Name: Register Number: Class:

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南僑中學

NAN CHIAU HIGH SCHOOL

END-OF-YEAR EXAMINATION 2016
SECONDARY THREE EXPRESS

MATHEMATICS
Paper 1

4048/01

4 October 2016, Tuesday

2 hours

Candidates answer on Question Paper

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number at the top of the cover page.
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** 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.
Calculators should be used 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 marks for this paper is 80.

Name: **Register Number:** **Class:**

Setter: Mr Yuen Wen Jun, Ms Tan Yi Chiann

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

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

Answer **all** the questions.

1 There is approximately 6.022×10^{23} atoms in 12 grams of Carbon.
An average Singaporean's mass is found to be approximately 58.935 kilograms.
It is given that 18.5% of a person's body mass is composed of Carbon.
Find the number of Carbon atoms found in an average Singaporean.
Leave your answer in standard form.

Answer ....atoms [2]

---

2 **(a)** List all the prime numbers that satisfy $-2 \le x < 11$.

Answer (a) .... [1]

(b) Solve the inequality $2x - 9 < x + 1 \le 2x - 5$.
Represent the solution on a number line.

Answer (b)

[2]

---

3 A salesman earns a 3% commission on the sales he makes.
He earned \$35 after selling a laptop that was on a 25% discount.
Find the original selling price of the laptop.

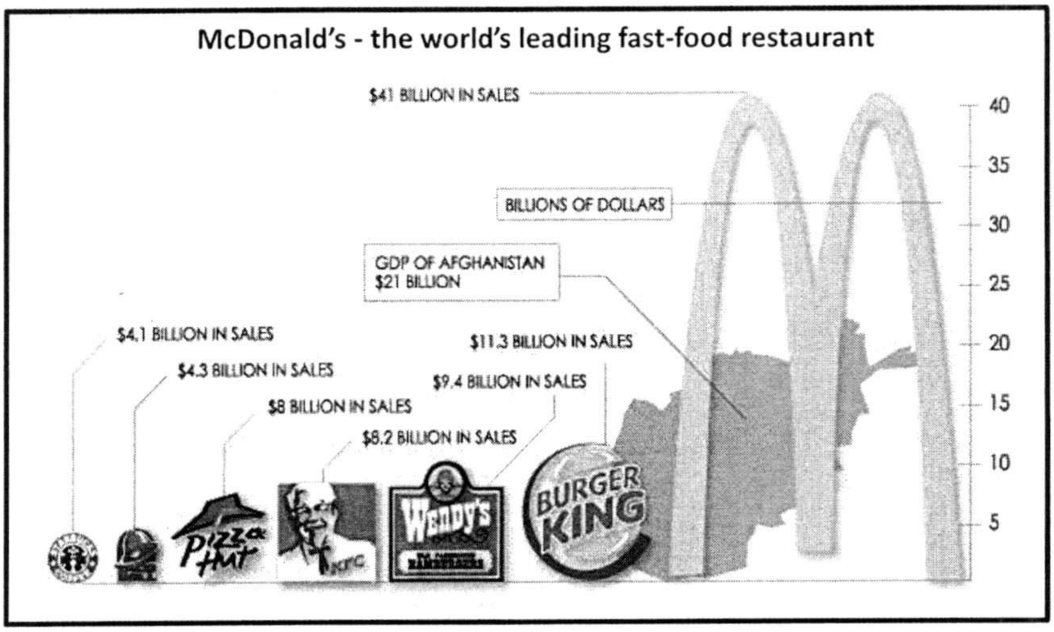
Answer \$ .... [2]

---

4 Singapore with an area of 719.1 km^2 is represented on a map by an area of 28.764 cm^2.
If the map has a scale of $1 : n$, find the value of n.

Answer $n =$ .... [2]

5 In 2002, a study was conducted by Princeton's International Networks Archive, to illustrate the sales by the leading global fast food restaurants, shown in the infographic below.



Explain one way in which the infographic is misleading.

....

....

.... [2]

---

6 Make x the subject for the equation $y = \dfrac{2x^2 - 1}{x^2 - 2}$.

Answer $x =$ .... [2]

7 Given that $\dfrac{\frac{1}{x}-\frac{1}{y}}{\frac{2}{y}-\frac{1}{x}}=\dfrac{1}{2}$, find the exact value of $\dfrac{y}{x}$.

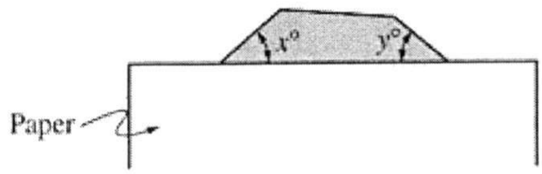
Answer $\dfrac{y}{x}=$ .... [3]

---

8 The remainder of $(k \div 13)$, $(k \div 14)$ and $(k \div 35)$ are all equal to 1.
Find the two smallest possible values of k.

