



**JULY EXAMINATION 2015**

**MATHEMATICS GRADE 12**

**PAPER 2; LO 3 & LO 4**

Time: 3 hours

Total: 150

**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY**

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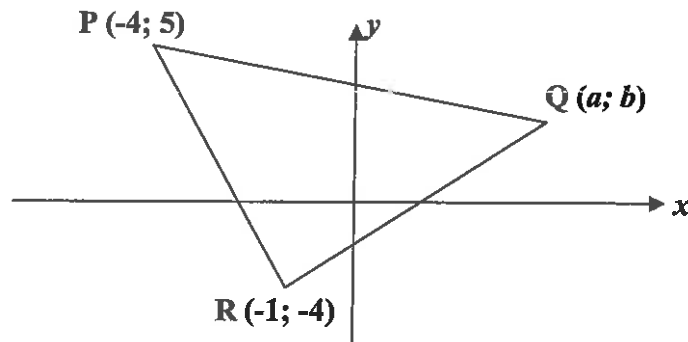
1. This question paper consists of 8 pages, graph paper, and a separate formula sheet. Please check that your paper is complete.
2. Read the questions carefully.
3. Answer all the questions.
4. Number your answers exactly as the questions are numbered.
5. You may use an approved non-programmable and non-graphical calculator, unless otherwise stated.
6. Answers must be rounded off to the first decimal place, unless otherwise stated.
7. All the necessary working details must be clearly shown.
8. It is in your own interest to write legibly and to present your work neatly.

Page 1 of 8

SECTION A

QUESTION 1:

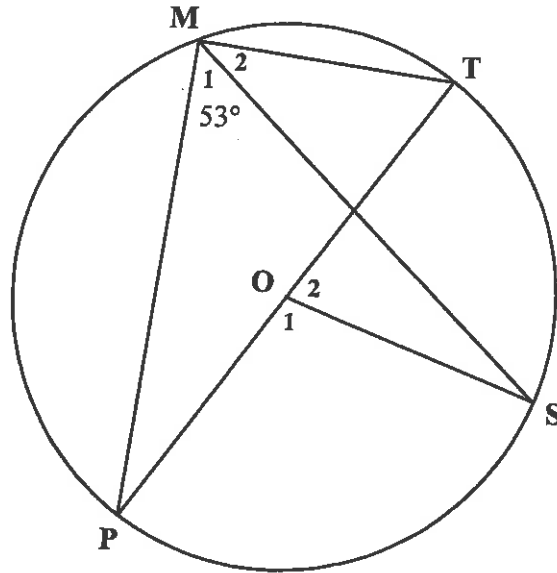
- a) Determine the equation of a straight line in a Cartesian plane intercepting the  $x$ -axis at 3 and the  $y$ -axis at -4. (3)
- b) In the diagram below P (-4; 5), Q ( $a$ ;  $b$ ) and R (-1; -4) are the vertices of a triangle and M (1; 0) is the midpoint of QR.



- 1) Calculate the values of  $a$  and  $b$  (4)
- 2) Determine the equation of the perpendicular bisector of QR (4)
- c) The straight line with equation  $px + qy + 2 = 0$  makes an angle of  $135^\circ$  with the positive  $x$ -axis and goes through the point (2; -1). Calculate the values of  $p$  and  $q$ . (5)
- d) A (-2; 1), B (1; -3) and C (-3;  $a$ ) are points in the Cartesian plane. Calculate the value of  $a$  if the length of the line segment joining C and the midpoint of AB is equal to 5 units. (to 1 decimal place) (6)
- [22]**

**QUESTION 2**

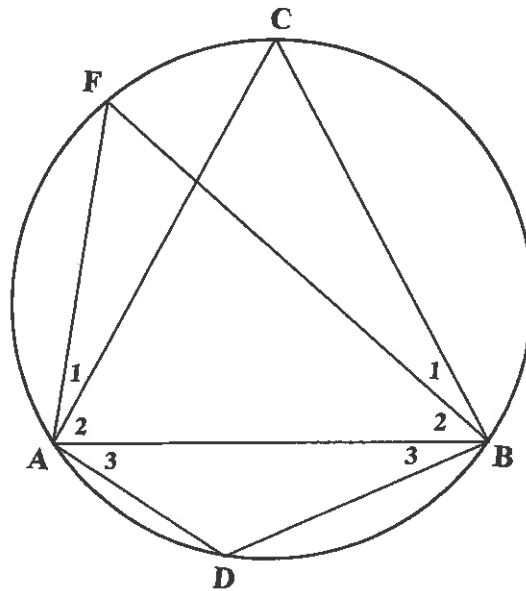
- a) In the diagram below, M, P, S and T are points on a circle with centre O. PT is a diameter. MP, MT, MS and OS are drawn.  $\hat{M}_1 = 53^\circ$



