Name:		Index Number:		Class:	

CATHOLIC HIGH SCHOOL
Preliminary Examination
Secondary 4 (O-Level Programme)

MATHEMATICS 4048/01

Paper 1 **13 SEPTEMBER 2018**

2 hours

Candidates answer in the space provided on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE ON THE MARGINS.

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 of the marks for this paper is **80**.

For Examiner's Use only
80

This document consists of **23** 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

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

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

Answer **all** the questions.

1 Given that $3^{\frac{1}{3}x} = 27\left(9^2\right)$, find the value of x.

Answer x = ...[1]

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2 A conical container has base radius of 5.8 cm and a capacity of 1.2 litres.

Calculate the height of the container.

Answer .....cm [1]

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3 14 men were hired to work 8 hours per day to complete a renovation job in 20 days. At the end of the 3rd day, x workers became sick and were hospitalised. Assume that all workers work at the same rate. On average, how many hours must each of the remaining men work for the remaining days in order to complete the job? Leave your answer in terms of x.

Answer .....hours [2]

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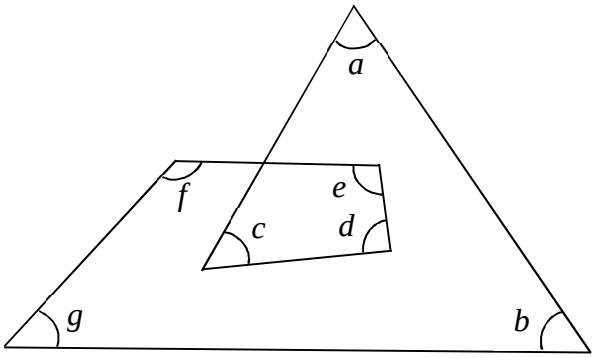
4 Find the sum of the angles a, b, c, d, e, f and g.



Answer .....° [2]

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5 **(a)** The intensity of radiation, p units, is inversely proportional to the square of the distance, h metres, from a radioactive source. Find the percentage change in radiation when the distance is decreased by 20%.

Answer .....% [2]

(b) The cost, $\$T$, of supplying x units of electricity to a household are given in the table below.

No. of units used, x	100	200	500	1 000
Total cost, $\$T$	22	27	42	67

Showing your working clearly, determine if T is directly proportional to x.

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.....[2]

6 A certain number is $2^x \times 5^3$ when it is written as a product of its prime factors.

(a) Write down the value of x if $2^x \times 5^3 = 2000$.

Answer $x =$ .....[1]

(b) State the condition of x if this number is to be a perfect cube.

Answer .....

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.....[1]

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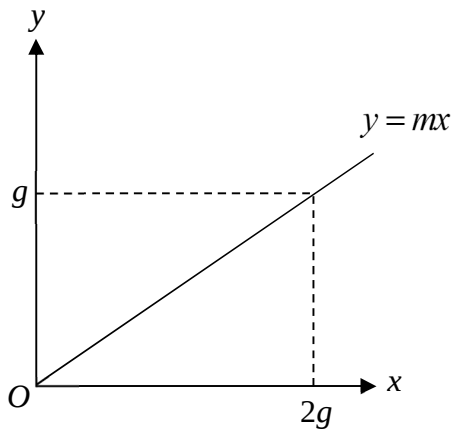
7 The diagram shows a straight line with equation $y = mx$, passing through the point $(2g, g)$.



(i) State the value of m.

Answer $m =$ .....[1]

(ii) Using the value of m found in **(i)**, sketch the graph of $y = -2mx + g$ in the diagram above. Label all intercepts clearly. [1]

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8 A map is drawn to a scale of 1 : 50 000.

