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**CRAWFORD INTERNATIONAL PRELIMINARY EXAMINATION
SEPTEMBER 2024
MATHEMATICS: PAPER II**

Time: 3 hours

150 marks

NAME OF CANDIDATE:	
NAME OF EDUCATOR:	

MARKER TO ENTER MARKS:

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	TOTAL
8	14	15	6	13	10	10	27	16	12	19	150

INSTRUCTIONS

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 25 pages and an Information Sheet of 2 pages. Please check that your question paper is complete.
2. Read all the questions carefully. **Answer ALL the questions on the question paper and hand it in at the end of the session.**
3. Three blank pages (pages 23 to 25) are included at the end of the paper. If you run out of space for a question, use these pages. **Clearly indicate the question number of your answer should you use this extra space.**
4. Diagrams are not necessarily drawn to scale.
5. Ensure that your calculator is set to **DEGREE MODE**.
6. You may use an approved non-programmable and non-graphical calculator, unless otherwise stated.
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. It is in your own interest to write legibly and present your work neatly.
9. Round off to **one decimal place** unless otherwise stated.

QUESTION 1

Patients were treated for a viral infection at a local hospital during the month of January. The dates and number of patients are recorded in the table below.

Dates in the month of January	3	5	8	12	15	19	22	26
Number of patients treated	270	275	376	420	602	684	800	820

Round your answers off to 2 decimal places:

- (a) Determine the equation of the least squares regression line. (3)
- (b) Calculate the correlation coefficient for this data set. (1)
- (c) Estimate on which day in January one can expect that 618 patients will be treated. Show your calculation to justify your conclusion. (2)
- (d) The medical staff predict that 995 patients will be treated on 31 January. Discuss the validity of this prediction. (2)

[8]

QUESTION 2

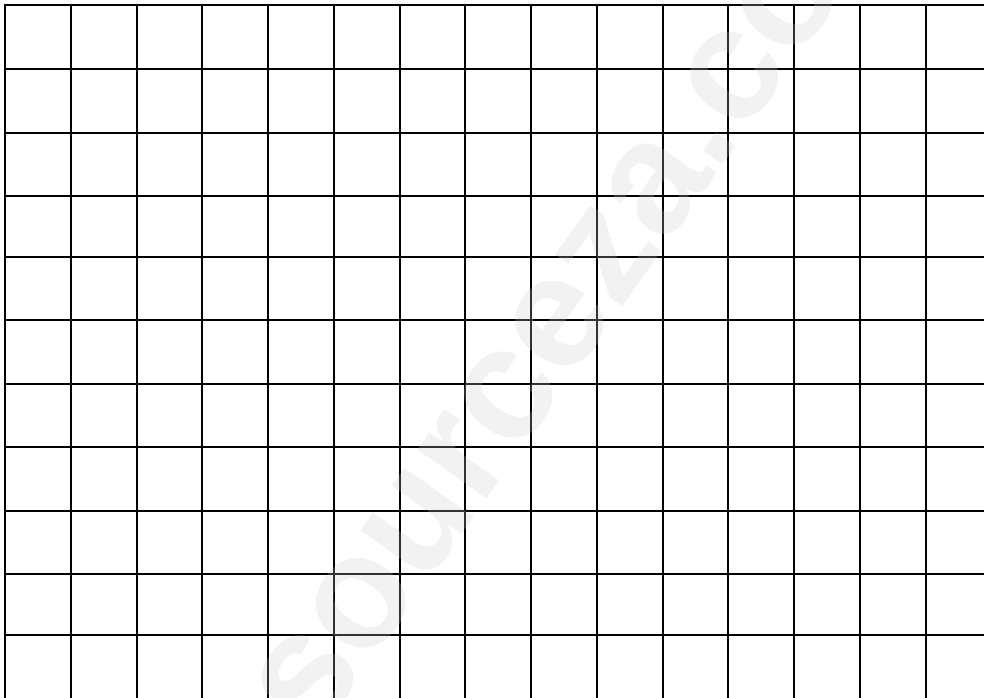
The time taken, in minutes, for a group of students to complete their mathematics homework, is summarised in the grouped frequency table.

