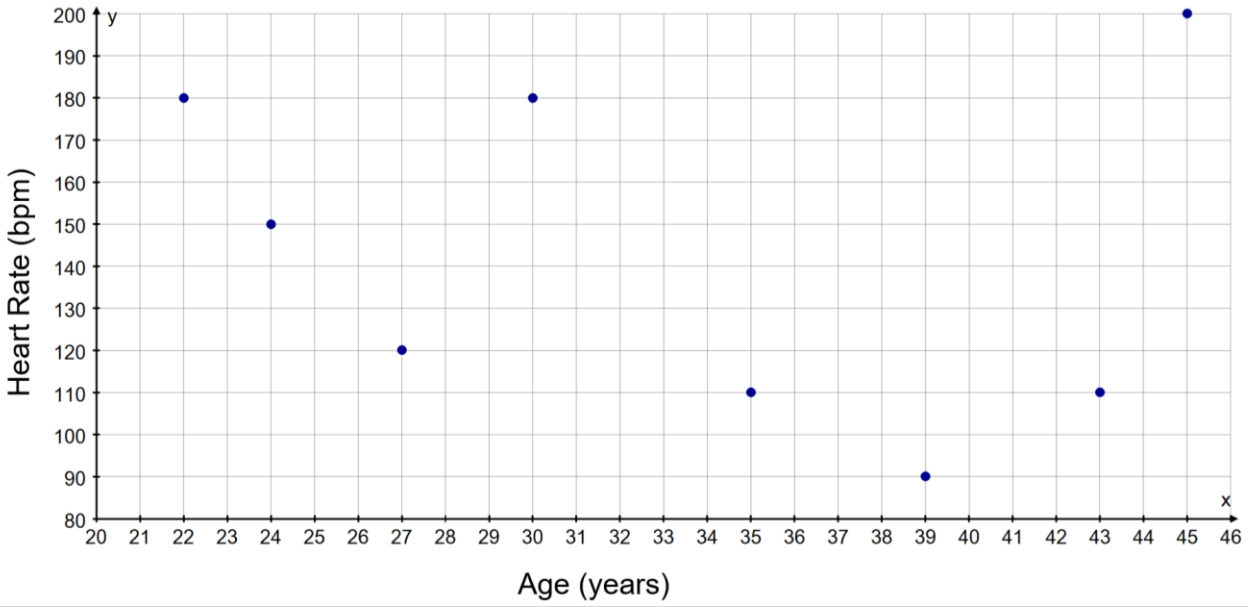
SECTION A

QUESTION 1

(a) The scatter graph shows the age of eight individuals and their maximum heart rate in beats per minute (bpm) after a particular exercise programme.

SCATTER GRAPH: AGE/MAXIMUM HEART RATE



(1) Use your calculator to determine the equation for the line of best fit in the form $y = A + Bx$. **Give your answer correct to 3 decimal places.**

(3)

(2) Use your equation to predict the maximum heart rate of a typical 50-year-old individual.

(2)

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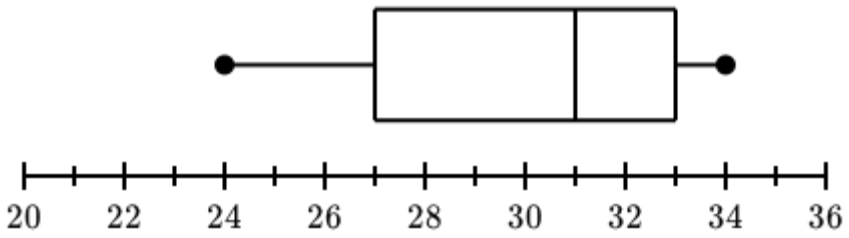
(3) Give two reasons why the prediction in (2) may not be reliable.

(2)

(b) The box and whisker plot below represents the times, in seconds, taken by a group of 60 students to run 200 metres.



(1) How many students ran between 27 seconds and 31 seconds?

(1)

(2) Using $Q_1 - 1{,}5 \times \text{IQR}$, determine whether 24 seconds would be an outlier or not.