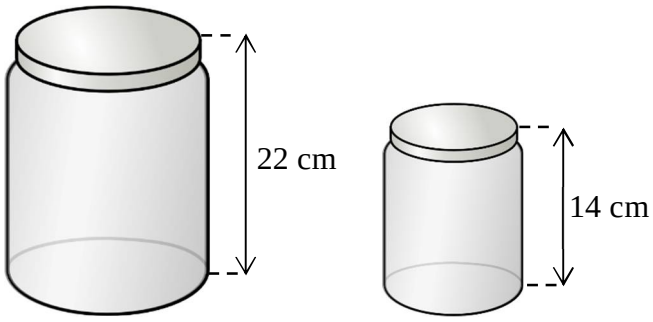
(a) An airport runway is represented by a line of length 5.8 cm on the map.
Calculate the actual length of the runway, giving your answer in kilometres.

Answer .....km [1]

(b) The area of the airport on the map is 50 cm^2.
Calculate the area in cm^2 which represents the same airport on a second map whose scale is 1 : 40 000.

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

9 The two jars are geometrically similar.



The height of the smaller container is 14 cm.
The height of the larger container is 22 cm.

(a) The mouth of the larger container has a circumference of 55 cm. Find the circumference of the mouth of the smaller container.

Answer .....cm [1]

(b) Both containers are completely filled with water. The smaller container can hold 1 litre of water. Find the volume of water in the larger container, giving your answer correct to the nearest cm^3.

Answer .....cm^3 [2]

10 Solve the following simultaneous equations.

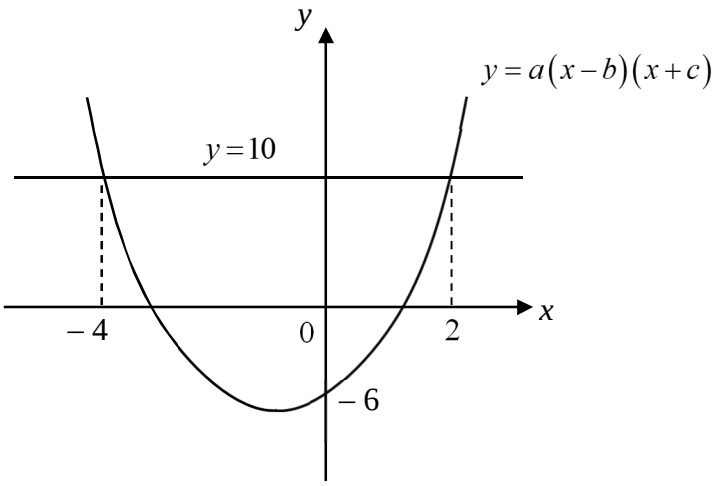
$$1.5x - \frac{11}{3}y = 14$$
$$6x + \frac{5}{3}y = 7$$

Answer $x =$ .....

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

11 The diagram shows the graph of $y = a(x-b)(x+c)$. The line $y = 10$ cuts the curve at $x = -4$ and $x = 2$ and the curve cuts the *y*-axis at $y = -6$.

Find the values of *a*, *b* and *c*, where *a*, *b* and *c* are positive integers.



Answer *a* = ...

b = ...

c = ...[5]

12 Simplify the following, expressing your answers in positive index only.

(a) $\sqrt{x\sqrt{x^{-\frac{2}{3}}}}$

Answer .....[2]

(b) $\sqrt[3]{64y^6} \times \frac{1}{y^3}$

Answer .....[2]

13 A bus travelled for 6 hours 27 minutes at an average speed of 60 km/h.

(a) Express 6 hours 27 minutes in hours.

Answer .....hours [1]

(b) Calculate the distance travelled by the bus.

Answer .....km [1]

(c) The bus then stopped at a rest-stop for 50 minutes and continued travelling for 30 minutes at 65 km/h. Find the average speed in m/s for the whole journey.

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

14 The table shows the heights of students from Class A.

Class A

Height (x cm)	Frequency
$155 < x \leq 160$	2
$160 < x \leq 165$	10
$165 < x \leq 170$	13
$170 < x \leq 175$	7

(a) For Class A, calculate an estimate for

(i) the mean height of the students,

Answer .....cm [1]

(ii) the standard deviation of the heights.