Time, t (minutes)	Frequency
$5 \leq t < 15$	3
$15 \leq t < 25$	f
$25 \leq t < 35$	7
$35 \leq t < 45$	6
$45 \leq t < 55$	4

- (a) The estimated mean of the grouped data was 30 minutes. (3)
Calculate the value of the missing frequency f , and show that $f = 8$.
- (b) Calculate the estimated standard deviation of the given data. (2)
- (c) Comment on the meaning of a standard deviation and explain how it relates to the data presented above. (2)

- (d) Determine the estimated number of values that lie above one standard deviation of the mean. Show your working. (3)

- (e) On the grid provided below, draw an ogive which represents the data above. (4)



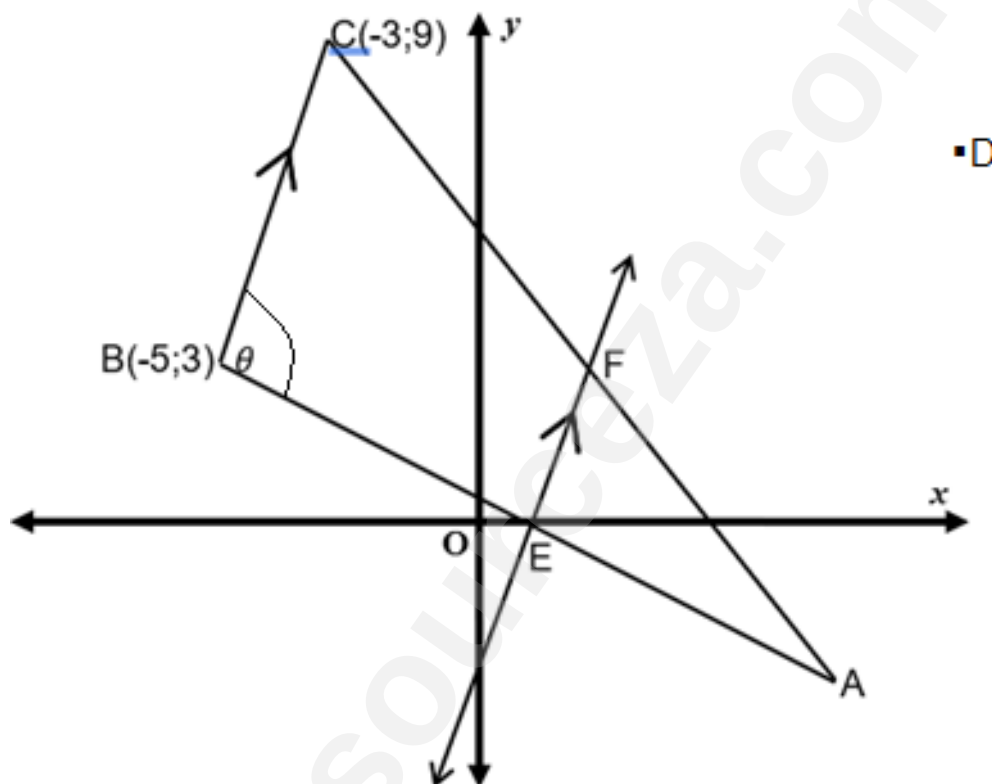
[14]

QUESTION 3

Refer to the diagram below:

- $EF \parallel BC$.
- the vertices of $\triangle ABC$ are A, B $(-5; 3)$ and C $(-3; 9)$.
- The x-intercept of line AB at point E is $(1; 0)$.
- $\hat{ABC} = \theta$

This diagram is NOT drawn to scale.



(a) Show that the equation of EF is $y = 3x - 3$.

