



華僑中學

**Hwa Chong Institution
Secondary 3 Examination (Practice A)**

CANDIDATE
NAME

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CLASS

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REGISTER
NUMBER

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Mathematics

2 hours

Additional materials:

Writing papers

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work that you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Answer **all** questions.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

The use of an approved scientific calculator is expected, where appropriate.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

You are reminded of the need for clear presentation in your answers.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 80.

This document consists of **6** printed pages.

Mathematical Formulae

Compound interest

$$\text{Total amount} = P \left(1 + \frac{r}{100} \right)^n$$

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Surface area of a sphere} = 4\pi r^2$$

$$\text{Volume of a cone} = \frac{1}{3} \pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3} \pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2} ab \sin C$$

$$\text{Arc Length} = r\theta, \text{ where } \theta \text{ is in radians}$$

$$\text{Sector area} = \frac{1}{2} r^2 \theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2}$$

- 1 Given that $x = 8a\sqrt{bx^2 + 1}$ and $a < 0$,
- (i) state the sign of x , [1]
- (ii) express x in terms of a and b . [3]
- 2 (a) Factorise $9a^2 - 12ab + 4b^2 - 6a + 4b$ completely. [2]
- (b) Express $\frac{1}{3(x-2)} - \frac{1}{2(x+2)} - \frac{3}{(x-2)^2}$ as a single fraction in its simplest form. [3]
- (c) Given that $(a^3 + b^3)^2 = (a^2 + b^2)^3$ and $ab \neq 0$, find the value of $\frac{a^2 + b^2}{ab}$. [3]
- 3 Given that $\frac{\left(9^{\frac{2}{3}}x^{\frac{2}{3}}\right)^9}{\left(27^{\frac{8}{3}}x^{\frac{4}{3}}\right)^6} = \left(\frac{1}{81}x^{\frac{1}{m}}\right)^k$ for all values of x , find the value of k and m . [4]
- 4 Find the largest integer x which satisfy the inequality $-x - 10 < 3x - 2 \leq 5 - \frac{3x - 4}{3}$. [4]
- 5 Find coordinates of the points of intersection of the line $x - 2y = 3$ and the curve $3x^2 - xy + y^2 = 5$. [4]
- 6 (a) It is given that matrices $\mathbf{P} = \begin{pmatrix} 1 & x \\ y & 0 \end{pmatrix}$ and $\mathbf{Q} = \begin{pmatrix} 1 & 0 \\ 4 + 2y & 1 \end{pmatrix}$.
- Find $\mathbf{Q} - \mathbf{P}$ and $\mathbf{P}^2$ in terms of x and y . [2]
- (b) A company manufactures 3 styles of TV consoles. The 3 styles require different amount of wood and duration for construction. The table below shows the amount of wood and the time required to produce one TV console of each style.

Style	Amount of wood required (m^2)	Construction duration (hr)
I	10	24
II	12	20
III	8	18

Each style comes in 2 grades, A and B , which uses different types of wood and labor cost per hour. The table below shows the cost of wood per square metre and the cost of labor per hour of each grade.

Grade	Cost of wood per m^2 (\$)	Labor cost per hour (\$)
A	40	60
B	30	50

- (a) Write down two matrices such that their product gives the cost of manufacturing the 3 styles of TV consoles by their grades.

Find this product.

[3]

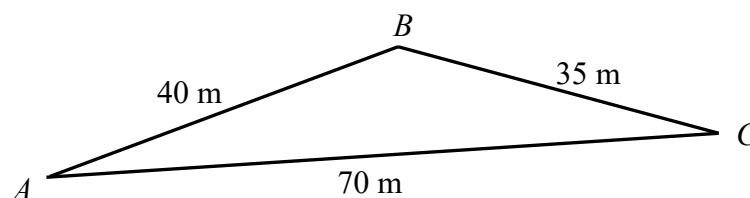
The company receives an order for 6 grade A and 10 grade B TV consoles of each style.

- (b) By using the product found in (i) and a further matrix, obtain a final matrix which gives the total cost of manufacturing 6 grade A and 10 grade B TV consoles of each different style.

[2]

- 7 The diagram shows three points, A , B and C on a horizontal plot of land.

It is given that $AB = 40$ m, $BC = 35$ m and $AC = 70$ m.



- (a) Calculate

- (i) $\angle ABC$ in degrees,

[2]

- (ii) the area of triangle ABC in m^2 .

[2]

There are two poles stationed vertically at A and B . The height of the pole at B is 5 m.