Answer .....cm [1]

(b) The mean height for Class B is 168 cm and the standard deviation is 3.2 cm.
Make two comparisons between the height for Class A and the height for Class B.

Answer

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.....[2]

15 **(a)** Factorise completely $6ax^2 - axy - 12ay^2$.

Answer .....[2]

(b) Factorise completely $(3x+1)^3 - 3x - 1$.

Answer .....[2]

16 **(a)** Solve $8a+6-15b-20ab=0$.

Answer $a =$ .....

$b =$ .....[3]

(b) Find the smallest prime number, p, such that $9+2p>12$.

Answer $p =$ .....[1]

17 **(a)** List the elements of the set A where $A = \{ 2n : n^2 < 16 , n \text{ is a whole number} \}$.

Answer { .....} [2]

(b) Given that ε = {chickens}, B = {black chickens} and S = {skinny chickens},

(i) Use set notation to express "some skinny chickens are black".

Answer .....[1]

(ii) Explain briefly the set statement $B \cap S' = \varnothing$.

Answer

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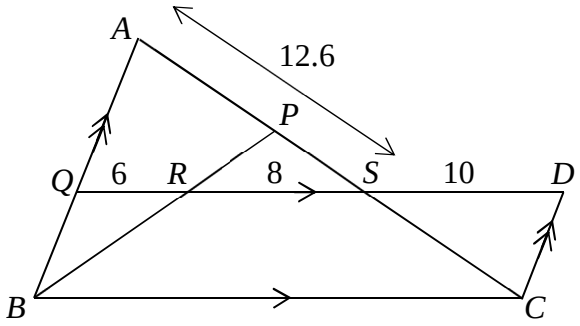
.....[1]

18 In the diagram, *AQB, PRB, QRSD* and *APSC* are straight lines.
BA is parallel to *CD*, and *QD* is parallel to *BC*.
QR = 6 cm, *RS* = 8 cm, *SD* = 10 cm and *AS* = 12.6 cm.



(a) Name a triangle similar to triangle *AQS*.

Answer Triangle .....[1]

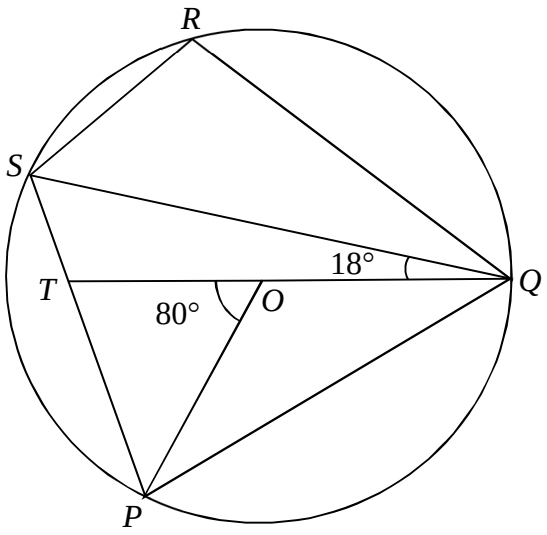
(b) Calculate *SC*.

Answer *SC* = ...cm [1]

(c) Calculate *PS*.

Answer *PS* = ...cm [2]

19



In the diagram, *P*, *Q*, *R* and *S* are points on the circumference of a circle centre *O*. *TOQ* is a straight line. It is given that angle $TOP = 80°$ and angle $SQT = 18°$.

Find, giving reasons for each answer,

(a) angle PSQ,

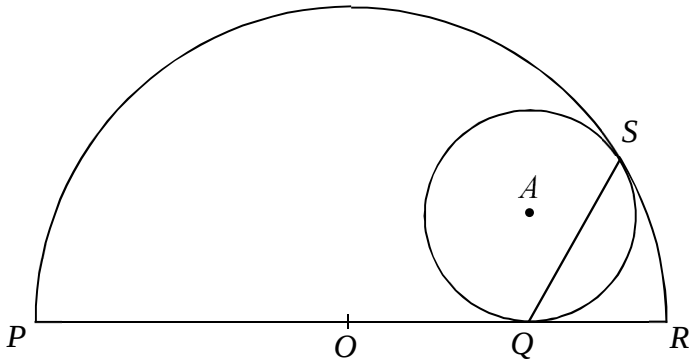
Answer .....° [2]

(b) angle QRS.

