HILLGROVE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR (EXPRESS) / 5 (NORMAL ACADEMIC)

CANDIDATE NAME	( )	CLASS	
CENTRE NUMBER	S	INDEX NUMBER	

MATHEMATICS **4048/01**

Paper 1 **16 Aug 2022**

2 hours

Candidates answer on the Question Paper. **8.45 AM to 10.45 AM**

READ THESE INSTRUCTIONS FIRST

Write your index number, class and name 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.

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.

For Examiner's Use	
TOTAL	80

Parent's/ Guardian's Signature: _____

Setter: Mrs Karen Ee

This document consists of 15 printed pages.

Mathematical Formulae

Compound interest

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

Mensuration

Curved surface area of a cone $= \pi rl$

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

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

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

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

Arc length $= r\theta$, where θ 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

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

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

1 Write the following numbers in order of size, starting with the smallest.

$$0.7\dot{1}\dot{9}, \quad \sqrt[3]{-0.512}, \quad -\frac{8}{9}, \quad 0.61^3$$

Answer ....., ..., ..., ... [2]

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2 The scale of a map is 8 cm : 1200 m.

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

Answer ..... [1]

(b) The actual area of a reservoir is 1.8 km^2.

Calculate the area of the reservoir represented on the map in square centimetres.

Answer ..... cm^2 [2]

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3 The sine of an angle is 0.899.

Give two possible values for the angle in radians.

Answer ..... or ..... [2]

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4 (a) Express 3969 as a product of its prime factors.

Answer ..... [2]

(b) Using your answer to part (a), explain why 3969 is a perfect square.

Answer ..... [1]

(c) p and q are both prime numbers.

Find the value of p and of q so that $3969 \times \frac{p}{q}$ is a perfect cube.

Answer $p =$ .....

$q =$ ..... [2]

(d) The highest common factor (HCF) of two numbers is 63.
The lowest common multiple (LCM) of the two numbers is 3969.
Both numbers are smaller than 600.

Find the two numbers.

Answer ..... and .....[2]

5 Six positive integers have a mean of 7, a median of 6.5 and a mode of 10.
Find the six numbers.

Answer .... [2]

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6 m is a positive integer.
Show that, for all m, $2^{5m+3} - 32^m$ is a multiple of 7.

Answer

[2]

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7 Andrew is 25% heavier than Brian. Brian is 25% lighter than Calvin.
Find the ratio of the weight of Andrew to that of Calvin.

Answer ..... [2]

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8 Under the Customs Act 1960, Singapore-registered vehicles are required to have a minimum amount of motor fuel, at least three-quarters of the tank, when leaving Singapore via the land checkpoints. This is commonly referred to as the "three-quarter tank rule".

Mrs Tan wants to drive into Malaysia. The full capacity of her car's fuel tank is 47 litres. Currently, the fuel tank is 12.5% full. She tops it up at a petrol station with Regular 95 with Techron fuel and paid $75.

Fuel products	Price per litre before 14% site discount
Regular 92 with Techron	S$2.89
Regular 95 with Techron	S$2.94
Regular 98 with Techron	S$3.58

Justify whether Mrs Tan has fulfilled the "three-quarter tank rule" to drive into Malaysia. Show your calculations clearly.

Answer

.....

..... [4]

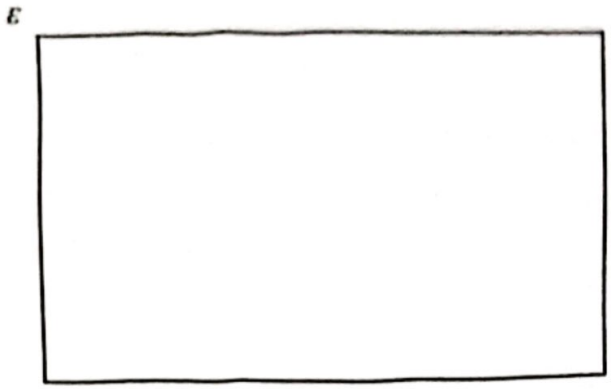
9 $\varepsilon = \{\text{ integers } x : 0 \le x \le 8\}$

$A = \{6, 7, 8\}$

$B = \{x : \frac{1}{2}(3-x) < 1\}$

(a) Complete the Venn diagram to represent the sets ε, A and B.

Answer



[3]

(b) List the elements obtained in the set $A' \cap B$.

Answer ..... [1]

(c) Underline the correct statements from the list below.

$A \subset B$ $\quad \{8\} \in A$ $\quad 8 \notin B$ $\quad A \cup B = B$ $\quad A \cap B \neq \varnothing$ [2]

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10 Write as a single fraction in its simplest form $\frac{7x}{18} - \frac{5(x-2)}{12}$.

Answer ..... [2]

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11 **(a)** Factorise completely $h^2 - 1 - hk + k$.

Answer ..... [2]

(b) Using factorisation, solve $14x^2 - 15x - 9 = 0$.

Answer $x =$ ..... or .....[3]

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12 Simplify $\left(\frac{y^{15}}{32}\right)^{\frac{2}{5}} \times 4y^{-2}$.

Answer .....[3]

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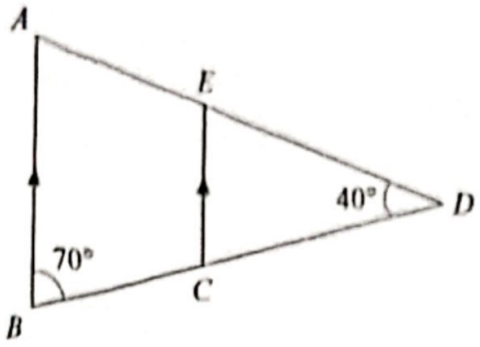
13 The diagram shows a triangle ABD. The points C and E are on BD and AD respectively such that BA is parallel to CE.



