INMIN SECONDARY

CANDIDATE NAME

MARK SCHEME

CLASS

INDEX NUMBER

MATHEMATICS (SYLLABUS A)

Paper 2

Secondary 4 Normal (Academic)

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces at the top of this page. Write in dark blue or black pen. You may use an HB pencil for any diagrams or graphs. Do not use staples, paper clips, glue or correction fluid.

Section A

Answer all questions.

Section B

Errors

Accuracy

Brackets

Geometry

Presentation

Answer one question.

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

If working is needed for any question it must be shown with the answer. Omission of essential working will result in loss of marks. The total of the marks for this paper is 70.

Qn No.

The use of an approved scientific calculator is expected, where appropriate. If the degree of accuracy is not specified in the question and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place. For π , use either your calculator value or 3.142.

Errors

Marks Awarded

Marks Penalised Total Marks for PRWC

Simplification

Units

Parent's/Guardian's Signature:

Qn No.

This document consists of **20** printed pages and **2** blank pages.



4045/02

1 August 2024

2 hours

XINMIN SECONDARY SCHOOL 行民,中学

SEKOLAH MENENGAH XINMIN **Preliminary Examination 2024**

Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

Arc length = $r\theta$, where θ is in radians

Sector area =
$$\frac{1}{2}r^2\theta$$
, where θ 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

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

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

Section A (62 marks)

Answer **all** the questions in this section.

1 The stem-and-leaf diagram shows the temperature, in °C, over 15 days in June in a city.

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Key: 1 | 7 represents 17°C

(a) Find

(i) the range of the temperatures,

(range) $32 - 17 = 15^{\circ}C$ [B1]

Answer°C [1]

(ii) the mean temperature, correct to 1 decimal place,

(mean)
$$\frac{17+19+...+32}{15}$$
 [M1 or $\frac{362}{15}$]
= 24.133°C
= 24.1°C (1dp) [A1]
*Give [A2] If students just write 24.1°C
Answer°C [2]

(iii) the standard deviation of the temperatures. (sd) 4.1611 = 4.16°C (3sf) [B1]

Answer°C [1]

(b) Another day in June has a temperature of 22° C.

Given that this temperature value is to be included in the above diagram, would the mean temperature increase or decrease? Without the use of calculations, explain your answer.

Answer	
the mean temperature of the initial set of 15 days. Therefore adding this will	
cause the new mean temperature to be lower. [B1]	[1]

(a) Written as the product of its prime factors, $8316 = 2^2 \times 3^3 \times 7 \times 11$.

(i) Express 840 as the product of its prime factors.

$$840 = 2^3 \times 3 \times 5 \times 7 \quad [B1]$$

(ii) Find the highest common factor of 8316 and 840.

 $840 = 2^{3} \times 3 \times 5 \times 7$ $8316 = 2^{2} \times 3^{3} \times 7 \times 11$ HCF (8316, 840) = 2² × 3 × 7 = 84 [B1]

(iii) Find the smallest integer value of n such that 840n is a multiple of 8316.

 $n = 3^2 \times 11$ = 99 [B1]

(b) Rearrange
$$q = \frac{7p}{p-2}$$
 to make p the subject.

$$q = \frac{7p}{p-2}$$

$$q(p-2) = 7p \quad [M1]$$

$$pq - 2q = 7p$$

$$pq - 7p = 2q$$

$$p(q-7) = 2q \quad [M1]$$

$$p = \frac{2q}{q-7} \quad [A1]$$

The diagram shows a rectangular garden measuring 13 m by 10 m. The garden is surrounded by a path of uniform width of x m, shown shaded in the diagram. The total area of the path is 84 m².

Garden

13 m

x m

10 m

(a) Write down an equation in x and show that it simplifies to $2x^2 + 23x - 42 = 0$.