Answer .....° [2]

20 The diagram shows a circle with centre A and radius 2 cm inside a semicircle, centre O, and radius 6 cm. The circle touches the circumference of the semicircle at S and the diameter of the semicircle PR at Q. QS is a chord in the circle.

Find the angle RQS.



Answer ..... ° [4]

21 A local distributor supplies a certain brand of washing detergent to 4 different supermarkets in Singapore. The number of boxes of washing detergent supplied per delivery to each supermarket, the sizes and cost price are shown in the table below.

	Number of boxes of washing detergent per delivery			Number of deliveries over 4 months
Size of each box	2.5 kg	5 kg	10 kg	
Supermarket *A*	-	250	100	5
Supermarket *B*	750	600	300	9
Supermarket *C*	500	200	-	12
Supermarket *D*	-	600	-	11
Price per box	\$3.80	\$6.40	\$9.20	

(i) Given that **P** and **Q** are matrices such that the product **PQ** represents the weight of washing detergent supplied to each supermarket per delivery, find **P** and **Q**.

Answer **P** = ...[1]

Q = ...[1]

(ii) If **W** = **PQ**, find the matrix **W**.

Answer **W** = ...[1]

(iii) If $\mathbf{N} = (5 \quad 9 \quad 12 \quad 11)$, find the matrix product **NP** and explain the significance of this product.

Answer **NP** = ...[1]

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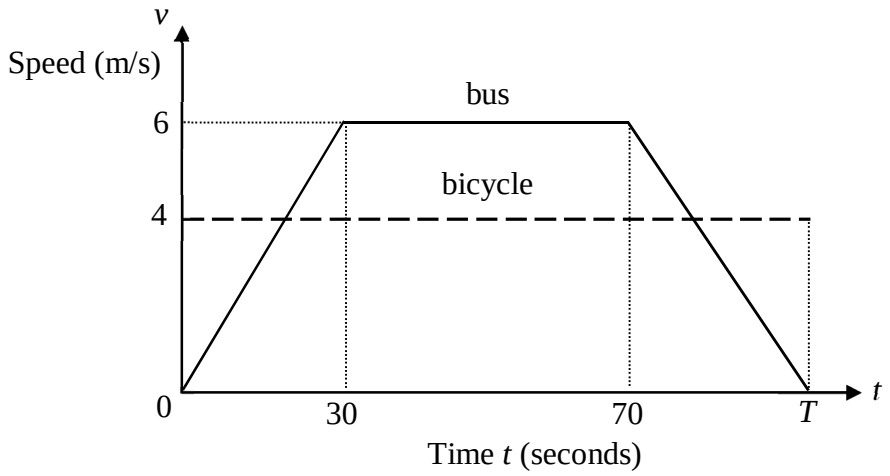
(iv) Using matrix multiplication, find the total amount of money the distributor collects from the orders over the 4-month period.

Answer $.....[1]

22



The diagram shows the speed-time graphs of a bicycle and a bus during a period of T seconds.

(a) Calculate the speed of the bus after 18 seconds.

Answer ..... m/s [1]

(b) Find the value of T if the deceleration of the bus is 0.15 m/s^2.

Answer ..... s [1]

(c) Find the time when the bus starts to overtake the bicycle.

Answer ..... s [2]

23 In the triangle ABC, $AB = 9.5$ cm, $AC = 10.4$ cm and $BC = 6.5$ cm.
Draw triangle ABC in the space below. [2]

(a) **(i)** Construct the bisector of angle ABC. [1]

(ii) Construct the perpendicular bisector of the line BC. [1]

(b) These two lines intersect at P.

