



KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MATHEMATICS P2

COMMON TEST

JUNE 2023

MARKS: 150

TIME: 3 hours

**N.B. This paper consists of 9 pages, 1 information sheet,
and 1 diagram sheet.**

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of **9** questions.
2. Answer **ALL** the questions.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Clearly show **ALL** calculations, diagrams, graphs, etc. 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 off answers to **TWO** decimal places, unless stated otherwise.
8. Diagrams are **NOT** necessarily drawn to scale.
9. An information sheet with formulae is included at the end of the question paper.
10. Write neatly and legibly.



QUESTION 1

Seven scores for a test out of 50 marks were recorded. However, when recording the data the statistician had some difficulty with his computer. He listed the following conditions that he had remembered,



Scores	a	b	c	d	e	f	g
--------	-----	-----	-----	-----	-----	-----	-----

- Maximum Value is 42
- Range is 35
- Median is 23
- The difference between the median and the upper quartile is 14
- The Inter – Quartile Range is 22
- $e = 2c$
- The mean is 25.

Determine the values of the scores. (Show all working)

(10)

[10]**QUESTION 2**

The class teacher of a grade 10 class collected the following data for her learners. She recorded the time taken by the learners to complete different tasks assigned.

Time in minutes	No. of learners			
$0 < t \leq 10$	5			
$10 < t \leq 20$	8			
$20 < t \leq 30$	18			
$30 < t \leq 40$	7			
$40 < t \leq 50$	2			

2.1 Calculate the estimated mean time.

(3)

2.2 Draw a frequency polygon (Ogive) curve on the system of axes provided.

(5)

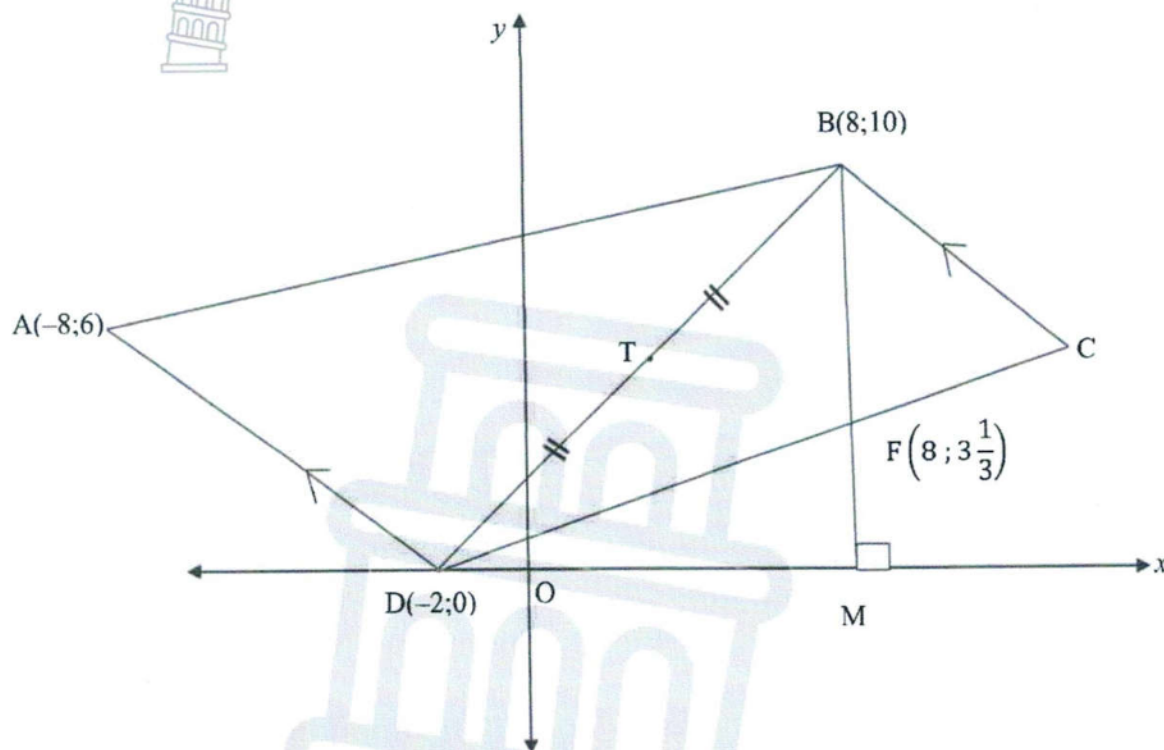
2.3 Calculate how many learners took more than 60 % of the time to complete the tasks assigned to them.

(3)

[11]

QUESTION 3

In the sketch below, $A(-8;6)$, $B(8;10)$, C and $D(-2;0)$ are the vertices of a trapezium having $AD \parallel BC$. T is the midpoint of DB . From the vertex B , BM is drawn perpendicular to the x -axis and intersects DC in $F\left(8;3\frac{1}{3}\right)$.



- 3.1 Calculate the gradient of AD. (2)
- 3.2 Determine the equation of BC in the form $y = mx + c$. (3)
- 3.3 Prove that $BD \perp AD$. (3)
- 3.4 Calculate the size of $\widehat{BDM}$. (2)
- 3.5 If $TC \parallel DM$ and points T and C are symmetrical about the line BM. Calculate the coordinates of C. (3)
- 3.6 Calculate the area of $\triangle BDF$. (5)

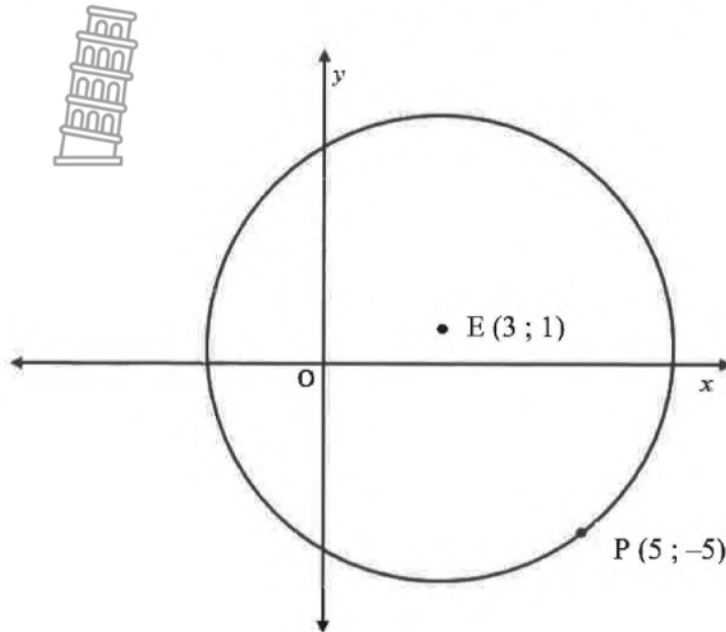
[18]

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QUESTION 4

In the diagram below, the circle centred at E (3 ; 1) passes through the point, P (5 ; -5).