(2)

(3) The time for the fastest student was recorded incorrectly. It was 25 seconds. How would this affect the median?

(1)
[11]

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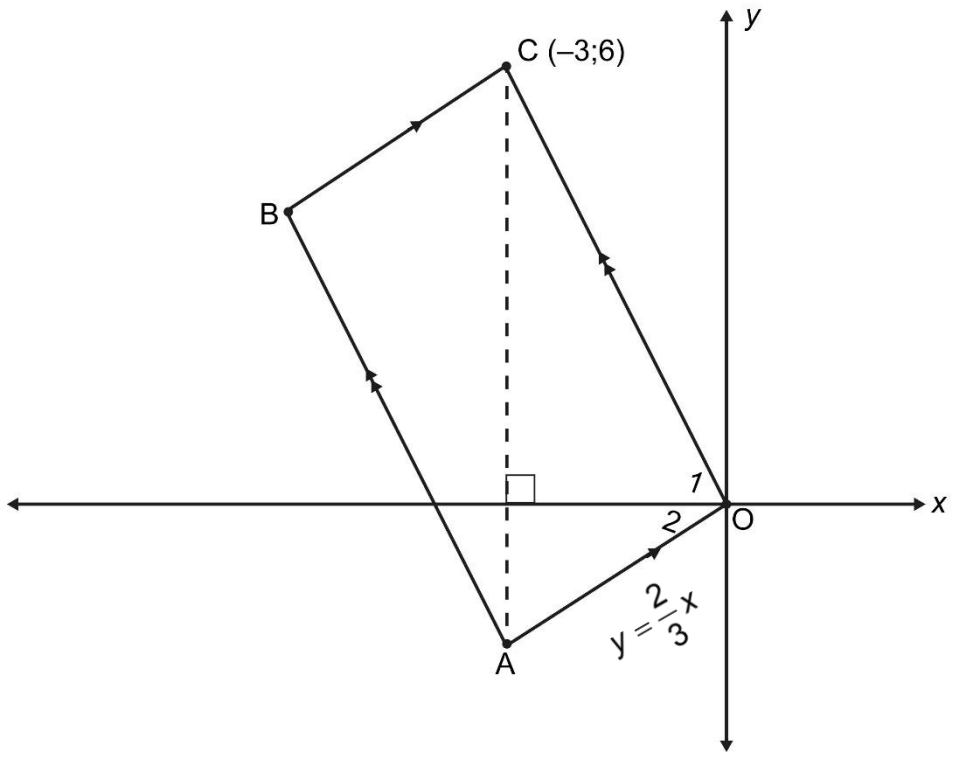
QUESTION 2

In the diagram:

- ABCO is a parallelogram with vertex O at the origin.
- Point $C(-3;6)$ is given.
- The equation AO is given as: $y = \frac{2}{3}x$
- Diagonal AC is perpendicular to the *x*-axis.



(a) Determine the equation of BC in the form $y = mx + c$.

(3)

(b) Determine the coordinates of A.

(3)

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(c) Determine the equation of AB.

(3)

(d) Determine the coordinates of B.

(4)
[13]

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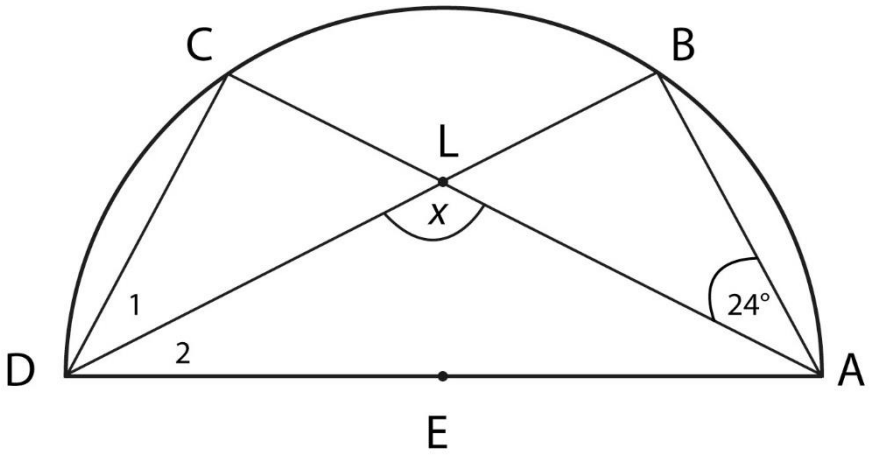
QUESTION 3

