Calculator Model No.:

Class	Full Name	Index Number

bowen SECONDARY
I believe, therefore I am

Preliminary Examination 2023

N

4045/01

MATHEMATICS SYLLABUS A

Secondary 4 Normal Academic/ 4 Normal Technical (OOS)
1 August 2023 **2 hours**

Candidates answer on the Question Paper.
Additional Materials: Writing papers upon request

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

If working is required 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**.

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 your answer to three significant figures. Give answer 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.

DO NOT OPEN THIS PAPER UNTIL YOU ARE TOLD TO DO SO

For Examiner's Use
70

This document consists of **18** printed pages, including this cover page.

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

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

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

Answer **all** the questions.

1 The table shows the maximum and minimum temperatures of three cities in a day during the month of January.

City	Beijing	Geneva	Helsinki
Maximum temperature	2°C	5°C	– 1°C
Minimum temperature	– 8°C	– 1°C	– 7°C

(a) Find the average of the minimum temperatures of Beijing and Geneva.

Answer …….....°C [1]

(b) State the city with the biggest difference between its maximum and minimum temperatures. Show the calculations you make.

Answer ……..... [1]

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2 A bag contains only red, blue and yellow marbles.
$\frac{1}{6}$ of the marbles are yellow. The ratio of red and blue marbles is 2 : 3.

(a) Write the ratio of yellow marbles : blue marbles in its simplest form.

Answer ..... : ..... [1]

(b) If the bag contains 16 yellow marbles, how many blue marbles are there?

Answer ..... [1]

---

3 Express 71 km/h in m/s, giving your answer correct to 2 significant figures.

Answer ..... m/s [2]

---

4 **(a)** Subtract the sum of $-3x^2 + 15 - 10x$ and $9x^2 + 3x - 14$ from $-7x + 15x^2 + 1$.

Answer ……..... [2]

(b) The cube root of r is equal to $24x$ divided by the square root of $9x^2$.
Find the value of r.

Answer r = ……..... [2]

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5 The body mass index, *BMI*, for a person with mass *m* kg and height *h* metres, is given by the formula

$$BMI = \frac{m}{h^2}$$

(a) The body mass index for a person in the healthy range is $18.5 \leq BMI < 23$.
If Belinda's height is 172cm, find the maximum mass of Belinda to stay within the healthy range. Give your answer as an integer.

Answer ……..... kg [2]

(b) Rearrange the formula to make *h* the subject.

Answer $h =$ …..... [1]

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6 A monitor cost $\frac{1}{5}$ as much as a laptop. The total cost of the monitor and laptop after a 30% discount is \$2730. Find the cost of the laptop before discount.

Answer \$ ..... [2]

---

7 Find the smallest prime number satisfying the inequality $-2x \leq 5x - 18$.

Answer …..... [2]

---

8 In a sequence, a constant number is subtracted from the previous number to obtain the next term. The first four terms of the sequence are 35, p, q and 11.

(a) Find the values of p and q.

Answer p = …..

q = ….. [1]

(b) Find an expression for the nth term of the sequence.

Answer …..... [1]

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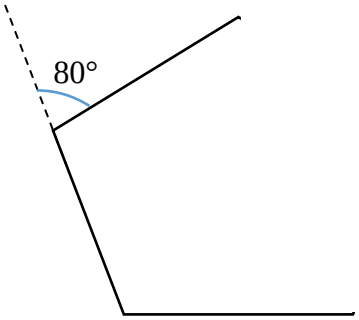
9 **(a)**



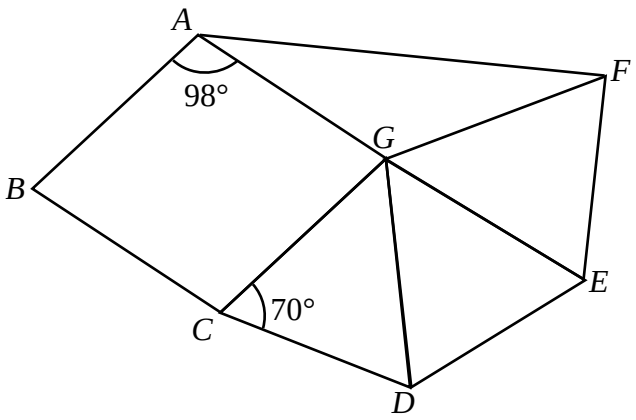
Benny says the diagram above is part of a regular polygon.
Is he correct? Explain your answer.