(i) Using P as the centre, PB as radius, draw a circle. [1]

(ii) The circle will pass through one of the other two vertices of the triangle.
Explain why this circle will pass through this vertex.

Answer b(ii)

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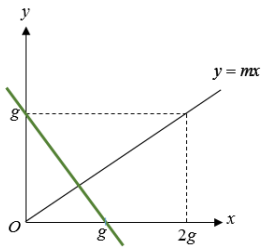
.....[1]

End of paper

2018 Catholic High School Preliminary Examination

Mathematics Paper 1 (4048/1)

1. $x = 21$
2. 34.1 cm
3. $\dfrac{112}{14-x}$
4. 540°
5. (a) $56\dfrac{1}{4}\%$
   (b) Not directly proportional
6. (a) $x = 4$
   (b) x must be a multiple of 3
7. (i) $m = \dfrac{1}{2}$
   (ii)



8. (a) 2.9 km
   (b) 78.125 km^2
9. (a) 35 cm
   (b) 3880 cm^3
10. $x = 2, y = -3$
11. $a = 2, b = 1, c = 3$
12. (a) $x^{\frac{1}{3}}$
    (b) $\dfrac{4}{y}$
13. (a) $6\dfrac{9}{20}$ hours or 6.45 hours
    (b) 387 km
    (c) 15.0 m/s
14. (a) (i) $166\dfrac{13}{32}$ cm
    (ii) 4.28 cm
    (b) The mean height of Class A (166 cm) is lower than that of Class B (168cm).
    The spread of the standard deviation in Class A is wider than that of Class B.
15. (a) $a(3x+4y)(2x-3y)$
    (b) $3x(3x+1)(3x+2)$
16. (a) $a = -\dfrac{3}{4}$ or $b = \dfrac{2}{5}$
    (b) $p = 2$

17. (a) $A = \{0, 2, 4, 6\}$

(b) (i) $S \cap B \neq \varnothing$ or $B \subset S$

(ii) There is no chicken that is black and not skinny. OR
All black chickens are skinny.

18. (a) *CDS* or *ABC*

(b) 9 cm

(c) 4.5 cm

19. (a) 50°

(b) 108°

20. 60°

21. (i) $\mathbf{P} = \begin{pmatrix} 0 & 250 & 100 \\ 750 & 600 & 300 \\ 500 & 200 & 0 \\ 0 & 600 & 0 \end{pmatrix}$ $\mathbf{Q} = \begin{pmatrix} 2.5 \\ 5 \\ 10 \end{pmatrix}$

(ii) $\mathbf{W} = \begin{pmatrix} 2250 \\ 7875 \\ 2250 \\ 3000 \end{pmatrix}$

(iii) $\mathbf{NP} = \begin{pmatrix} 12750 & 15650 & 3200 \end{pmatrix}$

12750, 15650 and 3200 represent the number of boxes of 2.5kg, 5kg and 10kg of washing detergent delivered to the supermarkets respectively.

(iv) $\begin{pmatrix} 12750 & 15650 & 3200 \end{pmatrix} \begin{pmatrix} 3.8 \\ 6.4 \\ 9.2 \end{pmatrix} = \begin{pmatrix} 178050 \end{pmatrix}$

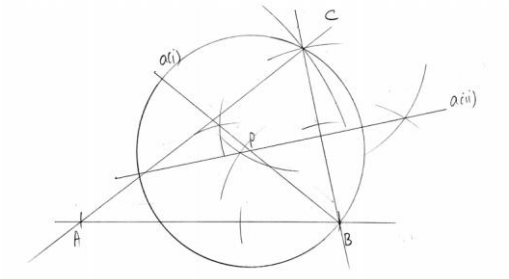
$178050

22. (a) 3.6 m/s

(b) $T = 110$

(c) 45 s

23. (a)(i), (a)(ii), (b)(i)



(b)(ii) Since *P* lies on the perpendicular bisector of *BC*, any point on this bisector is equidistant to *B* and *C*. Thus *PB* = *PC* and they are the radii of the circle. Hence the circle will pass through *C*.