4.1 Determine the equation of :

4.1.1 The circle in the form $x^2 + y^2 + Ax + By + C = 0$. (4)

4.1.2 The tangent to the circle at P (5 ; -5) in the form $y = mx + c$. (5)

4.2 A smaller circle is drawn inside the circle. Line EP is the diameter of the small circle.

Determine the:

4.2.1 Coordinates of the centre of the smaller circle. (4)

4.2.2 Length of the radius. (2)

4.3 Hence, or otherwise, determine whether the point C(9 ; 3) lies inside, outside or on the circle centre, E. (4)

[19]



QUESTION 5

5.1 If $\tan 12^\circ = q$, then determine the value of the following, without using a calculator:

5.1.1 $\cos 192^\circ$ (3)

5.1.2 $\cos 24^\circ$ (3)

5.1.3 $1 - 2\sin^2 6^\circ$ (2)

5.2 Evaluate the following trigonometric expression without using a calculator:

$$\frac{2 \sin^2(x - 180^\circ) \cos(180^\circ - x)}{\cos(90^\circ + x) \sin x - \cos(x - 90^\circ) \sin(720^\circ - x)} \quad (7)$$

5.3 Given: $(1 - \tan A) \left(\frac{\cos A}{\cos 2A} \right) = \frac{1}{\cos A + \sin A}$

5.3.1 Prove the identity. (3)

5.3.2 Write down the maximum value of $\frac{1}{\cos A + \sin A}$ (2)

5.4 Calculate the value of

$$\sum_{38^\circ}^{52^\circ} \cos^2 A \quad (4)$$

[24]

QUESTION 6

6.1 Sketch the graphs of $f(x) = \sin \frac{1}{2}x$ and $g(x) = \cos(x + 60^\circ)$ for $x \in [-180^\circ; 180^\circ]$ on the grid given at the back. (6)

6.2 Use your graphs to answer the following questions:

6.2.1 Write down the range of the graph of f . (2)

6.2.2 State the period of g . (1)

6.2.3 Determine the values of x for which $f(x) = g(x)$. (4)

6.2.4 If $h(x) = g(x + 30^\circ)$, write down the equation of h . (3)

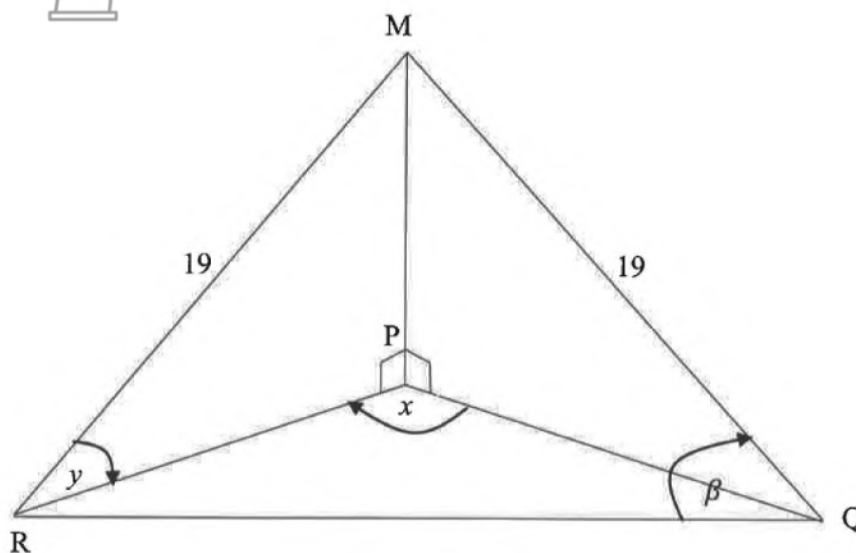
[16]

QUESTION 7

In the diagram below, MP is a vertical tower. MQ and MR are wire ropes used to stabilize MP and are each 19 metres in length. R, P and Q are in the same horizontal plane.

The angle of elevation of M from R is y .

$\widehat{RPQ} = x$ and $\widehat{MQR} = \beta$



7.1 Prove that the Area of $\Delta PQR = \frac{361 \sin x \cos^2 y}{2}$ (5)

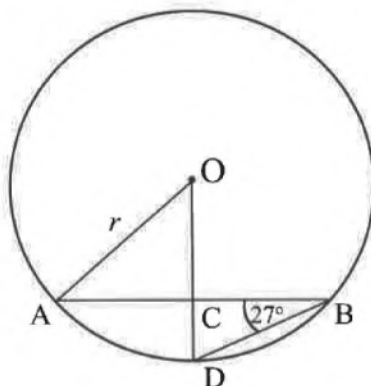
7.2 Show that, $RQ = 38 \cos \beta$ (6)

[11]



QUESTION 8

- 8.1 O is the centre of the circle, radius r , and chord $AB = \sqrt{128}$ cm. $OC \perp AB$ and $OC : CD = 3 : 2$. $\angle ABD = 27^\circ$



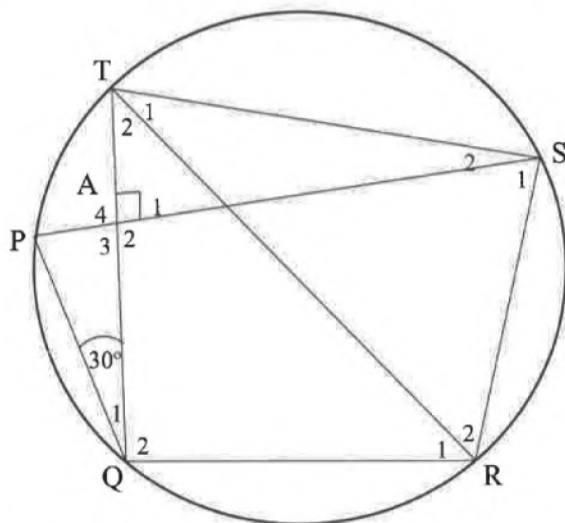
8.1.1 Calculate the length of the radius of the circle, without using a calculator. (5)