Answer ……

……

…… [2]

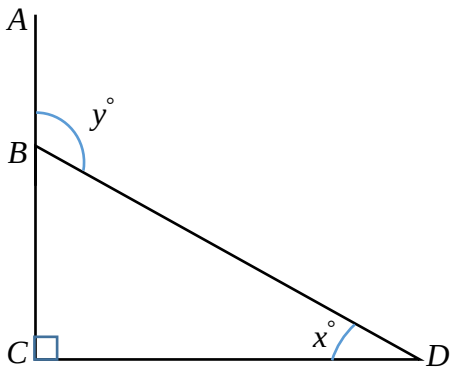
(b)



ABCG is a rhombus and angle *GAB* is 98°. *CGD*, *EGD* and *FGE* are congruent triangles whereby *GC* = *GD* = *GE* = *GF* and angle *GCD* is 70°.
Find angle *AGF*.

Answer …… [2]

10 In the diagram, ABC is a straight line, CD = 12cm, BD = 13cm and angle BCD = 90°.



(a) Find as a fraction in its simplest form, the value of

(i) $\sin x^\circ$,

Answer ..... [2]

(ii) $\cos y^\circ$.

Answer ..... [1]

(b) Find the shortest distance from C to BD.

Answer ..... cm [2]

11 When written as the product of their prime numbers,

$$588 = 2^2 \times 3 \times 7^2$$

$$140 = 2^2 \times 5 \times 7$$

(a) Find the smallest integer k such that $140k$ is a square number.

Answer $k =$..... [1]

(b) Identical cubes are placed in a rectangular box measuring 504mm by 588mm by 140mm. Find the least number of cubes to fit the box exactly.

Answer …..... cubes [3]

---

12 A number is selected randomly from 2-digit numbers that are less than 25.
Find the probability of selecting a prime number.

Answer …..... [2]

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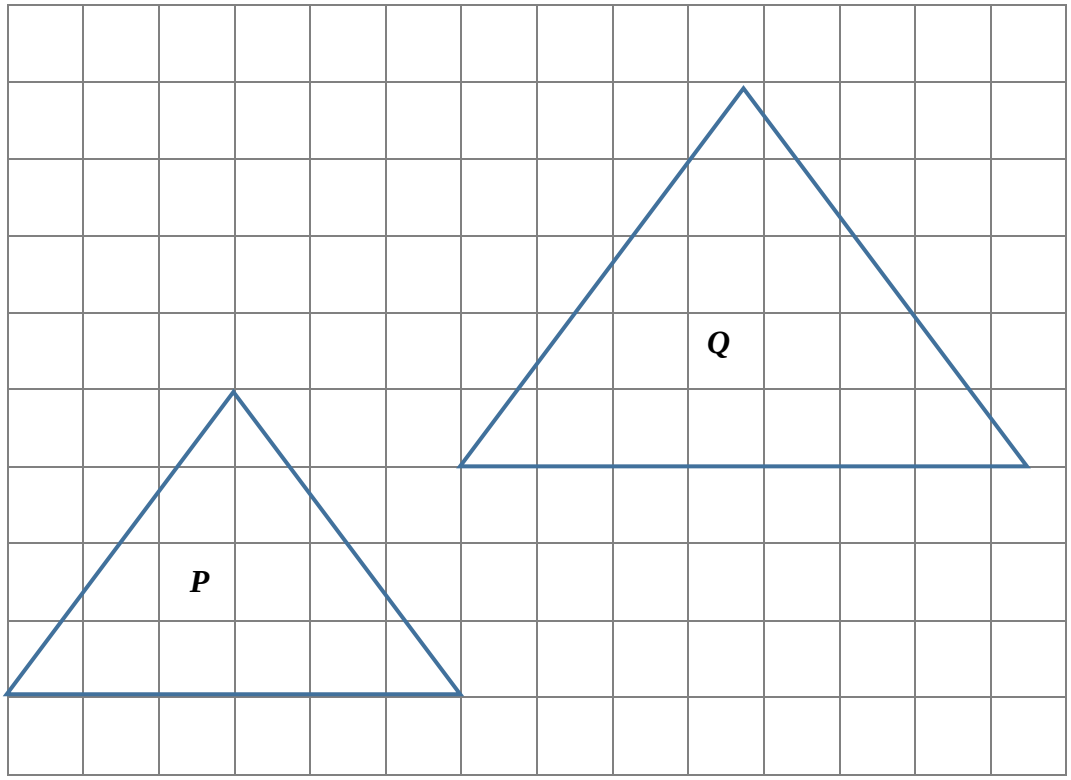
13 Triangle ***Q*** is an enlargement of Triangle ***P*** on the 1-centimetre grid.