Given that $\angle ABC = 70°$ and $\angle CDE = 40°$, explain whether a circle can be drawn to pass through the points A, B, C and E.

Give a reason for each step of your working.

Answer

.....

..... [3]

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14 Patricia invests \$12 000 at a rate of r % per year compound interest.
At the end of 9 years, the value of her investment is \$14 829.

Calculate the value of r.

Answer $r =$ ..... [3]

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15 In a 5-sided polygon (pentagon), two of its interior angles are $x°$ each and the rest of its interior angles are $y°$ each. The sum of an interior angle $x°$ and an interior angle $y°$ is $230°$.

(a) Using the above information, form two equations in terms of x and y.

Answer .....

..... [2]

(b) Solve the simultaneous equations in **(a)** to find the value of x and of y.

Answer $x =$ .....

$y =$ .....[3]

(c) Hence, calculate the largest exterior angle of the pentagon.

Answer ..... ° [1]

16 The first four lines in the sequence of numbers are given below.

Line 1: $1^2 = 1 = \frac{1\times 2\times 3}{6}$

Line 2: $1^2 + 2^2 = 5 = \frac{2\times 3\times 5}{6}$

Line 3: $1^2 + 2^2 + 3^2 = 14 = \frac{3\times 4\times 7}{6}$

Line 4: $1^2 + 2^2 + 3^2 + 4^2 = 30 = \frac{4\times 5\times 9}{6}$

(a) Write down the 5th line of the above sequence.

Answer ..... [1]

(b) Find an expression, in terms of n, for the sum of $1^2 + 2^2 + 3^2 + 4^2 + \ldots + n^2$.

Answer ..... [1]

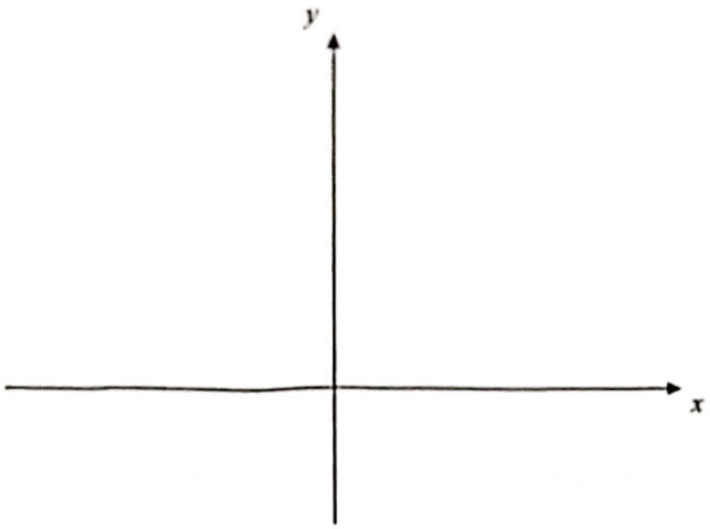
(c) Hence or otherwise, find the sum of $4^2 + 8^2 + 12^2 + 16^2 + \ldots + 48^2$.

Answer ..... [2]

17 **(a)** **Sketch** the graph of $y = 9 - (x + 2)^2$ on the axes below.

Indicate clearly the coordinates of the points where the graph crosses the axes and the turning point on the curve.

Answer



[3]

(b) Write down the equation of the line of symmetry of the graph $y = 9 - (x + 2)^2$.

Answer ..... [1]

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18 In a bag, there are red, blue and green marbles. There are 3 more green marbles than blue marbles. Half of the bag consists of red marbles.

Given that the probability of choosing a blue marble is $\frac{1}{7}$, find the number of green marbles in the bag.

Answer ..... [3]

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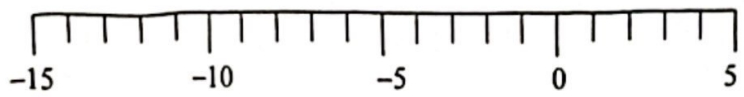
19 (a) (i) Solve the inequalities $x-\frac{1}{5}<\frac{x+3}{2}\leq x+7$.

Answer ..... [2]

(ii) Represent your solution to part (a)(i) on the number line below. [1]



(b) Given that x and y are integers such that $x-\frac{1}{5}<\frac{x+3}{2}\leq x+7$ and $1\leq y\leq 5$, find

(i) the smallest possible value of $\frac{x}{y}$,

Answer ..... [1]

(ii) the greatest possible value of $y-x^2$.

Answer ..... [1]

20 (a) The position vector of point A is $\begin{pmatrix} -3 \\ 4 \end{pmatrix}$ and the position of point B is $\begin{pmatrix} 2 \\ -8 \end{pmatrix}$.

(i) Find $\left|\overrightarrow{AB}\right|$.

Answer ..... [2]

(ii) Given that $\overrightarrow{BA} = 2\overrightarrow{AC}$, find the coordinates of point C.

Answer ..... [2]

(b) The point P has coordinates $(1,5)$ and $\overrightarrow{PQ} = \begin{pmatrix} -5 \\ -2 \end{pmatrix}$.

Find the equation of the line PQ.

Answer .....[2]

21 Line AB is drawn below.

Answer

(a) Construct the perpendicular bisector of AB. [1]

(b) The point C is equidistant from points A and B, and on a bearing $038°$ from A.
Mark and label the position of C. [1]

(c) Construct the bisector of angle BAC. [1]

(d) Shade the region that is closer to AC than to AB and closer to A than to B. [1]

(e) The point D is equidistant from the lines AB and AC and 5 cm away from B.
Find the two possible positions of D and label them D_1 and D_2. [2]