8.1.2 Calculate, with reason and $\angle AOD$. (2)

- 8.2 Complete the following statement: (2)

8.2.1 The exterior angle of a cyclic quadrilateral is

8.2.2 TQ is a chord of the circle PQRST. $QAT \perp PAS$. $\widehat{Q_1} = 30^\circ$ and $\widehat{P} = \widehat{S_1}$.



- a) Name 3 angles each equal to 60° . (3)
- b) Calculate the size of $\widehat{QRS}$. (2)
- c) Prove that $PS \parallel QR$. (2)
- d) Prove that TR is a diameter of the circle. (2)

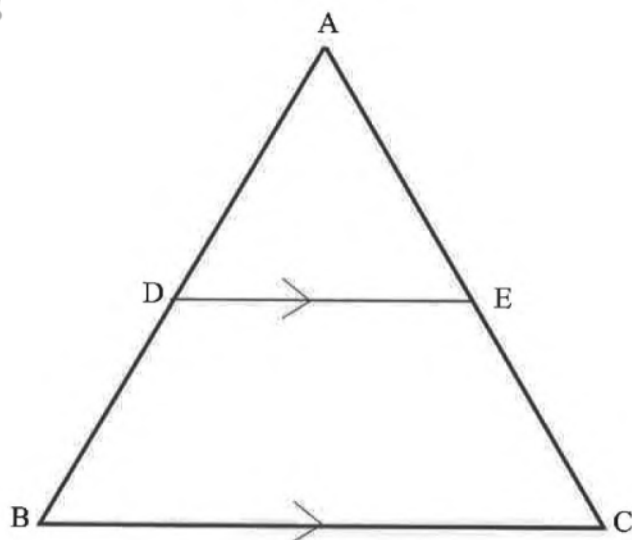


[18]

QUESTION 9

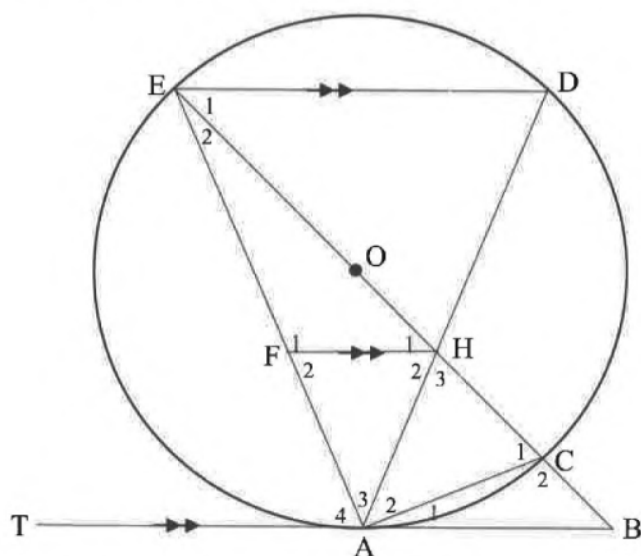
9.1 In $\triangle ABC$, $DE \parallel BC$. Prove :

$$\frac{AD}{DB} = \frac{AE}{EC}$$



(6)

9.2 In the diagram, O is the centre of the circle ACDE. EC is produced to B. TAB is a tangent to the circle at A. EC and AD intersect at H. F is a point on EA. $ED \parallel FH \parallel TAB$. EOHCB is a straight line. $AH : HD = 5 : 7$.



9.2.1 Prove $\triangle ABC \sim \triangle EBA$

(4)

9.2.2 Calculate r , the radius of the circle, if $AB = 5$ metres and $BC = \frac{2r}{3}$ metres.

(4)

9.2.3 Write down, with reason the value of $AF : FE$.

(2)

9.2.4 Determine $\frac{\text{Area of } \triangle AFH}{\text{Area of } \triangle AED}$.

(4)

9.2.5 Calculate the length of OH.

(3)

[23]

TOTAL MARKS: 150

INFORMATION SHEET: MATHEMATICS

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

$$A = P(1 - i)^n$$

$$A = P(1 + i)^n$$

$$T_n = a + (n-1)d$$

$$S_n = \frac{n}{2}(2a + (n-1)d)$$

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(r^n - 1)}{r - 1}; \quad r \neq 1$$

$$S_\infty = \frac{a}{1 - r}; \quad -1 < r < 1$$

$$F = \frac{x[(1+i)^n - 1]}{i}$$

$$P = \frac{x[1 - (1+i)^{-n}]}{i}$$

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \tan \theta$$

$$(x-a)^2 + (y-b)^2 = r^2$$

$$\text{In } \triangle ABC: \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A \quad \text{area } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

$$\sin(\alpha + \beta) = \sin \alpha \cdot \cos \beta + \cos \alpha \cdot \sin \beta$$

$$\sin(\alpha - \beta) = \sin \alpha \cdot \cos \beta - \cos \alpha \cdot \sin \beta$$

$$\cos(\alpha + \beta) = \cos \alpha \cdot \cos \beta - \sin \alpha \cdot \sin \beta$$

$$\cos(\alpha - \beta) = \cos \alpha \cdot \cos \beta + \sin \alpha \cdot \sin \beta$$

$$\cos 2\alpha = \begin{cases} \cos^2 \alpha - \sin^2 \alpha \\ 1 - 2\sin^2 \alpha \\ 2\cos^2 \alpha - 1 \end{cases}$$

$$\sin 2\alpha = 2 \sin \alpha \cdot \cos \alpha$$

$$\bar{x} = \frac{\sum f \cdot x}{n}$$

$$\sigma^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n}$$

$$P(A) = \frac{n(A)}{n(S)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$\hat{y} = a + bx$$