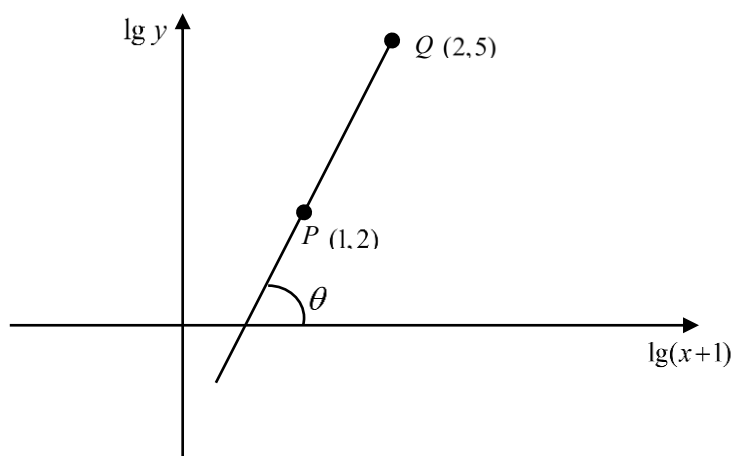
Let the top of the pole at A and B be P and Q respectively.

- (b) Given that the angle of depression of Q from P is 3.6° , find, to one decimal place, the height of the pole at A . [3]
- (c) A drone flies at constant height of 2 m above ground level from A to C in a straight path. Find the greatest angle of elevation of Q from the drone. [3]
- (d) Given Z is a point along AC such that $AZ : ZC = 1 : 2$ and the drone is allowed to fly strictly inside triangle ABC in random motion, find the probability that the drone is located in triangle BZC at any instant. [2]

8 The equation of a circle, C on a Cartesian plane is $x^2 + y^2 - 4x - 6y - 23 = 0$.

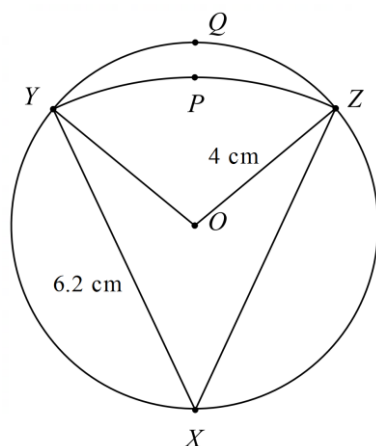
- (i) Find the coordinates of the centre of C and its radius. [3]
- (ii) Without sketching any diagram, show that C touches the line $x = -4$. [2]
- (iii) The circle, C moves along a straight line on the same plane at a bearing of 045° with the North as the y -axis. It covers a distance of $\sqrt{50}$ units with its size and shape constant during the journey. Find the general form of the equation of the circle at its destination. [4]

9 The variables x and y are related such that when $\lg y$ is plotted against $\lg(x+1)$, a straight line graph passing through $P(1,2)$ and $Q(2,5)$ is obtained.



- (i) Find an expression of y in terms of x . [4]
- (ii) Find the value of θ which is the acute angle in radian formed by the straight line and the horizontal axis. [2]

- 10 In the diagram, the points X , Y and Z lie on the circumference of a circle with centre O and radius 4 cm. YPZ is an arc of another circle with centre at X .



Given that $XY = 6.2$ cm, calculate

- (i) $\angle OXY$ in radian, [2]
- (ii) the area of sector XYZ , [2]
- (iii) the arc length of YQZ . [3]

- 11 **Solutions to this question by accurate drawing will not be accepted.**

PQR is a triangle with point $P(-9, 9)$ and point $Q(-1, -3)$. The point R lies on the perpendicular bisector of PQ and the equation of QR is $y - 8x - 5 = 0$. Find

- (i) the equation of perpendicular bisector of PQ , [2]
- (ii) the coordinates of R . [2]

The point S is such that $PRQS$ is a rhombus.

- (iii) Find the coordinates of S . [2]
- (iv) Given that the equation of line l is $33y - 22x - 867 = 0$, show how you can tell that this line l does not intersect with the perpendicular bisector of PQ . [2]

- 12 (a) Express $\frac{4x}{2x+1}$ in the form $a + \frac{b}{2x+1}$, where a and b are integers. [2]
- (b) Hence, sketch the graph of $y = \frac{4x}{2x+1}$, indicate clearly the x -intercepts, y -intercept and asymptotes if any. [3]
- (c) The graph of $y = h(x)$ undergoes two successive transformations
- I A translation of 4 units in the positive x -direction,
 - II A scaling with a scale factor of 2, parallel the y -axis.

The resulting graph is $y = 6 \lg(x - 2)$. Find $h(x)$. [2]

End of Paper