(b) Solve the equation
$$2x^2 + 23x - 42 = 0$$
 and find the width of the path.
 $2x^2 + 23x - 42 = 0$
 $x = \frac{-23 \pm \sqrt{(23)^2 - 4(2)(-42)}}{2(2)}$ [M1]
 $x = 1.6027$ or $x = -13.102$
 $= 1.60$ (3sf) $= -13.1$
 \therefore The width of the path is 1.60 m [A1*- with both 1.60 and -13.1 written]
*Do not penalise if students rejected -13.1 due to context.
Answer m [2]



4 Min cycled from her home to a park. The distance-time graph shows her journey.



5 (a) It is given that 6x = 7y. The quantities y and z are in the ratio 9 : 2.

Write the ratio x : y : z in its simplest form.

$$6x = 7y$$

$$\frac{x}{y} = \frac{7}{6}$$

x: y
7: 6 [M1- accept equivalent ratio]
x: y: z
7: 6
9: 2 22
21: 18: 4 [A1]

(b) Simplify
$$\left(\frac{2}{a^6}\right)^{-3}$$
, leaving your answer in positive index form.

$$\begin{pmatrix} \frac{2}{a^6} \\ -3 \end{pmatrix}^{-3} = \left(\frac{a^6}{2}\right)^3 \text{ [M1]} \\ = \frac{a^{18}}{8} \text{ [A1]} \\ = \frac{1}{\left(\frac{8}{a^{18}}\right)} \\ = \frac{a^{18}}{8} \text{ [A1]} \\ = \frac{a^{18}}{$$

(c) $(1.4 \times 10^x) \div (2.5 \times 10^y) = k \times 10^n$, where $1 \le k < 10$.

(i) Find the value of k.

$$(1.4 \times 10^{x}) \div (2.5 \times 10^{y})$$

= $\frac{1.4 \times 10^{x}}{2.5 \times 10^{y}}$
= $0.56 \times 10^{x-y}$
= $5.6 \times 10^{-1} \times 10^{x-y}$
= $5.6 \times 10^{x-y-1}$
 $k = 5.6$ [B1]

(ii) Write an expression for n in terms of x and y.

n = x - y - 1 [B1]

6

(a) Nadia invested some money for five years at 1.2% simple interest per year. At the end of five years, it was worth \$22260.

How much did she invest?

Let the amount invested be \$P (simple interest) $\frac{P \times 1.2 \times 5}{100}$ [M1] = 0.06P (total) P + 0.06P = 22260 [M1- or 22260 - 0.06P = P] 1.06P = 22260 P = $\frac{22260}{1.06}$ = 21000 [A1] She invested \$21000

<u>Alt Mtd</u>

(interest earned in 5 yrs) $1.2\% \times 5 = 6\%$ [M1] 106% --- \$22260 $1\% --- \frac{22260}{106}$ $100\% --- \frac{22260}{106} \times 100$ [M1] = \$21000 [A1]

Answer \$[3]

OFFER A Deposit: 15% of the cash price Instalments: \$110 per month over 1 year OFFER B Deposit: One-fifth of the cash price Instalments: \$60 per month over 2 years

The cash price of a vacuum cleaner is \$1299. Jovan wants to buy the vacuum cleaner with either Offer A or Offer B.

Which offer should he choose? Explain your answer.

(Offer A total)
$$\left(\frac{15}{100} \times 1299\right) + (12 \times 110)$$
 [M1]
= \$1514.85
(Offer B total) $\left(\frac{1}{5} \times 1299\right) + (24 \times 60)$ [M1]
= \$1699.80
Answer Jovan should choose Offer ...A... because ...the total cost is cheaper

[3] [A1- Award only if both total amounts are correct. Accept equivalent explanation.]

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7 (a) Complete the table of values for $y = x^2 + \frac{2}{x}$.

(c) Use your graph to find the values of x when y = 3.8.

x = 0.575 [B1- accept 0.525, 0.55, 0.575, 0.6, 0.625] or x = 1.65 [B1- accept 1.6, 1.625, 1.65, 1.675, 1.7]

(d) By drawing a suitable tangent, find the gradient of the curve when x = 2.

Draw tangent line at x = 2 [M1] gradient = $\frac{8.5 - 1.5}{3 - 1}$ = 3.5 [A1- accept 3.3 to 3.7]

8 (a) x is inversely proportional to the cube root of y.