$$b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}$$

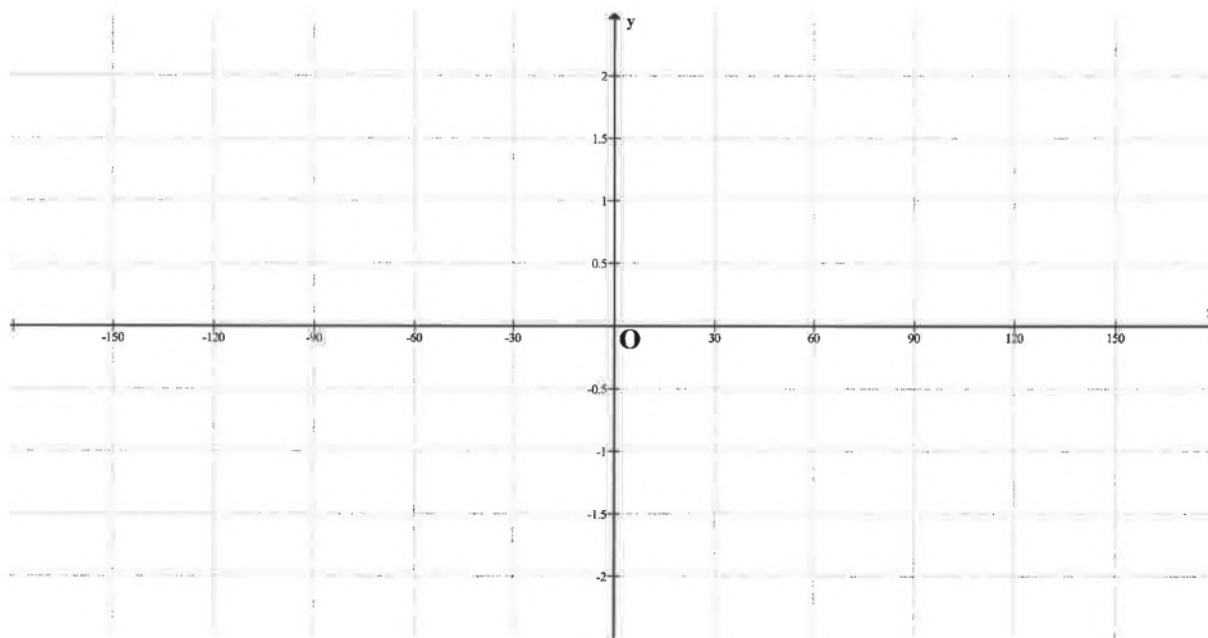
DIAGRAM SHEET

QUESTION 2



Time in minutes	No. of learners	
$0 < t \leq 10$	5	
$10 < t \leq 20$	8	
$20 < t \leq 30$	18	
$30 < t \leq 40$	7	
$40 < t \leq 50$	2	

QUESTION 6.1



FINAL



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**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MATHEMATICS P2
MARKING GUIDELINE
COMMON TEST
JUNE 2023

MARKS: 150

N.B. This marking guideline consists of 16 pages.

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QUESTION 1

1.1	$g = 42$ Minimum : $a = 42 - 35 = 7$ $d = 23$ $f - 23 = 14$, Therefore $f = 37$ $f - b = 22$, Therefore $b = 15$ $\frac{7 + 15 + c + 23 + 2c + 37 + 42}{7} = 25$ $\frac{3c + 124}{7} = 25$ $3c + 124 = 175$ $3c = 51$ $c = 17$ Therefore $e = 34$	A✓ Value of g A✓ Value of a A✓ Value of f A✓ Value of d CA✓ Value of b CA✓ Setting up equation CA✓ Simplifying numerator CA✓ equation in c CA✓ Value of c CA✓ Value of e	(10)
			[10]

QUESTION 2

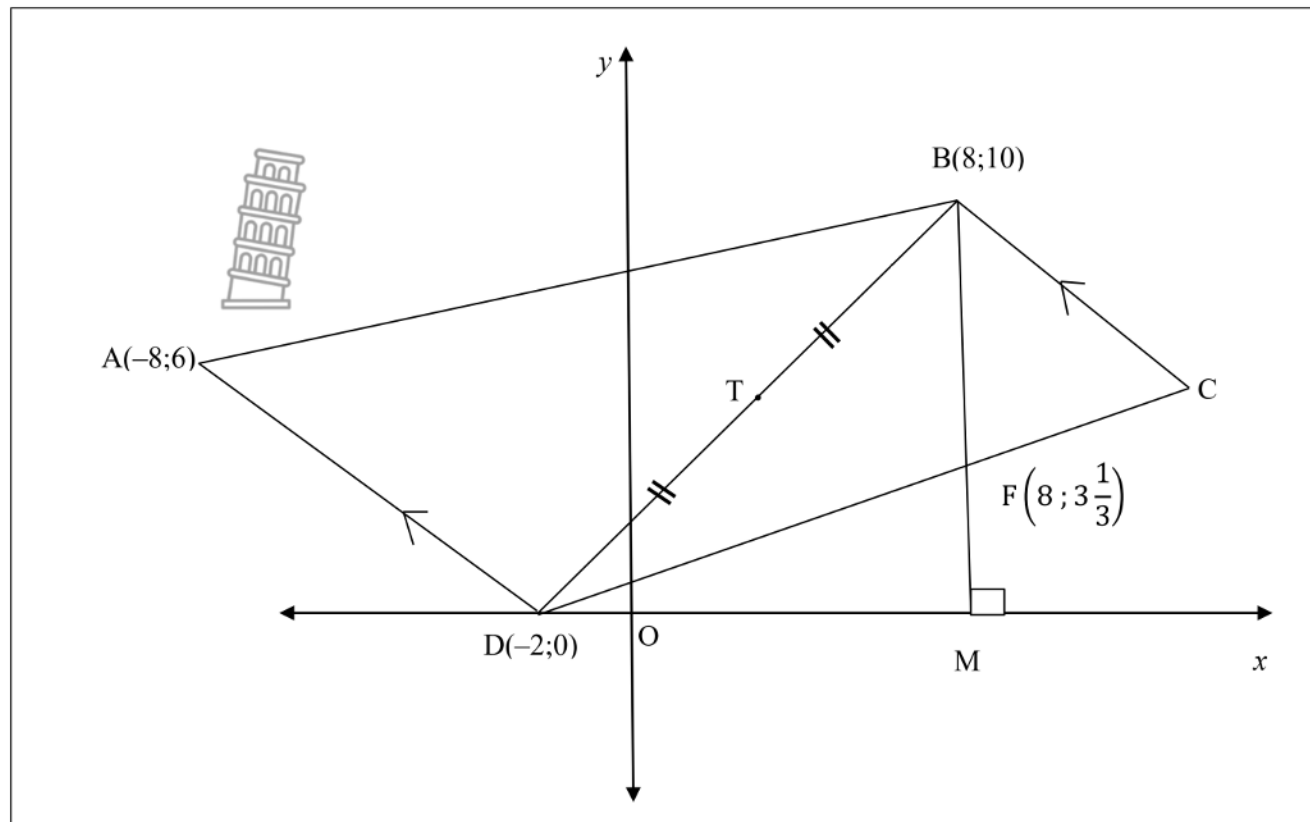
Time (in minutes)	Number of Learners	Midpoint of Interval(x)	f.x	Cf
$0 < t \leq 10$	5	5	25	5
$10 < t \leq 20$	8	15	120	13
$20 < t \leq 30$	18	25	450	31
$30 < t \leq 40$	7	35	245	38
$40 < t \leq 50$	2	45	90	40
Total	40		930	



