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中正中學

CHUNG CHENG HIGH SCHOOL (MAIN)

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Parent's Signature

**PRELIMINARY EXAMINATION 2022
SECONDARY 4**

MATHEMATICS

4048/01

Paper 1

Wednesday 14 September 2022

2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

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.

Answer **all** questions.

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 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, unless the question requires the answer in terms of π .

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 number of marks for this paper is 80.

For Examiner's Use

Total

/ 80

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

- 1 Evaluate $\frac{9.45 \times \sqrt{36.03}}{\sqrt[3]{-26.9}}$, correct to 3 significant figures.

Answer [1]

- 2 Simplify $\frac{16a-12b}{32a^2-18b^2}$.

Answer [2]

- 3 Ken drives at an average speed of 85 km/h on the expressway for the first stage of his journey. After exiting the expressway, he continues to drive at an average speed of 60 km/h on the city roads for the second stage of his journey.

If the average speed of his entire journey is 75 km/h, find the ratio of the time taken for the first stage of his journey to the time taken for the second stage of his journey.

Answer : [2]

- 4 Factorise completely $2x^2 + 3x - 12y - 8xy$.

Answer [2]

- 5 The mass of an electron is 9.11×10^{-28} g.

(a) Write in standard form, the mass of an electron in kg.

Answer kg [1]

The mass of a hydrogen atom is 1.66×10^{-27} kg.

(b) Find the number of electrons that will have the same mass as 1 hydrogen atom, giving your answer to the nearest whole number.

Answer [1]

- 6 Teacher: The length of a certain rectangle is decreased by 20%, whereas its breadth is increased by 20%.

Student: The area of the rectangle will remain the same as the percentage decrease of the length is equal to the percentage increase of the breadth. Therefore, there is a 0% change in the area.

Is the student's statement correct? Support your answer with mathematical calculations.

Answer

.....
[2]

- 7 Find the range of values of x which satisfy the inequalities

$$\frac{x-2}{9} \leq \frac{2x+5}{15} \leq \frac{x+4}{6}.$$

Answer [3]

- 8 Solve the equation $x(x+1) = 6$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- 9 Given that $x = \sqrt{\frac{2a-3y}{b+2y}}$,

- (a) calculate x when $a = 5$, $b = -2$ and $y = 3$,

Answer $x = \dots\dots\dots$ [1]

- (b) express y in terms of a , b and x .

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

- 10** A company manufactures two sizes of the same brand of shampoo. The prices of the two sizes are indicated in the table below.

Shampoo Size (ml)	Price (\$)
330	7.95
620	14.35

Which shampoo size is a better value for money? Explain your answer clearly.

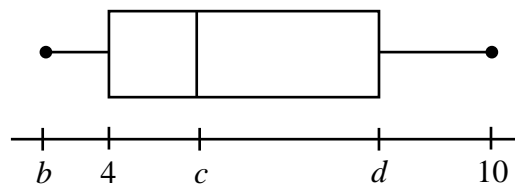
Answer

.....
 [2]

- 11** The numbers of hours spent daily online by 10 students are recorded in ascending order.

3, 4, 4, 4, 5, 6, 7, 8, 9, a

The data is presented as a box and whisker plot shown below.



Find the values of a , b , c and d .

Answer $a = \dots\dots\dots$, $b = \dots\dots\dots$, $c = \dots\dots\dots$, $d = \dots\dots\dots$ [2]

12 $\xi = \{\text{integers } x: 30 < x \leq 40\}$

$$A = \{x : \frac{1}{2}x - 7 > 10\}$$

$$B = \{x : x \text{ is a multiple of } 5\}$$

- (a)** Draw a Venn Diagram to illustrate this information.

Answer

[2]

- (b)** List the elements in $A' \cup B$.

Answer { } [1]

- (c)** Given also that $C = \{\text{prime numbers}\}$ and $D = \{\text{multiples of } 20\}$, complete the following statements.

- (i)** Sets B and C are sets because $B \cap C = \dots\dots\dots$ [1]

- (ii)** Set D is a of B because $B \cap D = \dots\dots\dots$ [1]

13 A map is drawn to scale of 4 cm: 1 km.

(a) Write this scale in the form 1 : n .