Determine, with reasons, the size of  $\hat{O}_2$

- b) In the diagram below, A, D, B, C and F are points on a circle.  $AB = BC$ . (4)

$\hat{A}BC = 50^\circ$



Calculate, with reasons, the size of:

1)  $\hat{F}$

(4)

2)  $\hat{D}$

(2)

[10]

**QUESTION 3:**

a) If  $\cos 65^\circ = a$ , express the following in terms of  $a$ .

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

2)  $\sin 410^\circ$  (3)

3)  $\cos 130^\circ$  (4)

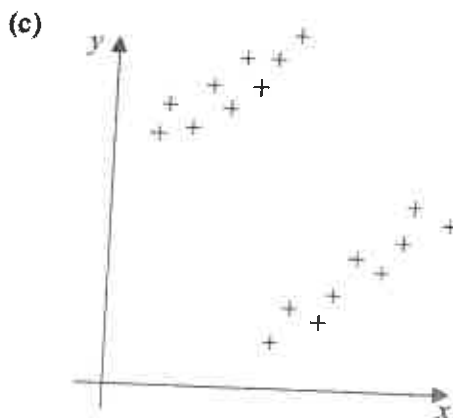
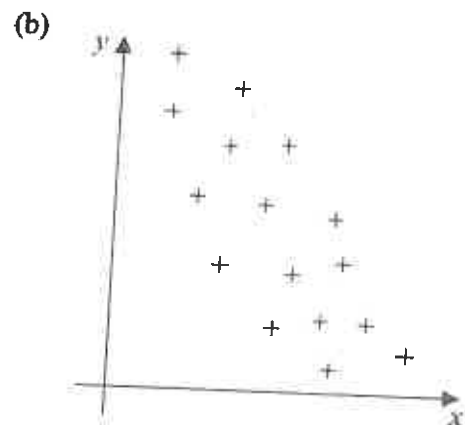
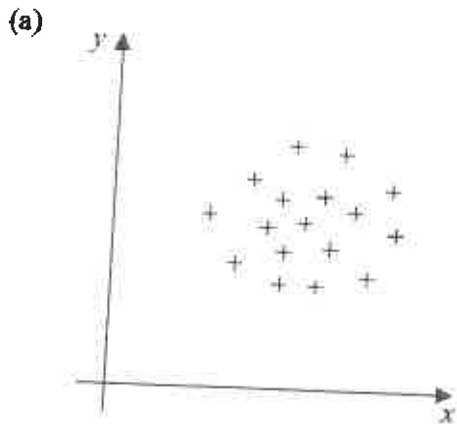
b) Simplify without the use of a calculator.  $\frac{\sin(90^\circ - x)\sin(180^\circ - x)\tan(x - 360^\circ)}{\cos(90^\circ - x)\cos 240^\circ \cdot \tan 225^\circ}$  (6)

c) Given that  $f(\theta) = \frac{1}{4}(3 + \cos 4\theta)$ . Find the greatest and least possible values of  $f(\theta)$ . (3)

[18]

**QUESTION 4:**

a) Estimate, without undertaking any calculation, the value of the correlation coefficient between the variables  $x$  and  $y$  in each of the scatter diagrams below.