Given that x = 3 when y = 8, find the value of x when y = 64.

 $x = \frac{k}{\sqrt[3]{y}}, \text{ where } k \text{ is a constant}$ When x = 3 and y = 8, $3 = \frac{k}{\sqrt[3]{8}}$ [M1- or $3(\sqrt[3]{8}) = k$] $3 = \frac{k}{2}$ k = 6 $\therefore x = \frac{6}{\sqrt[3]{y}}$ When y = 64, $x = \frac{6}{\sqrt[3]{64}}$ = 1.5 [A1]

(b) Write $\frac{5}{x-3} + \frac{1}{x^2-9}$ as a single fraction in its simplest form.

$$\frac{5}{x-3} + \frac{1}{x^2 - 9}$$

$$= \frac{5}{x-3} + \frac{1}{(x+3)(x-3)}$$
 [M1- factorise]
$$= \frac{5(x+3)+1}{(x+3)(x-3)}$$
 [M1- make same denominator]
$$= \frac{5x+15+1}{(x+3)(x-3)}$$

$$= \frac{5x+16}{(x+3)(x-3)}$$
 [A1]

$$\frac{Alt \ mtd}{5} + \frac{1}{x^2 - 9}$$

$$= \frac{5(x^2 - 9) + x - 3}{(x - 3)(x^2 - 9)}$$
[M1- make same denominator]
$$= \frac{5x^2 - 45 + x - 3}{(x - 3)(x + 3)(x - 3)}$$

$$= \frac{5x^2 + x - 48}{(x - 3)(x + 3)(x - 3)}$$

$$= \frac{(5x + 16)(x - 3)}{(x - 3)(x + 3)(x - 3)}$$
[M1- factorise completely]
$$= \frac{5x + 16}{(x + 3)(x - 3)}$$
 [A1]

13

(c) Solve these simultaneous equations.

2x - 5y = 123x - 2y = 7Elimination mtd 1 2x - 5y = 12 - (1)3x - 2y = 7 - (2) $(1) \times 3: 6x - 15y = 36 - --(3)*$ $(2) \times 2: 6x - 4y = 14 - --(4)^*$ (3) - (4): 6x - 15y - (6x - 4y) = 36 - 14 [M1- correct elim mtd] -11y = 22y = -2 [A1] Elimination mtd 2 sub into (1), 2x - 5y = 12 - (1)2x - 5(-2) = 123x - 2y = 7 - - - (2)2x + 10 = 12 $(1) \times 2: 4x - 10y = 24 - --(3)^*$ 2x = 2 $(2) \times 5: 15x - 10y = 35 - - - (4)*$ x = 1 [A1] (3) - (4): 4x - 10y - (15x - 10y) = 24 - 35[M1- correct elim mtd] -11x = -11Substitution mtd 1 Substitution mtd 2 2x - 5y = 12 - (1)from (1): 2x = 5y + 123x - 2y = 7 - - - (2) $x = \frac{5y + 12}{2} - --(3)^*$ $(1) \times 3: 6x - 15y = 36$ $6x = 15y + 36 - --(3)^*$ $(2) \times 2: 6x - 4y = 14$ sub (3) into (2), $6x = 4y + 14 - --(4)^*$ $3\left(\frac{5y+12}{2}\right)$ -2y = 7sub (4) into (3), 15y + 36 = 4y + 14 [M1- correct substn mtd] [M1- correct substn mtd] 11y = -22y = -2 [A1] Substitution mtd 3 sub into (1), from (2) : 3x = 2y + 72x - 5(-2) = 12 $x = \frac{2y+7}{3} - --(3)^*$ 2x + 10 = 122x = 2sub (3) into (1), x = 1 [A1] $2\left(\frac{2y+7}{3}\right) - 5y = 12$ [M1- correct substn mtd]

Answer $x = \dots$

 $y = \dots \dots \dots \dots \dots [3]$



The diagram shows a closed solid made from a cylinder and a hemisphere.