Answer [1]

(b) A park on the map has an area of 8 cm². Find the actual area of the park.

Answer km² [2]

14 (a) Express 550 as the product of its prime factors.

Answer [1]

(b) x is an odd number.

The lowest common multiple of 10, 55 and x is 550.

Find the two possible values of x .

Answer $x =$ or [2]

(c) Find the smallest integer p such that $550p$ is a perfect square.

Answer $p =$ [1]

- 15** y is inversely proportional to $(x + 1)^n$, where n is a constant and $x > -1$.

Given that $y = 9$ when $x = 0$ and that $y = 3$ when $x = 8$, find

- (a) the value of n ,

Answer $n = \dots\dots\dots$ [2]

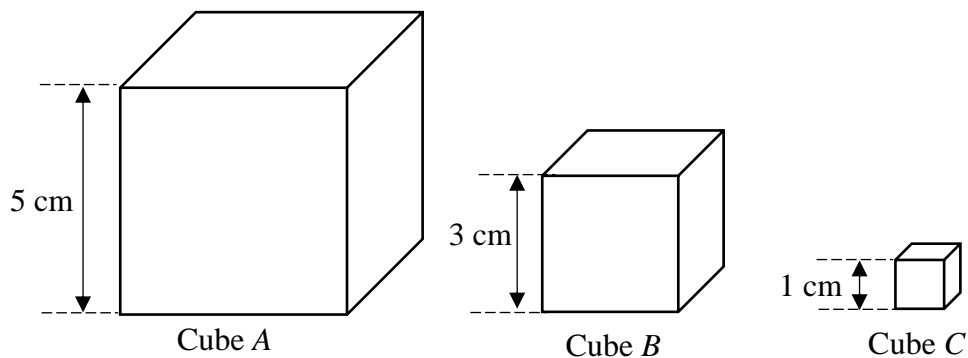
- (b) the equation connecting y and x .

Answer $\dots\dots\dots$ [1]

- 16** The weekly sales of three brands of chicken essence, A , B and C , are shown in the following table.

Chicken Essence	A	B	C
Weekly Sales (number of bottles)	500	300	100

Three cubes, labelled A , B and C , are used to represent the sales for brands A , B and C respectively.



Explain why this representation is misleading.

Answer

.....

[1]

- 17** A bag contains 12 strawberry sweets and 6 blueberry sweets.

Two sweets are drawn from the bag at random without replacement.

- (a)** Mary says the probability that one sweet is strawberry and the other is blueberry is

$$\left(\frac{12}{18}\right)\left(\frac{6}{17}\right) = \frac{4}{17}.$$

Explain what she has done wrong and give the correct answer.

Answer

.....

 [2]

- (b)** Find, as a fraction in its simplest form, the probability that both sweets are strawberry.

Answer [1]

18 $\overrightarrow{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}, \overrightarrow{QR} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}, \overrightarrow{RS} = \begin{pmatrix} k \\ 11.6 \end{pmatrix}.$

- (a) Find $|\overrightarrow{PR}|$, giving your answer correct to the nearest whole number.

Answer [2]

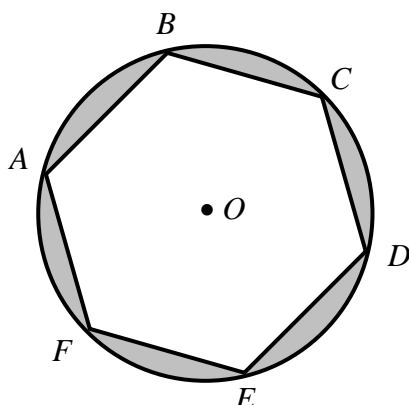
- (b) If Q is the point $(1, 7)$, find the position vector of P .

Answer [2]

- (c) Given that \overrightarrow{RS} is parallel to \overrightarrow{PQ} , find the value of k .

Answer $k =$ [2]

- 19 A regular hexagon $ABCDEF$, is inscribed in a circle with centre O . The length of each side of the hexagon is 7 cm.