2.1	Estimated Mean = $\frac{930}{40} = 23,25$	A✓930 A✓40 CA✓ Answer (only if denominator is 40) (Answer only full marks)	(3)
2.2	DO NOT MARK THIS QUESTION 		
2.3	60 % of 50 minutes = 30 minutes 9 learners	A✓ Calculation A✓ 30 minutes A✓ Answer (AO full marks)	(3)



QUESTION 3

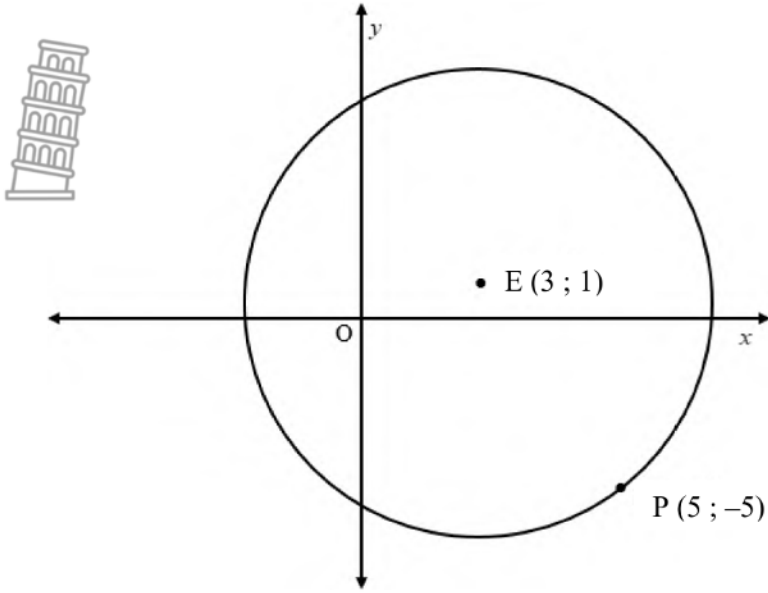


3.1	$m_{AD} = \frac{6-0}{-8+2} = \frac{6}{-6} = -1$	A✓subst. of points A and D CA✓Answer	(2)
3.2	$m_{AD} = m_{BC} = -1 \dots (AD \parallel BC)$ $y = mx + c$ $10 = -1(8) + c$ $18 = c$ $y = -x + 18$	CA✓gradient of BC CA✓subst. of point C and gradient CA✓Answer	(3)
3.3	$m_{BD} = \frac{10-0}{8+2} = \frac{10}{10} = 1$ Since the product of the gradients of lines AD and BD = -1 Therefore $BD \perp AD$	A✓subst. of points A and D A✓Gradient of BD A✓Justification	(3)
3.4	$\tan \theta = 1$ $\widehat{BDM} = 45^\circ$	CA✓ $\tan \theta = 1$ CA✓Answer	(2)
3.5	T(3 ; 5) ... midpoint C(13 ; 5)	A ✓coordinates CA CA✓coordinates of C	(3)

3.6	$BF = \sqrt{(8-8)^2 + \left(10 - 3\frac{1}{3}\right)^2} = 6\frac{2}{3} = \frac{20}{3}$ Area of $\triangle BDF = \frac{1}{2}(10)\left(\frac{20}{3}\right) = \frac{100}{3} = 33\frac{1}{3}$ square units.  OR Area of $\triangle BDF = \text{Area of } \triangle DBM - \text{area of } \triangle DFM$ $= \frac{1}{2}(10)(10) - \frac{1}{2}(10)\left(\frac{10}{3}\right)$ $= \frac{100}{3} = 33,3 \text{ units}^2$ OR $m_{DF} = \frac{1}{3}$ $\tan \hat{FDM} = \frac{1}{3}$ $\hat{FDM} = 18.43^\circ$ $BD = 10\sqrt{2}$ $DF = \frac{10\sqrt{10}}{3}$ $\therefore \text{Area of } \triangle BDF = \frac{1}{2} 10\sqrt{2} \times \frac{10\sqrt{10}}{3} \sin 26.57^\circ$ $= 33,3 \text{ units}^2$	A✓ Substitution A✓ BF value CA✓ Subst. into formula CA✓ Simplification CA✓ Answer	(5)
			[18]



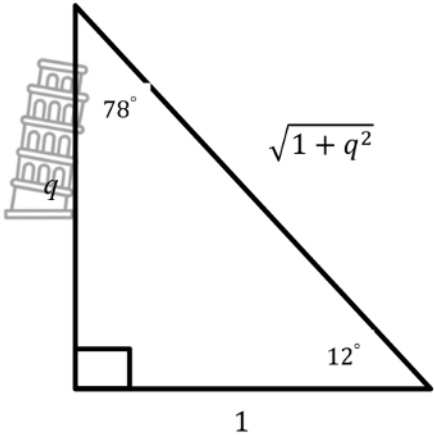
QUESTION 4

4.1		
4.1.1	$EP = \sqrt{(3 - 5)^2 + (1 + 5)^2}$ $EP = \sqrt{(-2)^2 + (6)^2}$ $EP = \sqrt{40}$ $(x - 3)^2 + (y - 1)^2 = 40$ $x^2 - 6x + 9 + y^2 - 2y + 1 = 40$ $x^2 + y^2 - 6x - 2y - 30 = 0$	A✓Substitution CA✓EP value CA✓Substitution CA✓Answer (4)
4.1.2	Radius: $m = \frac{1 + 5}{3 - 5} = -3$ Tangent: $m = \frac{1}{3}$ $y = mx + c$ $-5 = \frac{1}{3}(5) + c$ $-15 = 5 + 3c$ $-20 = 3c$ $c = -6\frac{2}{3}$ $y = \frac{1}{3}x - 6\frac{2}{3}$	A✓Gradient of radius CA✓Gradient of tangent (provided it is positive) CA✓Subst. Of point and gradient.  CA✓c value CA✓Answer (5)