(3)

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- (b) Calculate the value of θ . (5)
- (c) If $AE:BE$ is $1:1$, determine the coordinates of A. (2)
- (d) Calculate the length of FE. (3)
- (e) Determine the coordinates of D if ABCD is a parallelogram. (2)

[15]

QUESTION 4

Simplify the following trigonometric expression as far as possible:

$$\frac{\sin(2\theta)}{\tan(\theta)} - 2\cos(\theta + 90^\circ) \cdot \sin(360^\circ + \theta) \quad (6)$$

[6]**QUESTION 5**

- (a) Showing all calculations, determine the general solution for the equation

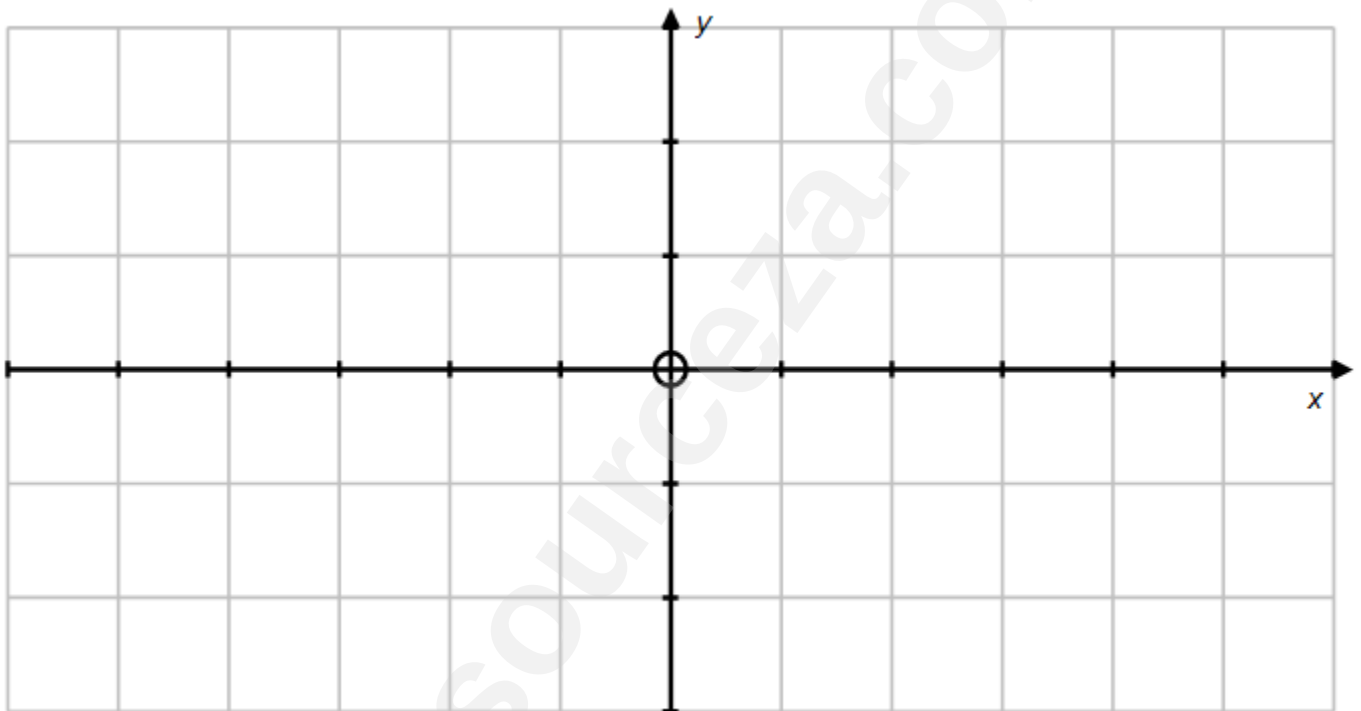
$$\sin 2x = -3\cos x. \quad (6)$$

(b) (1) On the same axes provided below, sketch the graphs of

$$f(x) = \sin 2x \quad \text{and} \quad g(x) = -2 \cos x \quad \text{for} \quad -180^\circ \leq x \leq 180^\circ.$$

Show all intercepts with the axes and coordinates of the turning points.