The cylinder and the hemisphere have a common radius of 7 cm. The height of the cylinder is *h* cm and the total surface area of the solid is 371π cm³.

(a) Show that the exact value of h is 16 cm.

Answer

9

curved SA hemisphere + curved SA cylinder + circle = total SA

$$\left(\frac{1}{2} \times 4\pi \times 7^{2}\right) + \left(\frac{2\pi \times 7 \times h}{2}\right) + \left(\pi \times 7^{2}\right) = 371\pi$$
 [M1- curved SA of hemisphere]
[M1- curved SA of cylinder]
[M1- equivalent eqn, allow ecf for SA]

$$98\pi + 14\pi h + 49\pi = 371\pi$$

$$14\pi h = 371\pi - 98\pi - 49\pi$$

$$14\pi h = 224\pi$$

$$h = \frac{224\pi}{14\pi}$$

$$= 16 \text{ cm (shown)}$$
[A1- no marks if students used non-exact values]

(b) Find the volume of the solid.

vol hemisphere + vol cylinder

$$= \left(\frac{1}{2} \times \frac{4}{3} \pi \times 7^{3}\right) + \left(\frac{\pi \times 7^{2} \times 16}{[M1 - \text{ vol of hemisphere}]}\right)$$

$$= 718.377 + 2463.008$$

$$= 3181.385$$

$$= 3180 \text{ cm}^{3} (3\text{sf})$$
[A1]

Answer cm³ [3]

(c) The solid is made of ash wood. The density of ash wood is 0.67 g/cm³.
 Find the mass of the solid.

(mass) $3181.385 \times 0.67 = 2131.52$ = 2130 g (3sf) [B1]

Answer g [1]

10 These are some information given by a company about the solar panels they produce.





The amount of electricity generated by each solar panel per day, in kilowatt-hour (kWh), can be found with information on the power generated in kilowatt (kW) and the number of peak sun hours per day.

It is calculated using this formula:

amount of electricity $(kWh) = power (kW) \times number of peak sun hours per day (h)$

The number of peak sun hours per day in Singapore is 5 hours. It is assumed that a month has 31 days and that the number of peak sun hours per day is constant each day.

(a) Show that each solar panel can produce 46.5 kWh of electricity in a month.

Answer (1 day) $0.3 \times 5 = 1.5$ kWh [M1] (1 month) $1.5 \times 31 = 46.5$ kWh (shown) [A1]

The table shows the estimated average monthly electricity consumption for households living in the different types of housing in Singapore.

Type of Housing	Estimated average monthly electricity consumption (kWh)
HDB 4-Room Flat	342
HDB 5-Room Flat	399
Terrace	821
Bungalow	2146

The Ng family lives in a terrace. Mr Ng wants to install some solar panels on their roof to generate at least 70% of their monthly electricity consumption.

(b) Calculate an estimate of the minimum amount of electricity that must be generated by the solar panels per month to meet Mr Ng's target.

[2]

(c) Mr Ng plans to purchase solar panels from this company. He has a rectangular space on his roof, where it is suitable to install the solar panels.

Given that his roof has a dimension of 7 m by 5 m, would Mr Ng be able to meet his target? Justify your answer with calculations.



Part 1 (2 marks): Either horizontal or vertical placement calculation

Horizontal Placement	Vertical Placement
(length wise) $7 \div 2.25 = 3\frac{1}{9}$	(length wise) $7 \div 1.1 = 6\frac{4}{11}$
$= 3 \max$	$= 6 \max$
(width wise) $5 \div 1.1 = 4\frac{6}{11}$	(width wise) $5 \div 3.35 = 2\frac{2}{9}$
$=4 \max$	$= 2 \max$
max no. of solar panels that can be	max no. of solar panels that can be
installed = $\underline{3} \times \underline{4}$	installed = $\underline{6} \times \underline{2}$
= <u>12</u>	= <u>12</u>

[[]M1- 3 & 4 or 6 & 2 seen] [M1- 12 solar panels]

Part 2 (2 marks)

<u>Mtd 1: Compare max amt of electricity that can be generated</u> (max amt of electricity generated per month) 12×46.5 [M1] = 558 kWh

Mr Ng <u>would not</u> be able to meet his target because the solar panels have to generate at least <u>574.7 kWh</u> of electricity per month but the amount of electricity that can be generated is <u>less</u>.