In the diagram below, C and B lie on the semi-circle with centre E.

- AD is a diameter of the semi-circle.
- AC and BD intersect at L.
- $\hat{CAB} = 24°$
- $\hat{DLA} = x$



State all relevant reasons with your statements.

(a) Determine: x

(3)

(b) Determine: $\hat{D}_1$

(2)

(c) If straight lines CE and BE are drawn, determine $\hat{CEB}$.

(2)
[7]

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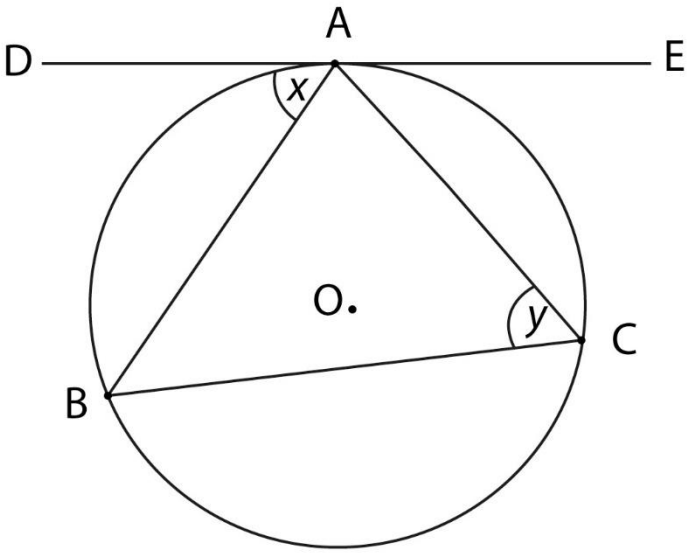
QUESTION 4

(a) In the diagram below, A, B and C lie on the circle with centre O.

- A, B and C are joined to form ΔABC.
- DE is a tangent to the circle at point A.



Prove the theorem that states: 'The acute angle between a tangent and a chord is equal to the angle in the alternate segment.' (Hint: Prove $x = y$)

Construction:

(1)

Proof:

(5)

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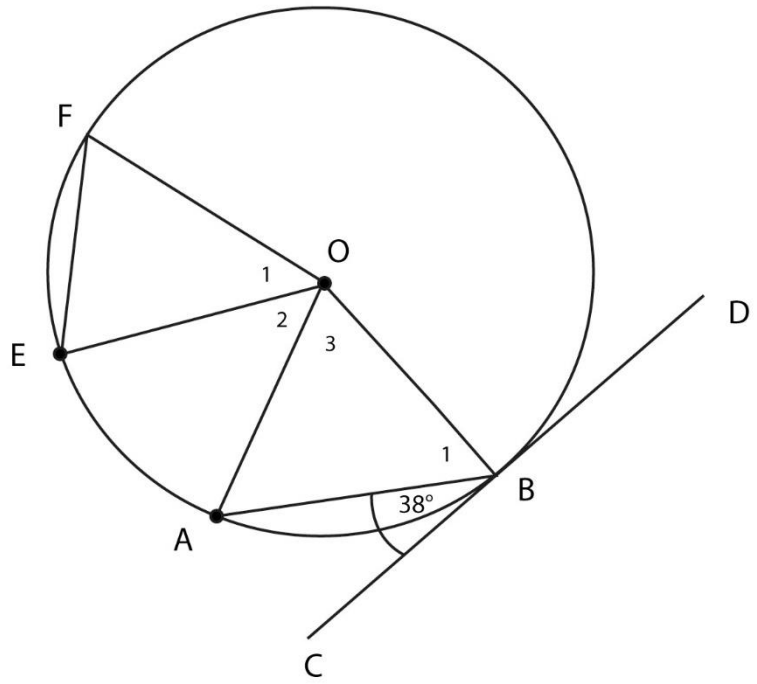
(b) In the diagram below, F, E, A and B are points on the circle with centre O.