4.2.1	Coordinates of Centre of smaller circle: $\left(\frac{3+5}{2}; \frac{1-5}{2}\right) = (4; -2)$	A✓ midpoint formula A✓ Substitution CA CA✓✓ Answer (AO full marks)	(4)
4.2.2	Radius of larger circle: $2\sqrt{10}$ Radius of smaller circle: $r = \frac{1}{2}(2\sqrt{10}) = \sqrt{10}$ units  OR Radius = $\sqrt{(4-3)^2 + (-2-1)^2}$ $= \sqrt{10}$ OR Radius = $\sqrt{(4-5)^2 + (-2-5)^2}$ $= \sqrt{10}$	A ✓ $\frac{1}{2}(2\sqrt{10})$ CA ✓ Answer	(2)
4.3	EC = $\sqrt{(9-3)^2 + (3-1)^2}$ $= \sqrt{6^2 + 2^2}$ $= \sqrt{36 + 4}$ $= \sqrt{40}$ $\therefore$ EC = radius $\therefore$ C lies on the circle, centre E OR $x^2 - 6x + 9 + y^2 - 2y + 1 = 40$ $x^2 + y^2 - 6x - 2y - 30 = 0$ OR $(x-3)^2 + (y-1)^2 = 40$ LHS = $(9-3)^2 + (3-1)^2 = 40$ RHS = 40 $\therefore$ LHS = RHS $\therefore$ It lies on the circle	A✓ Substitution CA ✓ EC = $\sqrt{40}$ CA ✓ equating to radius CA ✓ Conclusion	(4)
			[19]



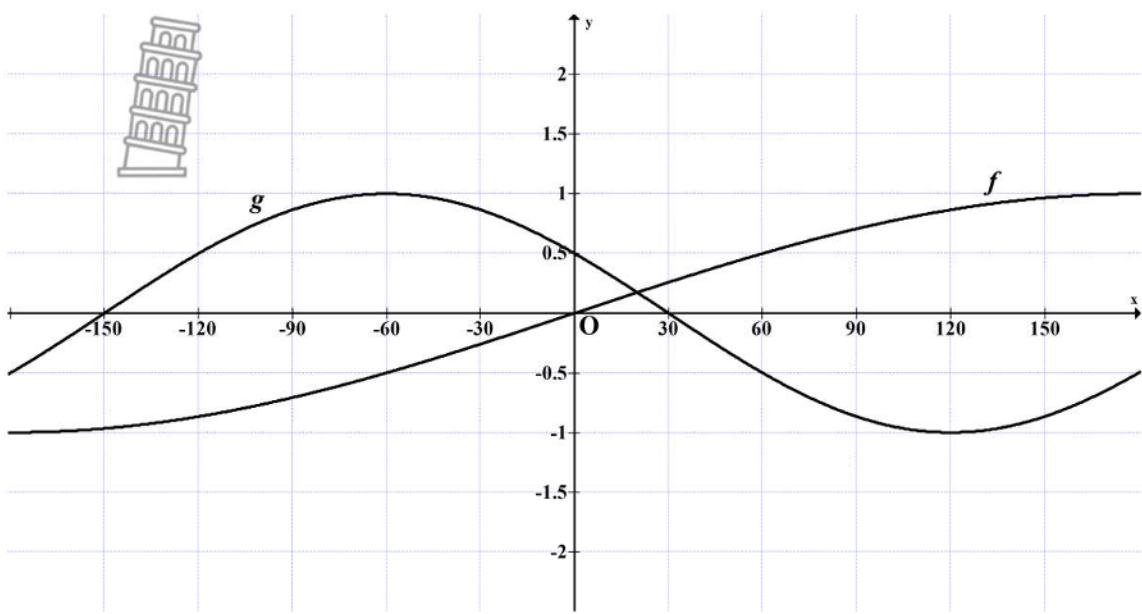
QUESTION 5

5.1			
5.1.1	$\begin{aligned}\cos 192^\circ &= -\cos 12^\circ \\ &= -\frac{1}{\sqrt{1+q^2}}\end{aligned}$	A✓ $\sqrt{1+q^2}$ A✓ $-\cos 12^\circ$ CA✓ Answer	(3)
5.1.2	$\begin{aligned}\cos 24^\circ &= 2 \cos^2 12^\circ - 1 \\ &= 2 \left(\frac{1}{\sqrt{1+q^2}} \right)^2 - 1 \\ &= \frac{2}{1+q^2} - 1\end{aligned}$ OR $\begin{aligned}\cos 24^\circ &= 1 - 2 \sin^2 12^\circ \\ &= 1 - 2 \left(\frac{q}{\sqrt{1+q^2}} \right)^2 \\ &= 1 - \frac{2q^2}{1+q^2}\end{aligned}$ OR $\begin{aligned}\cos 24^\circ &= \left(\frac{1}{\sqrt{1+q^2}} \right)^2 - \left(\frac{q}{\sqrt{1+q^2}} \right)^2 \\ &= \frac{1}{1+q^2} - \frac{q^2}{1+q^2} \\ &= \frac{1-q^2}{1+q^2}\end{aligned}$	A✓ Double angle Expansion CA✓ Substitution CA✓ Answer 	(3)