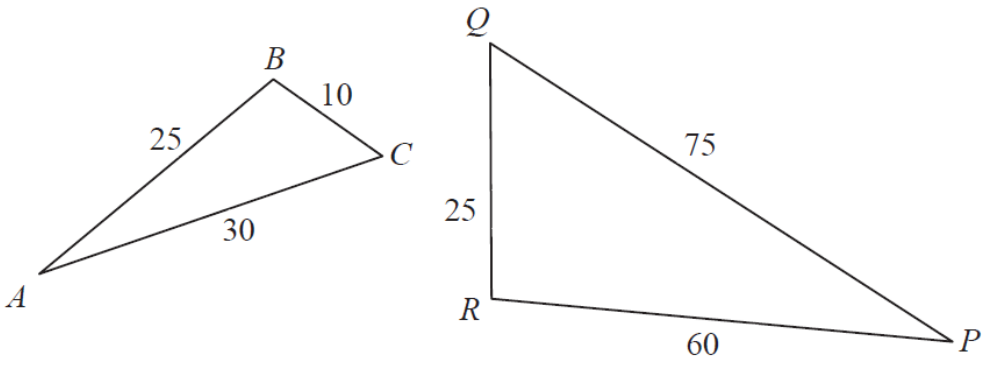
(a) Find the scale factor of the enlargement.

Answer …..... [1]

(b) Triangle ***P*** is enlarged by a scale factor of 0.8 to Triangle ***R***.
Find the area of Triangle ***R***.

Answer …..... cm^2 [2]

14



All the lengths given are in centimetres.
Explain, with clear workings, why the two triangles are not similar.

Answer ……

……

…… [2]

---

15 $\dfrac{7x}{(x-6)^2} + \dfrac{2}{6-x} = \dfrac{ax+b}{(x-6)(x-6)}$

Find the values of *a* and *b*.

Answer *a* = ……

b = …… [3]

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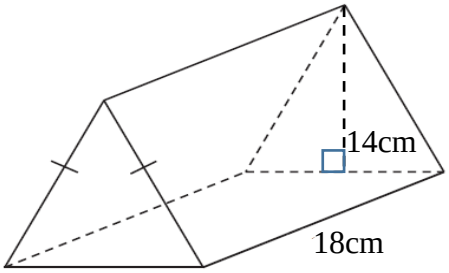
16 A right prism has a perpendicular height 14cm and uniform cross-sectional area of an isosceles triangle. The rectangular base has length 18cm.



Water is pumped into the prism at a constant rate of $12cm^3$ per second.
It takes approximately 1.4 minutes to fill the prism fully.

(a) **(i)** Calculate the volume of the prism.

Answer ….....cm^3 [2]

(ii) Hence, calculate the cross-sectional area of the prism.