- CD is a tangent to the circle at B
- $A\hat{B}C = 38°$



(1) Determine $\hat{A}$.

(3)

(2) If EF = AB, determine $\hat{O}_1$.

(3)
[12]

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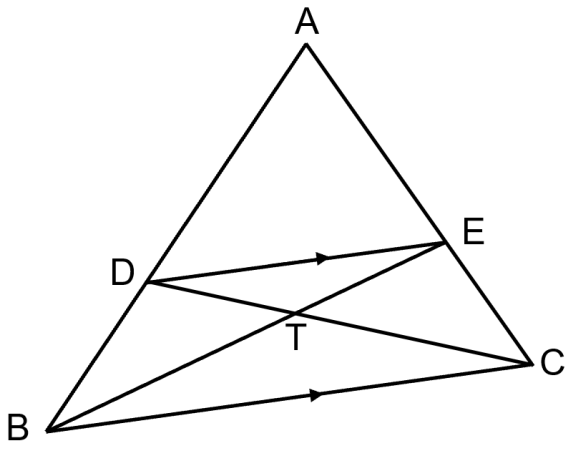
QUESTION 5

In the diagram, triangle ABC is given.

- D is a point on AB and E is a point on AC so that DE//BC
- BE and DC intersect at T
- DE = 8 cm
- DT = 4 cm
- ET = 6 cm
- TC = 7 cm



(a) Prove: ΔDET is similar to ΔCBT.

(3)

(b) Determine: BC + BT

(5)

(c) Determine: AD : DB

(3)
[11]

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QUESTION 6

(a) Simplify fully: $\dfrac{\sin(360° + \theta).\sin(90° + \theta).\tan(-\theta)}{\cos(90° - 2\theta).\tan(180° + \theta)}$

(7)

(b) If $\sin 17°.\cos 17° = k$, determine the following in terms of k:

(1) $\sin 34°$

(2)

(2) $2\sin^2 17° - 1$

(4)

(c) If $\sin\hat{A} = \frac{2}{3}$ and $\cos\hat{A} < 0$, determine without using a calculator the value of

(1) $\tan(-A)$

(4)

(2) $\sin\left(\hat{A} + 30°\right)$

(4)
[21]

75 marks

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SECTION B

QUESTION 7

The equation of the circle with centre P is: $x^2 + y^2 - 10x + 14y = -49$

(a) If the equation of the tangent to the circle at point $T(2;-3)$ is $4y = kx + t$, determine the values of k and t.

(7)

(b) If a second circle with equation $(x-4)^2+(y-3)^2=r^2$ has an x-intercept at $x=7$, determine whether these circles intersect each other.

(6)
[13]