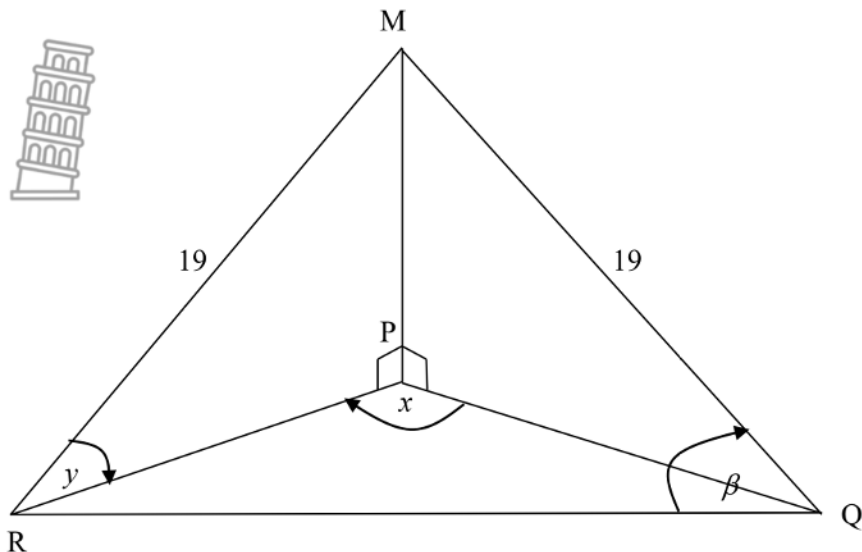
5.1.3	$1 - 2\sin^2 6^\circ$ $= \cos 12^\circ$ $= \frac{1}{\sqrt{1+q^2}}$	A✓Double angle CA✓Answer	(2)
5.2	$\frac{2\sin^2(x-180^\circ)\cos(180^\circ-x)}{\cos(90^\circ+x)\sin x - \cos(x-90)\sin(720^\circ-x)}$ $= \frac{2(-\sin x)^2 \cdot (-\cos x)}{-\sin x \cdot \sin x - (\sin x \cdot -\sin x)}$ $= \frac{-2\sin^2 x \cos x}{0}$ $= \text{undefined}$	A✓ $(-\sin x)^2$ A✓ $-\cos x$ A✓ $-\sin x$ A✓ $\sin x$ A✓ $-\sin x$ CA✓ $\frac{-2\sin^2 x \cos x}{0}$ CA✓Answer	(7)
5.3.1	LHS: $(1 - \tan A) \left(\frac{\cos A}{\cos 2A} \right)$ $= \left(1 - \frac{\sin A}{\cos A} \right) \left(\frac{\cos A}{\cos^2 A - \sin^2 A} \right)$ $= \left(\frac{\cos A - \sin A}{\cos A} \right) \frac{\cos A}{(\cos A - \sin A)(\cos A + \sin A)}$ $= \frac{1}{\cos A + \sin A}$ $= \text{RHS}$	A ✓ $\frac{\sin A}{\cos A}$ A ✓ $\cos^2 A - \sin^2 A$ A ✓ simplification	(3)
5.3.2	DO NOT MARK THIS QUESTION		
5.4	DO NOT MARK THIS QUESTION		
			[18]



QUESTION 6

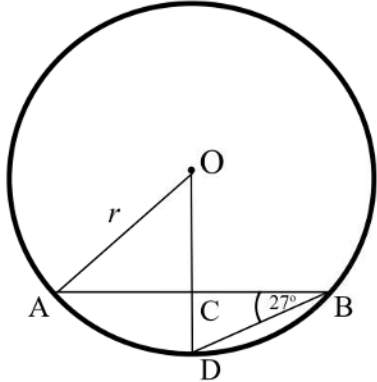
6.1			
	Graph of f: A 1 mark for x – intercepts A 1 marks for minimum and maximum points A 1 mark for shape Graph of g: A 1 mark for end points A 1 mark for x – intercepts A 1 mark for y – intercept (6)		
6.2.1	$y \in [-1 ; 1]$	CA✓ $[-1 ; 1]$ A ✓ notation	(2)
6.2.2	360°	A✓ Answer	(1)
6.2.3	$\sin \frac{1}{2}x = \cos(x + 60^\circ)$ $\sin \frac{1}{2}x = \sin [90^\circ - (x + 60^\circ)]$ $\sin \frac{1}{2}x = \sin [30^\circ - x]$ $\frac{1}{2}x = 30^\circ - x$ $\frac{3}{2}x = 30^\circ$ $x = 20^\circ$	A✓ Co - Ratio A✓ Equation in sine only A✓ $\frac{1}{2}x = 30^\circ - x$ A✓ Answer CA(AO full marks)	(4)
6.2.4	$h(x) = g(x + 30)$ $h(x) = \cos(x + 30 + 60)$ $h(x) = \cos(x + 90)$ $h(x) = -\sin x$	A ✓ substitution A✓ $\cos(x + 90)$ A✓ Answer (AO full marks)	(3)
			[14]

QUESTION 7

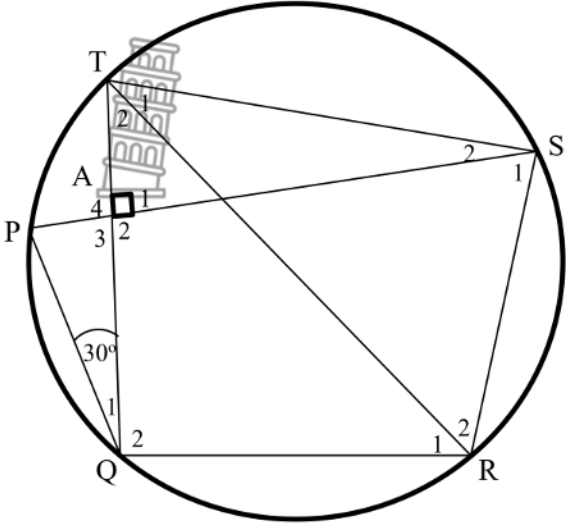


7.1	$\frac{PR}{19} = \cos y$ $PR = 19 \cos y$ Now $PR = PQ$($\triangle MPR \equiv \triangle MPQ$...90deg HS) $\text{Area of } \triangle PQR = \frac{1}{2} (19 \cos y)(19 \cos y) \sin x$ $= \frac{361 \sin x \cos^2 y}{2}$	A✓Trig ratio A✓Length of PR A✓Congruent triangles A✓Reason SAS A✓Substitution into Area Formula	(5)
7.2	$RQ^2 = 19^2 + 19^2 - 2(19)(19) \cos(180^\circ - 2\beta)$ $RQ^2 = 361 + 361 - 722(-\cos 2\beta)$ $RQ^2 = 722 + 722 \cos 2\beta$ $RQ^2 = 722 + 722(2\cos^2 \beta - 1)$ $RQ^2 = 1444 \cos^2 \beta$ $RQ = 38 \cos \beta$ OR $MR^2 = RQ^2 + MQ^2 - 2RQ \cdot MQ \cos \beta$ $19^2 = RQ^2 + 19^2 - 2(RQ)(19) \cos \beta$ $0 = RQ^2 - 38 RQ \cdot \cos \beta$ $\frac{38 RQ \cos \beta}{RQ} = \frac{RQ^2}{RQ}$ $RQ = 38 \cos \beta$	A✓Size of angle RMQ A✓Subst. Cosine rule A✓Reduction A✓Simplifying A✓Double angle expansion A✓$1444 \cos^2 \beta$	(6)
			[11]