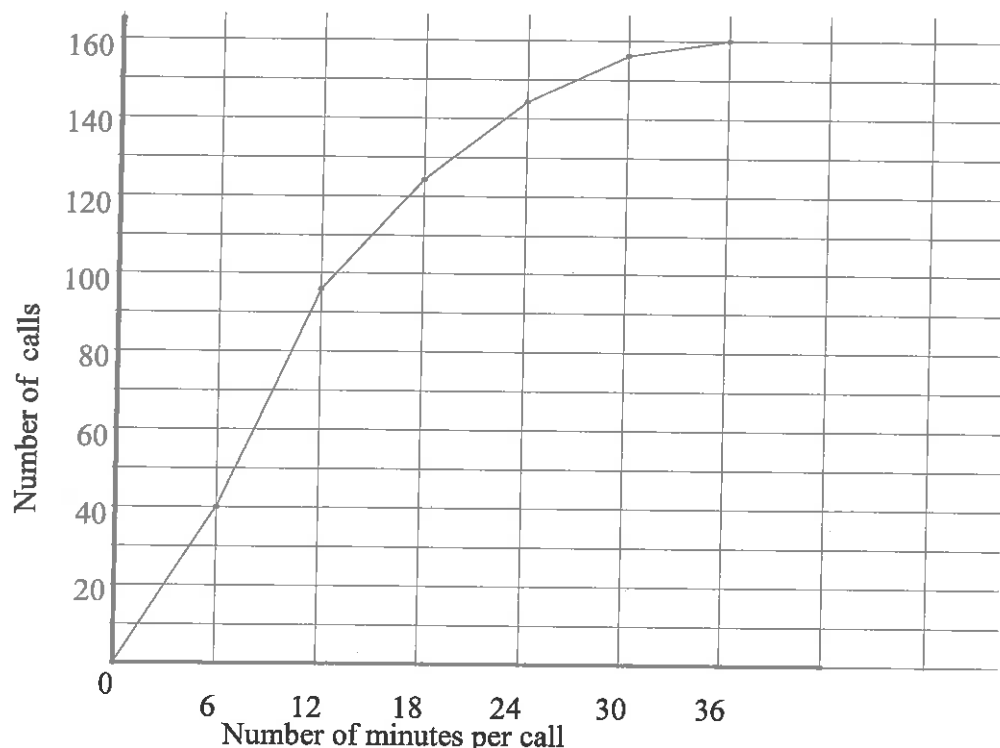
(6)

- b) A mathematics teacher recorded the length of time  $y$  minutes, taken to travel to school when leaving home  $x$  minutes after 7am on seven selected mornings. The results are as follows:

$x$	0	10	20	30	40	50	60
$y$	16	27	28	39	39	48	51

- 1) Use your calculator to evaluate the correlation coefficient  $r$ , for this data to 4 decimal places. (2)
  - 2) Determine the equation of the least squares regression line of  $y$  on  $x$  to 4 decimal places. (4)
  - 3) The mathematics teacher needs to arrive at school no later than 8.40am. The number of minutes by which the mathematics teacher arrives early at school, when leaving home  $x$  minutes after 7am, is denoted by  $z$ .
    - i) Deduce that  $z = (100 - a) - (1 + b)x$ . (3)
    - ii) Hence estimate, to the nearest minute, the latest time that the mathematics teacher can leave home without then arriving late at school. (3)
- c) Use the cumulative frequency graph to answer the questions below.

**Lengths of Phone Calls from a home during the first 6 months.**



- 1) How many phone calls were made during the 6 month period? (1)
  - 2) Calculate the mean length and standard deviation of a call. (6)
- [25]

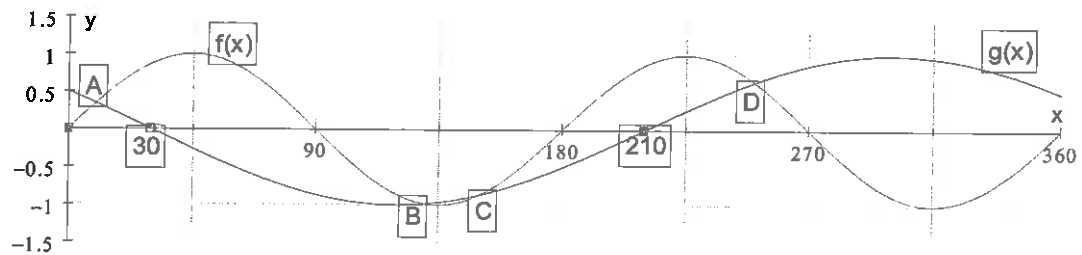
## SECTION B

### QUESTION 5:

- a)  $x^2 + 4x + y^2 + 2y - 8 = 0$  is the equation of a circle with centre M in a Cartesian plane.
- 1) Prove that the circle passes through the point N(1; -3) (2)
  - 2) Calculate the centre and radius of the equation. (3)
  - 3) Calculate the equation of the tangent to the circle at N. (4)
- b) If  $y = 2x + 3$  is a tangent to the circle  $x^2 + y^2 = r^2$ , find  $r$ . (5)
- c) Determine the equation of the bisector of the acute angle between the lines  $2x + y - 4 = 0$  and  $x - y - 3 = 0$  (6)
- [20]