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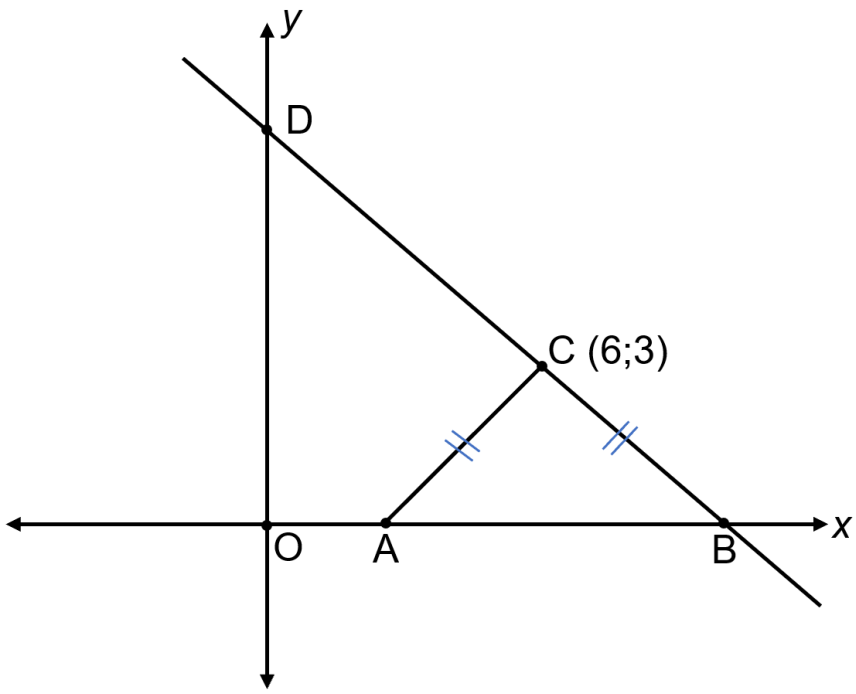
QUESTION 8

In the diagram the following is given:

- C(6;3) is a point on the straight line BCD with B on the x-axis and D on the y-axis.
- A is a point on the x-axis so that AC = CB.
- The gradient of AC = 3.



(a) Determine the equation of BCD.

(5)

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(b) Determine the equation of a circle with DA as the diameter.

(6)
[11]

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QUESTION 9

Given: $f(x) = \sin 3x$ and $g(x) = \tan\frac{3}{2}x$

(a) Determine the general solution for $f(x) = g(x)$.

(8)

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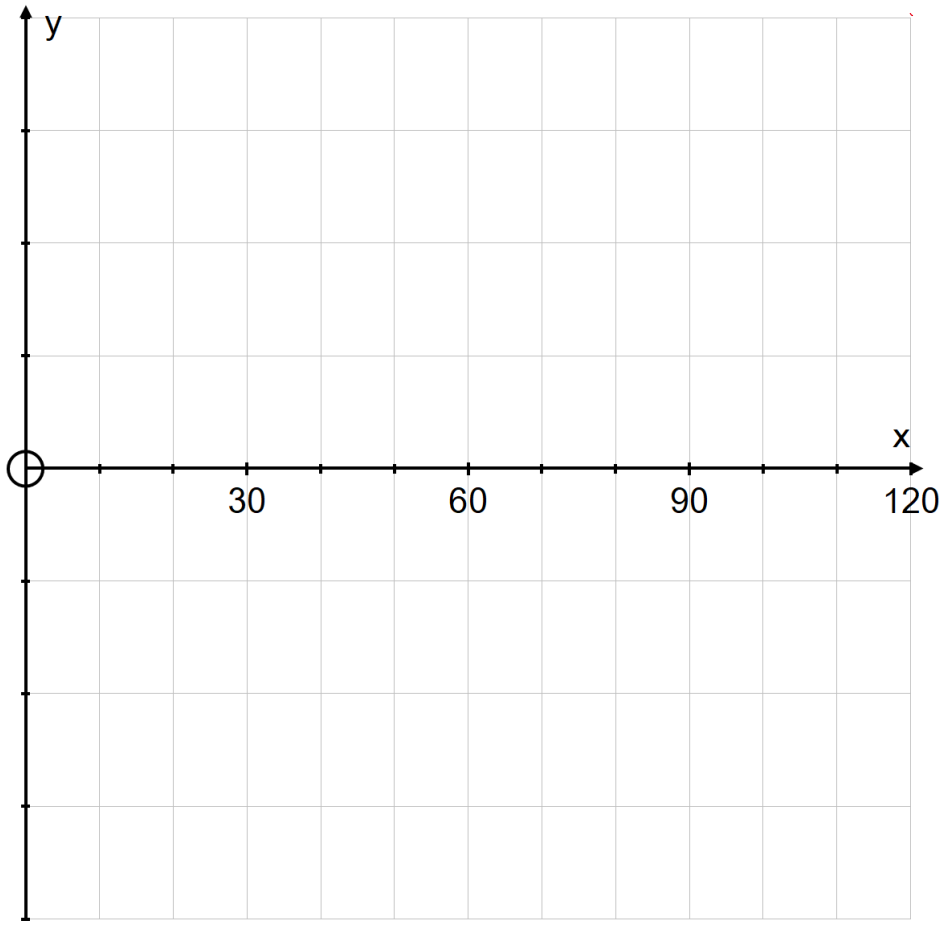
(b) Sketch the graphs for $f(x)$ and $g(x)$ on the set of axes provided for $0° \leq x \leq 120°$. Show all intercepts with axes, points of intersection between the graphs, and turning points.