(4)



(2) Use your graphs of f and g to determine the value(s) of x for which

$$\sin 2x + 2 \cos x > 0 \quad \text{for} \quad -180^\circ \leq x \leq 180^\circ.$$

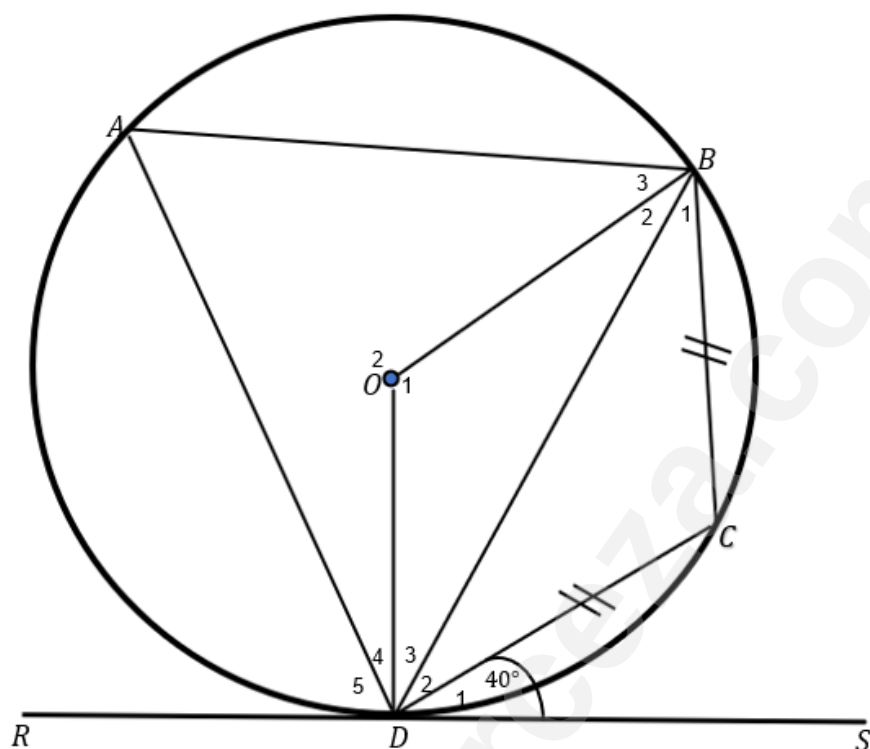
(3)

[13]

QUESTION 6

In the figure below, RDS is a tangent to the circle centre O at D.

$BC = DC$ and $\widehat{CDS} = 40^\circ$.



Determine the size of each of the following angles. State reasons in each case.

(a) $\widehat{D}_2$ (2)

(b) $\widehat{A}$ (3)

(c) $\hat{\theta}_1$ (2)

(d) $\hat{D}_3$ (3)

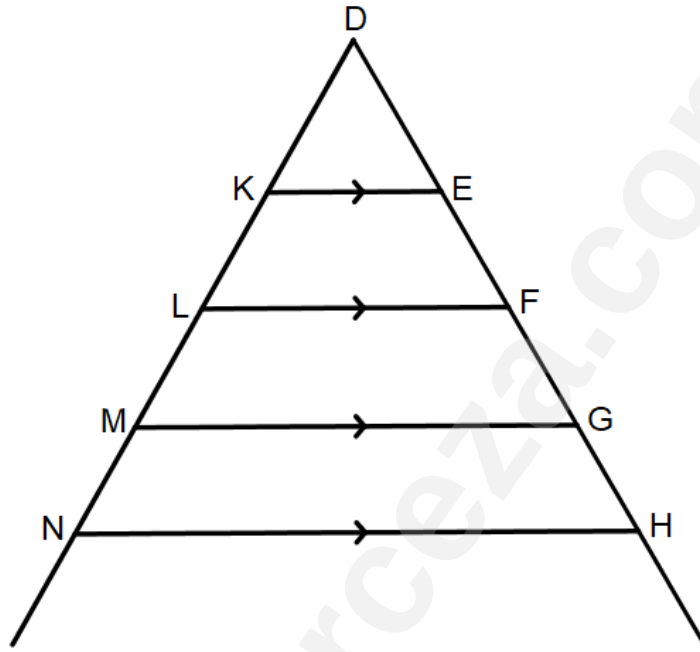
[10]