Calculate

- (a) $\angle AOB$,

Answer^o [1]

- (b) $\angle AFE$,

Answer^o [1]

- (c) the area of the shaded region.

Answer cm² [2]

- 20 (a) Express $y = x^2 + 5x + 15$ in the form $y = (x + a)^2 + b$.

Answer $y = \dots\dots\dots$ [2]

- (b) Write down the equation of the line of symmetry of $y = x^2 + 5x + 15$.

Answer $\dots\dots\dots$ [1]

- 21 The maximum daily temperature, in $^{\circ}\text{C}$, was recorded throughout the month of April. The results are shown in the table below.

Temperature ($T^{\circ}\text{C}$)	Number of days
$28 \leq T < 30$	4
$30 \leq T < 32$	8
$32 \leq T < 34$	16
$34 \leq T < 36$	2

Calculate an estimate for

- (a) the mean of the maximum daily temperature in April,

Answer $\dots\dots\dots^{\circ}\text{C}$ [1]

- (b) the standard deviation of the maximum daily temperature in April.

Answer $\dots\dots\dots^{\circ}\text{C}$ [1]

- 22** A company sells necklaces, bracelets and rings at two of its outlets and the number of jewellery items sold in each outlet in July are shown in the table below.

	Necklaces	Bracelets	Rings
Outlet 1	227	362	172
Outlet 2	192	257	231

- (a) Represent the above data in a 2×3 matrix, **A**.

Answer **A** = [1]

The cost of producing one necklace, one bracelet and one ring is \$15, \$8 and \$5 respectively.

This information can be represented by the matrix **C** = $\begin{pmatrix} 15 \\ 8 \\ 5 \end{pmatrix}$.

Each necklace is sold at \$35, each bracelet is sold at \$21 and each ring is sold at \$12.

The matrix **B** = $\begin{pmatrix} 35 \\ 21 \\ 12 \end{pmatrix}$ shows the selling price of each jewellery item.

- (b) Find **A(B – C)**.

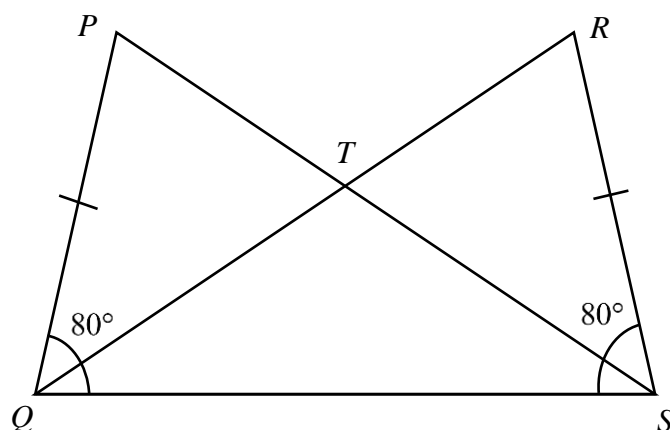
Answer [2]

- (c) Explain what your answer in (b) represents.

Answer

.....
 [1]

- 23 The diagram shows two triangles PQS and QRS . T is the point of intersection of PS and QR . $PQ = RS$ and $\angle PQS = \angle RSQ = 80^\circ$.



- (a) Show that triangle PQS and triangle RSQ are congruent.

Answer

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 [3]

- (b) Explain why a circle can be drawn passing through the points P , Q , R and S .

Answer

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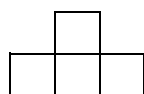
 [2]

- (c) Is T the centre of the circle passing through the points P , Q , R and S ?
 Explain your answer.

Answer

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 [1]

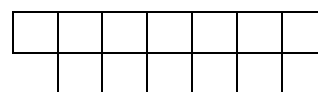
- 24** A 1-T block consists of 4 squares of 1 cm^2 each and it has a perimeter of 10 cm.
The following pattern shows 1-T blocks arranged to form a 2-T block and a 3-T block.



1-T block



2-T block



3-T block

The values for the perimeter of 1-T block and 2-T block are given below.

Block	1-T	2-T	3-T	4-T
Perimeter (cm)	10	14	a	b

- (a) Find the value of a and of b .