QUESTION 8

8.1	O is the centre of the circle, radius r, and chord $AB = \sqrt{128}$ cm. $OC \perp AB$ and $OC : CD = 3 : 2$. $\hat{ABD} = 27^\circ$ 		
8.1.1	$\frac{OC}{CD} = \frac{3}{2} = \frac{3r}{2r}$ $AC = CB = 4\sqrt{2}$ cm ... (line from centre $\perp$ chord) In $\triangle AOC$: $r^2 = \left(\frac{3}{5}r\right)^2 + (4\sqrt{2})^2$... Pythagoras $\frac{16}{25}r^2 = 32$ $r^2 = \frac{32}{1} \times \frac{25}{16} = 50 \text{ cm}^2$ $r = 5\sqrt{2}$ cm	A✓ OC and CD in terms of r. A✓ S/R A✓ Pythagoras (S/R) CA✓ Simplifying CA✓ Answer	(5)
8.1.2	$\hat{AOD} = 54^\circ$ (angle at the centre $2 \times$ angle at the circum)	A✓ S A✓ R	(2)



8.2.1	(Exterior angle of cyclic quad = int. opp. A)	S ✓✓	(2)
8.2.2			
a)	$\hat{P}$ $\widehat{QTS}$ $\hat{S}_1$	S✓ S✓ S✓	(3)
b)	$\widehat{QRS} = 120^\circ \dots$ [Opposite angles of cyclic quad.]	S✓ R✓	(2)
c)	$\widehat{QRS} + \hat{S}_1 = 120^\circ + 60^\circ = 180^\circ$ PS QR (Co-Interior angles are supplementary)	S✓ R✓	(2)
d)	$\hat{Q}_2 = 90^\circ \dots$ (Corresponding Angles ; PS QR) TR is a diameter of the circle. (Conv. Angle in the semi -circle) OR $\hat{S}_1 = 60^\circ \dots$ given $\hat{Q}_1 = 30^\circ \dots$ given $\hat{Q}_1 + \hat{Q}_2 + \hat{S}_1 = 180^\circ$ opp $\angle$'s of a cyclic quad $\therefore \hat{Q}_2 = 90^\circ$ $\therefore$ TR is a diameter ($\angle$'s subt by 90°) Conv $\angle$'s on semi circle)	S/R✓ R✓	(2)
			[18]

QUESTION 9

9.1	Proof: $\frac{\text{Area } \triangle ADE}{\text{Area } \triangle DBE} = \frac{\frac{1}{2} AD \times h_2}{\frac{1}{2} DB \times h_2} = \frac{AD}{DB}$ (Common vertex E, same height h_2) $\frac{\text{Area } \triangle AED}{\text{Area } \triangle DBE} = \frac{\frac{1}{2} AE \times h_1}{\frac{1}{2} EC \times h_1} = \frac{AE}{EC}$ (Common vertex D, same height h_1) $\text{Area } \triangle DBE = \text{Area } \triangle ECD$ (Common base DE, same height, $DE \parallel BC$) $\frac{\text{Area } \triangle ADE}{\text{Area } \triangle DBE} = \frac{\text{Area } \triangle AED}{\text{Area } \triangle ECD}$ $\therefore \frac{AD}{DB} = \frac{AE}{EC}$ Area of $\triangle ADE$ is common and $\text{Area } \triangle DBE = \text{Area } \triangle ECD$	S✓ Construction ✓S✓R S/R✓ ✓S✓R (No Marks if no construction indicated in drawing or words)	(6)
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9.2		
9.2.1	In Δ's ABC and EBA 1) $\hat{B} = \hat{B}$ [Common] 2) $\hat{A}_1 = \hat{E}_2$... [Tangent – Chord Theorem] 3) $\hat{C}_2 = \hat{E}\hat{A}B$ [Remaining Angles of Δ's] $\Delta ABC \parallel\parallel \Delta EBA$...[AAA]	S/R✓ S✓R✓ R✓ (4)
9.2.2	$\Delta ABC \parallel\parallel \Delta EBA$ $\frac{AB}{EB} = \frac{BC}{AB} = \frac{AC}{EA}$ similar triangles $\frac{5}{2r + \frac{2r}{3}} = \frac{\frac{2r}{3}}{5}$ $\frac{2r}{3} \left(2r + \frac{2r}{3} \right) = 25$ $\frac{4r^2}{3} + \frac{4r^2}{9} = 25$ $\frac{16r^2}{9} = 25$ $r^2 = 25 \times \frac{9}{16}$ $r = \sqrt{25 \times \frac{9}{16}} = \frac{15}{4} \text{ metres}$	S/R✓ S✓Substitution S✓Multiplication S✓Answer (4)
9.2.3	Let $AH = 5a$ and $HD = 7a$ $\frac{AF}{FE} = \frac{AH}{HD} = \frac{5a}{7a} = \frac{5}{7} \dots\dots [\text{Prop. Theorem; FH } \text{ ED}]$	✓S ✓R (2)

9.2.4	$\Delta AFH = \frac{5}{12} \Delta AHE \dots [\text{Common Vertex; Equal Heights}]$ $\Delta AFH = \frac{5}{12} \left(\frac{5}{12} \Delta AED \right) \dots [\text{Common Vertex; Equal Heights}]$ $\frac{\Delta AFH}{\Delta AED} = \frac{25}{144}$  OR $\frac{\text{Area } \Delta AFH}{\text{Area } \Delta AED} = \frac{\frac{1}{2} AF \cdot AH \sin \hat{A}_3}{\frac{1}{2} AE \cdot AD \sin A_3}$ $\therefore \left(\frac{AF}{AE} \right)^2 \text{ since } \frac{AF}{FE} = \frac{AH}{AD}$ $= \left(\frac{5a}{12a} \right)^2$ $= \frac{25}{144}$	✓S ✓R ✓S/R ✓S	(4)
9.2.5	Let $OH = x$ Then $HC = r - x = \frac{15}{4} - x$ metres $\frac{AF}{FE} = \frac{BH}{HE} \dots [\text{Prop. Theorem; FH} \parallel \text{AB}]$ $\frac{5}{7} = \frac{\frac{15}{4} - x}{\frac{15}{4} + x}$ $5 \left(\frac{15}{4} + x \right) = 7 \left(\frac{15}{4} - x \right)$ $\left(\frac{75}{4} + 5x \right) = \left(\frac{105}{4} - 7x \right)$ $75 + 20x = 105 - 28x$ $48x = 30$ $x = \frac{30}{48} = \frac{5}{8} \text{ metres}$	✓S/R ✓S ✓S 	(3)
			[22]

TOTAL MARKS: 150

THIS PAPER SHOULD BE MARKED OUT OF 139