Answer …..... cm^2 [1]

(b) Calculate the total surface area of the prism.

Answer …..... cm^2 [3]

17 Benny has £5000 to invest for three years.
The offer in the saving accounts of two local banks for Singapore currency only is seen below.

Bank *A*
2.75% per annum
Fixed for 3 years

Bank *B*
2.4% per annum
Compounded annually

The exchange rate for both banks is £1 for S$1.69.

Benny says Bank *B* gives more interest than Bank *A*.
Do you agree? Explain your answer.

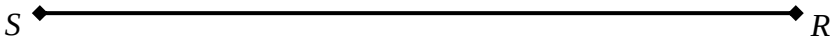
Answer ……

……

……

…… [3]

18



S, *T* and *R* are the positions of three schools on the map.
S and *R* are already indicated on the line above.
The bearing of *T* from *S* is 060° and intersects the perpendicular bisector of *SR*.

(a) By using constructions, find and label *T*. [2]

(b) Using a scale of 1cm to represent 2.5km, find the actual distance of *ST*.

Answer ….....km [1]

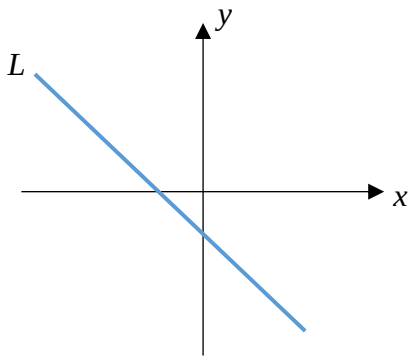
19 **(a)** By completing the square, express $x^2 - 8x + 5$ in the form of $(x \pm p)^2 \pm q$.

Answer …..... [2]

(b) Hence, solve $2x^2 - 16x + 10 = 0$, giving your answers correct to 2 decimal places.

Answer x = …..... or ……..... [2]

20 **(a)**



Benny says a possible equation for the line L is $3x - 2y - 5 = 0$.

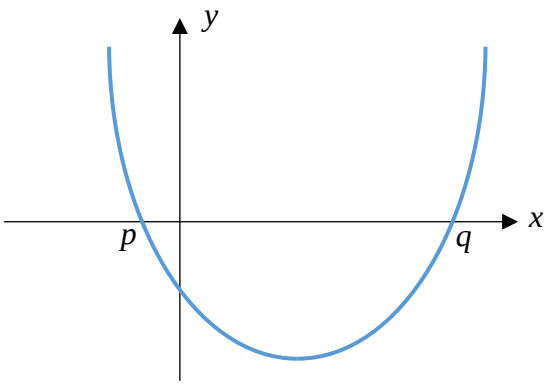
Is he correct? Explain your answer.

Answer ……

……

…… [2]

(b)



The equation of the curve is $y = 2x^2 - 12x - 14$.

Find the values of p and q.

Answer p = ……

q = …… [2]

21

1	1	3					
2	3	6	8	9			
3	0	0	1	2	3	5	5
4	5	9					

Key : 3 | 0 means 30 minutes

The stem and leaf diagram shows the amount of time (in minutes) taken by 15 students to complete an assignment.

(a) Find the angle of sector in a pie chart represented by students who took at least 30 minutes to complete an assignment.

Answer …..... [2]

(b) (i) Find the mean time.

Answer …..... minutes [1]

(ii) The time taken by a student to complete an assignment is missing from the stem and leaf diagram. When added to the data set, the median time remains unchanged. Find the largest possible time taken by the student.

Answer …..... minutes [1]

22 A is the point $(k, -4)$.
B is the point such that the x-coordinate is 3 less than the x-coordinate of point A and the y- coordinate is 8 more than the y-coordinate of point A.

(a) Find the gradient of line AB.

Answer …..... [1]

(b) Calculate the length of line AB.

Answer …..... units [1]

(c) C is the point $(3, -5)$ and lies on the line AB. Find the equation of line AB.

Answer …..... [2]