Answer $a = \dots\dots\dots$, $b = \dots\dots\dots$ [2]

- (b) Find the perimeter of a 7-T block.

Answer $\dots\dots\dots$ cm [1]

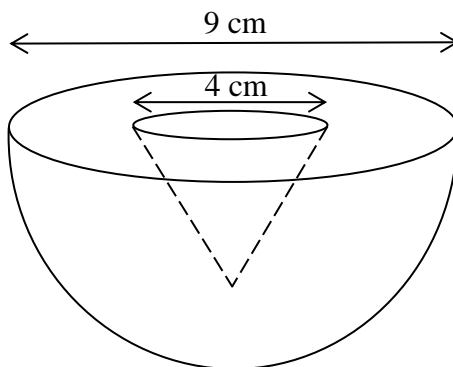
- (c) Write down the perimeter of a n -T block in terms of n .

Answer $\dots\dots\dots$ cm [1]

- (d) If the perimeter of a n -T block is 130 cm, find the number of squares in the given block.

Answer $\dots\dots\dots$ [2]

- 25 At a meteorological station, the meteorologists use a metallic container as shown in the diagram to collect rainwater samples. The container consists of a hemisphere of diameter 9 cm with a hollow in the form of an inverted circular cone of base diameter 4 cm.



The volume of the cone is $\frac{1}{15}$ of the volume of the hemisphere.

- (a) Show that the height of the cone is 3.0375 cm.

Answer

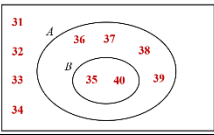
[2]

- (b) Find the total surface area of the metallic container.

Answer cm^2 [4]

~ End of Paper ~

Answer Key

1	-18.9 (3sf)
2	$\frac{2}{4a+3b}$
3	Ratio = 3: 2
4	$(x-4y)(2x+3)$
5	(a) 9.11×10^{-31} kg (b) 1822
6	The student's statement is incorrect. New area of rectangle = 0.96 of original area
7	$x \geq -10$
8	$x = -3$ or $x = 2$
9	(a) $\frac{1}{2}$ (b) $y = \frac{2a-bx^2}{3+2x^2}$
10	620 ml shampoo
11	$a = 10, b = 3, c = 5.5, d = 8$
12	(a)  (b) {31, 32, 33, 34, 35, 40} (c)(i) disjoint, { } (ii) subset, D
13	(a) 1 : 25 000 (b) 0.5 km^2
14	(a) $2 \times 5^2 \times 11$ (b) 25 or 275 (c) 22
15	(a) $n = \frac{1}{2}$ (b) $y = \frac{9}{\sqrt{x+1}}$
16	It does not truly represent the weekly sales of the three brands of chicken essence. Volume of cube A: Volume of cube B : Volume of cube C = 125: 27 : 1 but ratio of sales of brands A, B & C = 5 : 3 : 1.
17	(a) Mary calculated the probability based on the first sweet is strawberry and the second sweet is blueberry to get $\frac{12}{18} \times \frac{6}{17} = \frac{4}{17}$. For one sweet to be strawberry and the other to be blueberry, it can also be that the first sweet is blueberry and the second sweet is strawberry. Correct Answer: $\frac{12}{18} \times \frac{6}{17} + \frac{6}{18} \times \frac{12}{17} = \frac{8}{17}$. (b) $\frac{22}{51}$
18	(a) 9 (b) $\begin{pmatrix} 4 \\ 3 \end{pmatrix}$ (c) -8.7
19	(a) 60° (b) 120° (c) 26.6 cm^2
20	(a) $y = (x+2.5)^2 + 8.75$ (b) $x = -2.5$
21	(a) 32.1°C (b) 1.61°C
22	(a) $\begin{pmatrix} 227 & 362 & 172 \\ 192 & 257 & 231 \end{pmatrix}$ (b) $\begin{pmatrix} 10450 \\ 8798 \end{pmatrix}$ (c) Profit made from the sale of jewellery items in July for Outlet 1 and Outlet 2 respectively.
23	(a) SAS (b) - (c) No.
24	(a) $a = 18, b = 22$ (b) 34 (c) $4n + 6$ (d) 124
25	(a) - (b) 201 cm^2