QUESTION 7

In the diagram below, $KE \parallel LF \parallel MG \parallel NH$ and so on.

It is also given that $DK:KL = 2:1$, $DL:LM = 2:1$, $DM:MN = 2:1$ and so on.

$KE = 2$ units



- (a) Calculate the lengths of LF, MG and NH. Show your calculations.
You do NOT have to provide reasons.

(6)

- (b) If this pattern continues, calculate the length of the tenth parallel line.

(4)

[10]

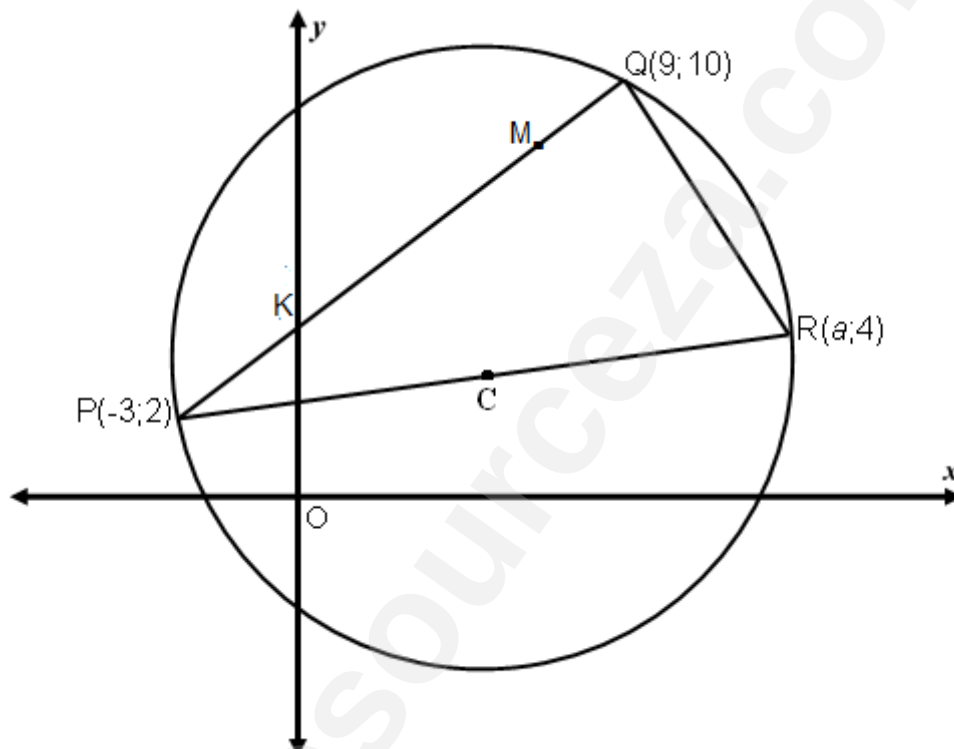
TOTAL SECTION A: 76 MARKS

SECTION B

QUESTION 8

The points $P(-3; 2)$, $Q(9; 10)$ and $R(a; 4)$ lie on the circumference of the circle, as shown in the figure below.

- PR is a diameter of the circle with centre C .
- M is a point on PQ so that $PM : PQ$ is $3 : 4$.
- K is a point on PQ and PQ cuts the y -axis at K .



(a) Show all calculations to prove that $a = 13$.