[A1- would not / no and "574.7 kWh" with comparison to 558 kWh]

<u>Mtd 2: Compare min no. of solar panels that must be installed to meet target</u> (min no. of solar panels needed) 574.7 ÷ 46.5 [M1- allow ecf from (b)'s 574.7]

$$= 12\frac{167}{465}$$
 (or 12.359)

$$= 13$$
 (round up)

Mr Ng <u>would not</u> be able to meet his target because he has to install at least <u>13</u> <u>solar panels</u> but he can only install <u>12 solar panels</u> on his roof. [A1- would not / no **and** "13" with comparison to 12]

[4]



Answer one question from this section. Each question carries 8 marks.

11 The masses of 160 potatoes planted using fertiliser *A* were recorded. The cumulative frequency diagram shows the distribution of the masses in grams.



(ii) the interquartile range. 129 - 116 [M1- either Q_1 or Q_3 correct] = 13 g [A1]

Answer g [2]

Answer g [1]

(b) The box-and-whisker plots show the masses of 160 potatoes of the same variety planted using fertiliser *B*.



(ii) the interquartile range. 137 - 119 = 18 g [B1]

Answer g [1]

(c) Which fertiliser produces potatoes that have a more consistent mass? Give a reason for your answer.

Answer Fertiliser \underline{A} because the potatoes planted using fertiliser A has

a <u>smaller interquartile range</u> than those planted using fertiliser *B*. [1] [B1- or because *B* has a bigger interquartile range]

(d) Two potatoes planted using fertiliser A are chosen at random.

Find the probability that both potatoes have a mass of at least 146 g.

(< 146 g) 156 potatoes (at least 146 g) 160 – 156 = 4 potatoes P(at least 146 g) = $\frac{4}{160} \times \frac{3}{159}$ [M1] = $\frac{1}{2120}$ [A1]

12 (a)



A, B, C and D are points on a circle with AC as a diameter. TA is a tangent to the circle. Angle $TAB = 38^{\circ}$ and angle $ACD = 40^{\circ}$.

Find the following angles, giving a reason for each.

(i) Angle *BAC*

 $90^{\circ} - 38^{\circ} = 52^{\circ}$

Answer Angle $BAC = \dots \frac{52^{\circ}}{\dots}$ because $\dots \frac{(\text{tangent } \perp \text{ radius})}{\dots}$ or the angle between a tangent and radius of a circle is a right angle. [2] [M1, A1- accept equivalent explanation]

(ii) Angle ABD

Answer Angle $ABD = \dots \frac{40^{\circ}}{10^{\circ}}$ because $\dots \frac{(\angle s \text{ in the same segment})}{10^{\circ}}$ or	
angles in the same segment are equal.	[2]
[M1, A1- accept equivalent explanation]	



21

The diagram shows a triangular park ABC on horizontal ground.

AB = 95 m, BC = 72 m and angle $ABC = 110^{\circ}$.

(i) Show that AC = 137.43 m, correct to 2 decimal places.

Answer

$$AC^{2} = 95^{2} + 72^{2} - 2(95 \times 72 \times \cos 110^{\circ})$$
 [M1]

$$AC = 137.433$$

$$= 137.43 (2dp) (shown)$$
 [A1]

[2]

Т

С

7.5

(ii) At *C*, there is a vertical lamp post of height 7.5 m. Calculate the angle of depression of *A* from the top of the lamp post.

$$\tan \angle TAC = \frac{7.5}{137.433}$$
[M1]

$$\angle TAC = 3.1236^{\circ}$$
Angle of depression of A from top of lamppost

$$= 3.1^{\circ} (1dp) (alt. \angle s, // lines) [A1]$$
A 137.433

Answer° [2]

(b)

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