### QUESTION 6:

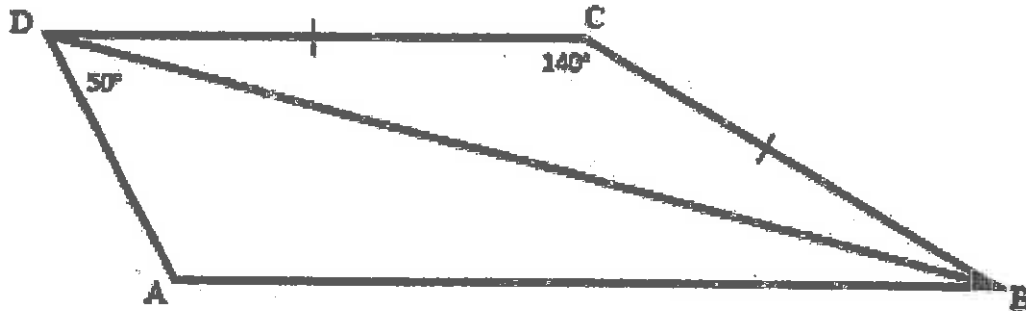
- a) Prove the following identity:  $\frac{\sin(2\beta + \beta) - \sin(2\beta - \beta)}{(\cos \beta - \sin \beta)(\cos \beta + \sin \beta)} = 2 \sin \beta$  (5)
- b) Given  $g(x) = \cos(x - b)$  and  $f(x) = \sin(ax)$



- 1) Calculate the values of  $a$  and  $b$  (3)
  - 2) Determine the  $x$ - coordinates of A, B C and D (6)
  - 3) Using the graph deduce for which values of  $x$  is  $2 \sin x \cdot \cos x > \frac{1}{2} \cos x - \frac{\sqrt{3}}{2} \sin x$  in the third quadrant (2)
- [16]

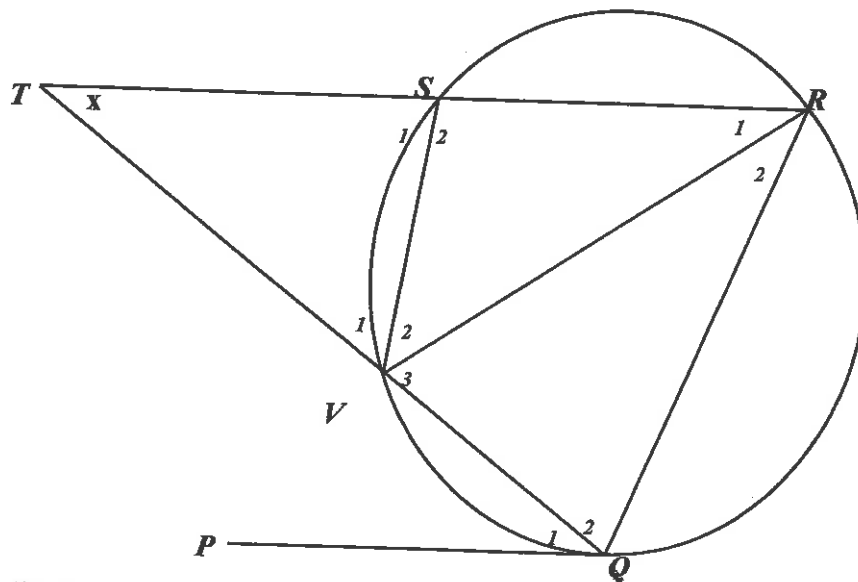
**QUESTION 7:**

- a) ABCD is a trapezium with  $BC = CD$  and  $AB \parallel CD$ . Furthermore  $\hat{ADB} = 50^\circ$  and  $\hat{BCD} = 140^\circ$ . BD is drawn.



Prove that C is the centre of the circle passing through A, B and D (i.e the circumscribed circle of  $\triangle ABD$ ). (6)

- b) In the diagram below, PQ is a tangent to the circle at Q. TSR is a line which cuts the circle at S such that  $TR \parallel PQ$ . QV is produced to meet RST at T.



- 1) State, with reasons, two other angles each equal to  $x$ . (4)
  - 2) Prove that  $\triangle TSV \parallel \triangle RQV$  (3)
  - 3) Prove that  $TS \cdot TR = TV \cdot TQ$  by first proving two triangles similar. (5)
- [18]