(6)

(c) Determine the values of x for $0° \leq x \leq 120°$ for which $f(x) \geq g(x)$.

(2)
[16]

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QUESTION 10

(a) Solve for θ correct to one decimal place if:

$$-270° \leq \theta \leq 90°,\ \cos\theta \neq 0 \text{ and } \cos 2\theta + 3\sin 2\theta = -1$$

(7)

(b) For what value(s) of $\theta \in [0°;360°]$ is $\sqrt{\cos 9\theta - 2\cos 4\theta.\cos 5\theta}$ defined?

(5)
[12]

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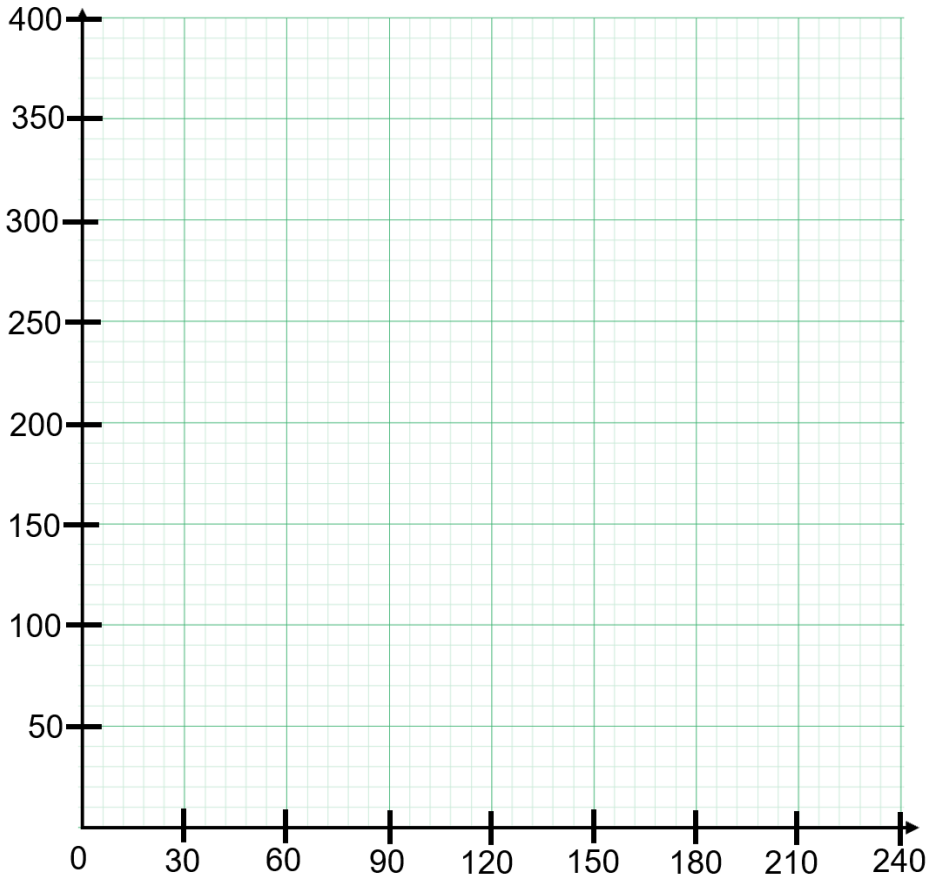
QUESTION 11

A golfer recorded the distance (d) in metres of her 400 shots.
The following is a summary of the data:

- $60 \leq d \leq 180$
- Lower quartile (Q_1) = 96
- Median = 135
- The Interquartile Range (IQR) = 48
- The 95th percentile = 174

(a) Sketch the cumulative frequency curve (Ogive) below to represent the given data. Show all key points on your curve clearly.