(4)

(b) Determine the equation of the circle. (6)

(c) Calculate the coordinates of M. (4)

(d) Calculate the size of $\hat{PKO}$. (3)

- (e) Consider a second circle with equation $x^2 - 28x + y^2 - 14y + 241 = 0$.

Determine the coordinates of the centre and the radius.

(5)

- (f) Prove that the two circles intersect each other.

(5)

[27]

QUESTION 9

- (a) Determine the values of a and b ($a, b > 0$) if $a \sin x + b$ has a maximum value of 5 and a minimum value of -1 (4)

- (b) A and B are acute angles with $\cos(A + B) = 0,8$ and $\cos(A - B) = -0,2$. Determine the value of $\tan A \tan B$, without the use of a calculator. (5)

(c) (1) Prove that $\frac{\sin 3A}{\sin A} = 4\cos^2 A - 1$ (5)

(2) Hence, or otherwise, determine the maximum and minimum value of

$\frac{\sin 3A}{\sin A}$ (2)

[16]

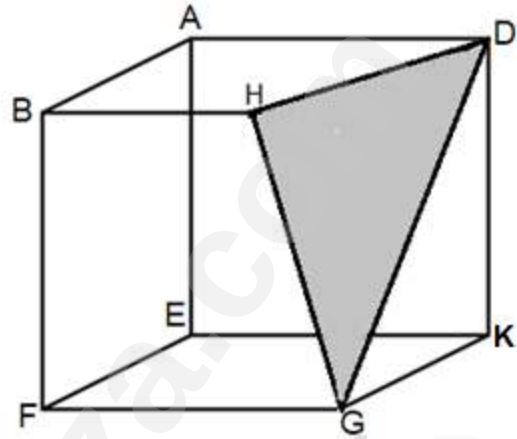
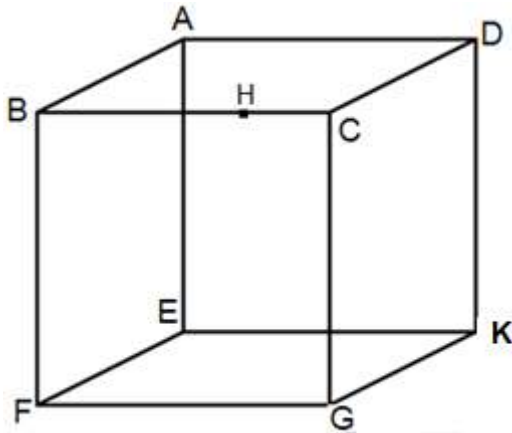
QUESTION 10

The diagram below represents a cube with vertices A, B, C, D, E, F, G and K.

H divides the side BC in the ratio 3 : 1.

Let $HC = x$.

A corner section with base HDG is cut out of the cube.



Refer to the diagram and answer the following questions. Show all calculations:

- (a) Determine the lengths of HG, HD and DG in terms of x and hence prove that $\hat{D}HG = 86,6^\circ$.