(5)

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(b) A friend of the golfer claims that the 40^{th} percentile is 140. Is the friend correct? Explain.

(1)

(c) If the mean distance of the shots is 122 m, describe the skewness of the data giving a reason.

(2)
[8]

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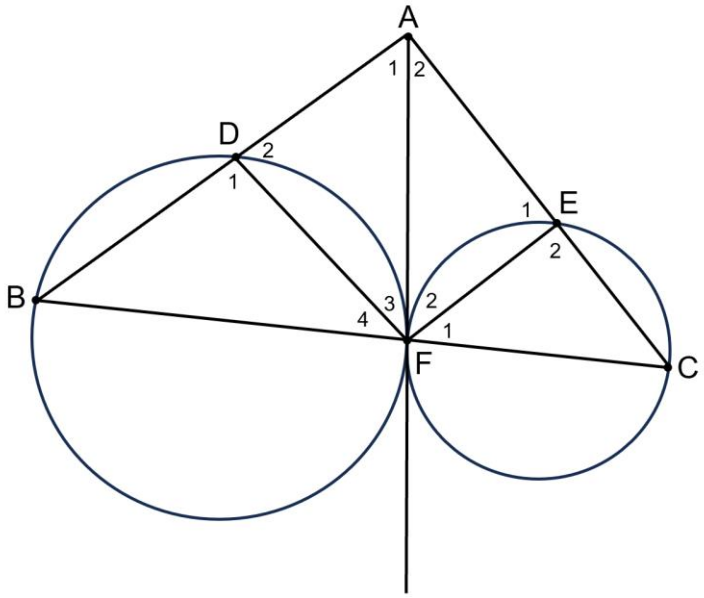
QUESTION 12

In the diagram below, AF is a common tangent to the two given circles at F.

- B and D are points on the larger circle and E and C are points on the smaller circle.
- ADB, AEC and BFC are straight lines.



Prove that AEFD is a cyclic quadrilateral.

(5)
[5]

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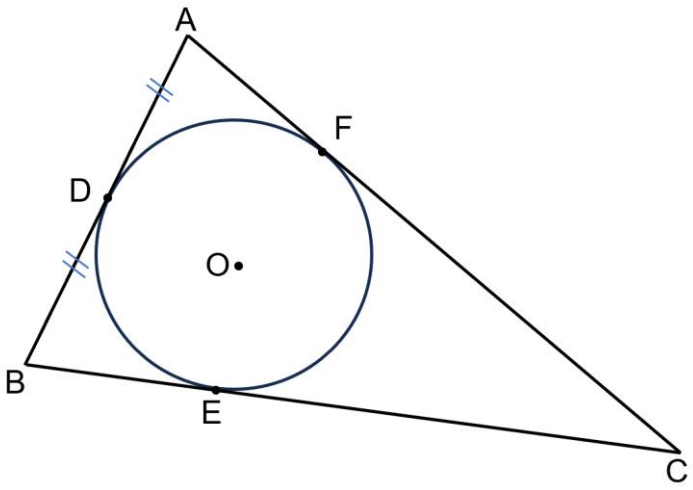
QUESTION 13

In the diagram below, the sides of ΔABC touch the circle with centre O at D, E and F.

- D is the midpoint of AB
- AD = 8 units
- EC = 21 units



(a) Determine $A\hat{B}C$.

(6)

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(b) Determine *r*, the radius of the circle.

(4)
[10]

75 marks

Total: 150 marks

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ADDITIONAL SPACE (ALL QUESTIONS)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.

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