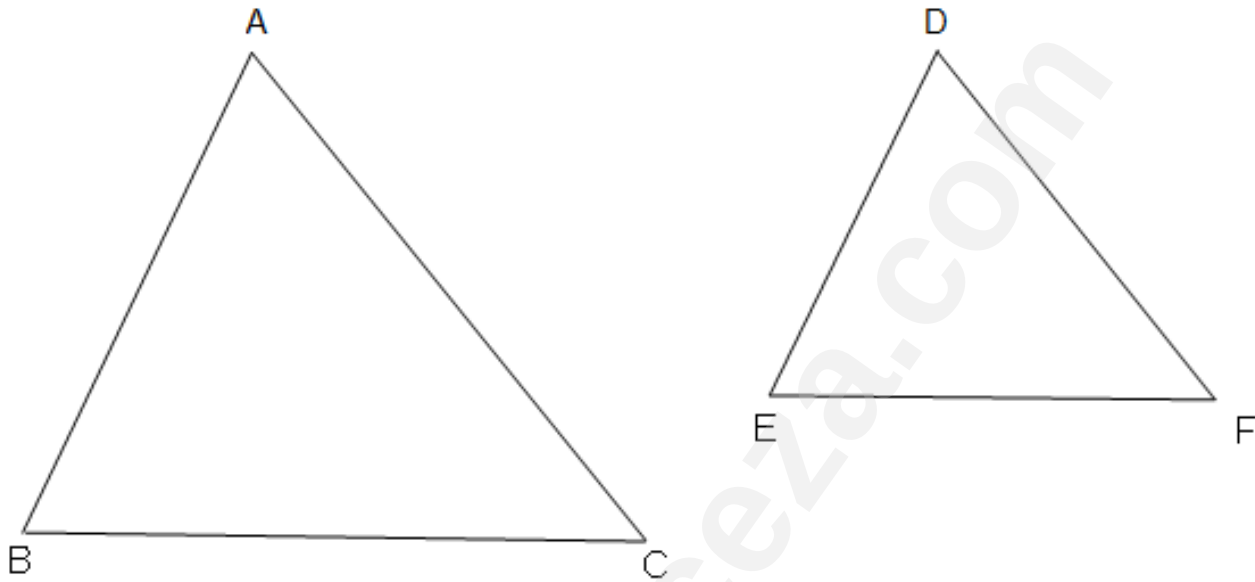
(8)

- (b) If the area of $\triangle HDG = 76,34 \text{ units}^2$, calculate the side lengths of the cube. Round your answer off to the nearest unit.

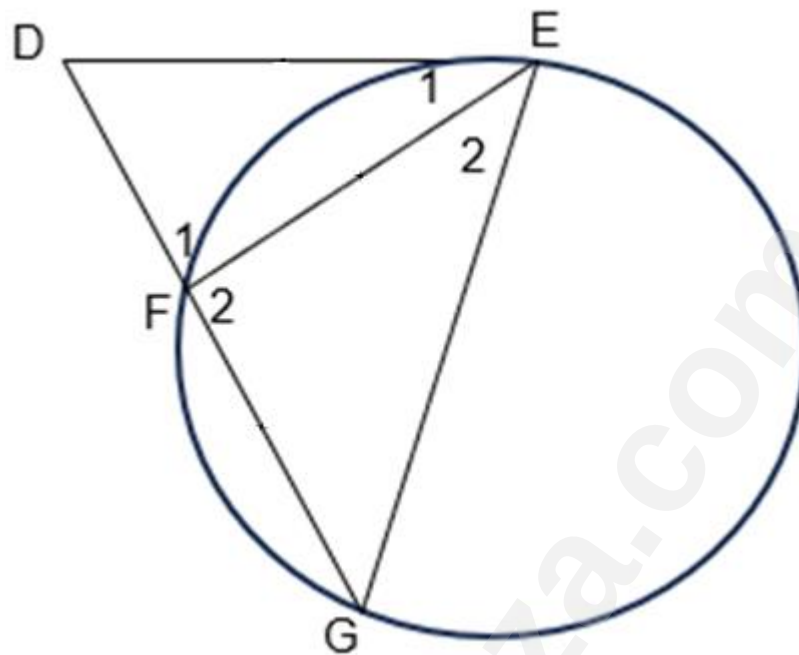
(4)

QUESTION 11

- (a) Using the given diagrams below, prove the theorem which states if two triangles are equiangular, then the corresponding sides are in proportion. (6)



- (b) In the figure DE is a tangent and DFG is a secant.



- (1) Prove that $DE^2 = DF.DG$

(4)

- (2) If it is further given that $DE = EF = FG$ and if $\frac{DF}{DE} = X$, prove that

$$1 = x^2 + x$$

(5)

(3) Prove that $\cos D = \frac{1}{2}x$

(4)

[19]

ADDITIONAL SPACE

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

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ADDITIONAL SPACE

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