Answer .... [3]

9 **(a)**



In the figure above, a regular polygon is partially covered with a sheet of paper.
If $x + y = 72$, find the number of sides that the polygon has.

Answer (a) .... [2]

(b) In a convex n-sided irregular polygon, the largest interior angle is 160° while the smallest interior angle is 130°.
Find the greatest and least possible value of n.

Answer (b) Greatest n =..........................

Least n =.......................... [3]

10 **(a)** The number of push-ups, N, done per minute by an NCC cadet is inversely proportional to his mass, m kg. If a 50 kg cadet can do 30 push-ups per minute, form an equation connecting N and m.

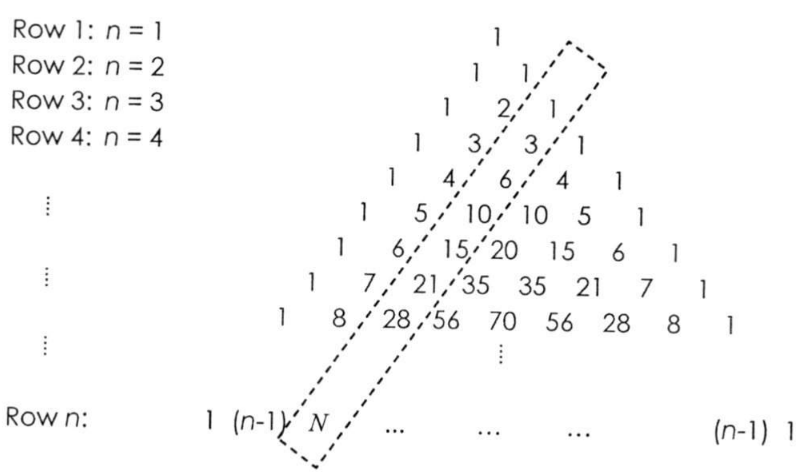
Answer (a) .... [2]

(b) Given that 3 NCC cadets can do a total of 12 push-ups in 5 seconds at the same time and assuming that all cadets will do push-ups at the same constant rate without getting tired. Find the amount of time needed for 20 cadets to do a total of 1600 push-ups at the same time.

Answer (b) .... seconds [2]

---

11 The figure below shows a Pascal's Triangle.



Find N, the third term from the left in the n-th row, where $n \geq 3$, in terms of n.

Answer $N =$ .... [2]

12 **(a)** Mr Lee has five children. His eldest child is 19 years old.
The mean, median and mode of his children's ages are all equal to 15.
Find the least possible age of the youngest child.

Answer (a) .... [2]

(b) It is further given that the mean age of the three eldest children is equal to 17.
Find the age of the youngest child.

Answer (b) .... [2]

---

13 **(a)** By using completing the square method, express $x^2 + 2x - \frac{5}{4}$ in the form $(x+h)^2 + k$.

Answer (a) .... [2]

(b) Write down the equation for the line of symmetry for $y = x^2 + 2x - \frac{5}{4}$.

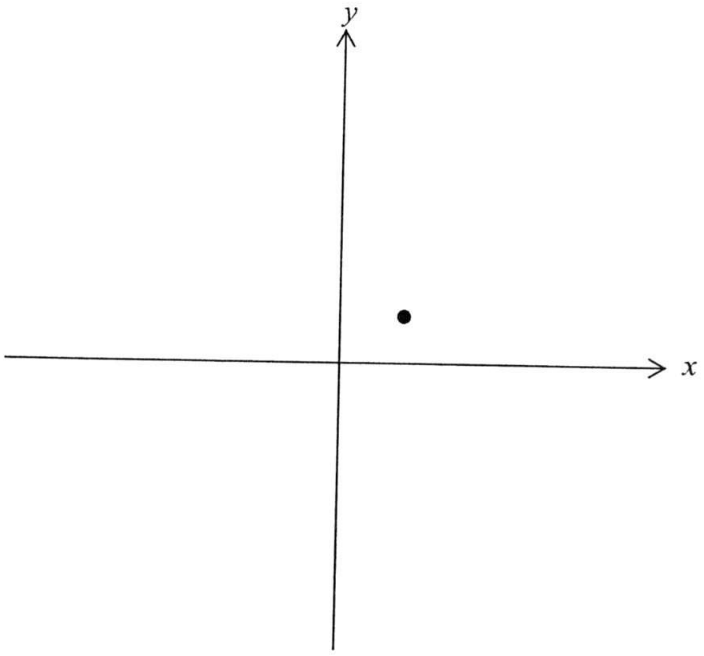
Answer (b) .... [1]

(c) Write down the coordinates of the minimum point for $y = x^2 + 2x - \frac{5}{4}$.

Answer (c) (........ , ...) [1]

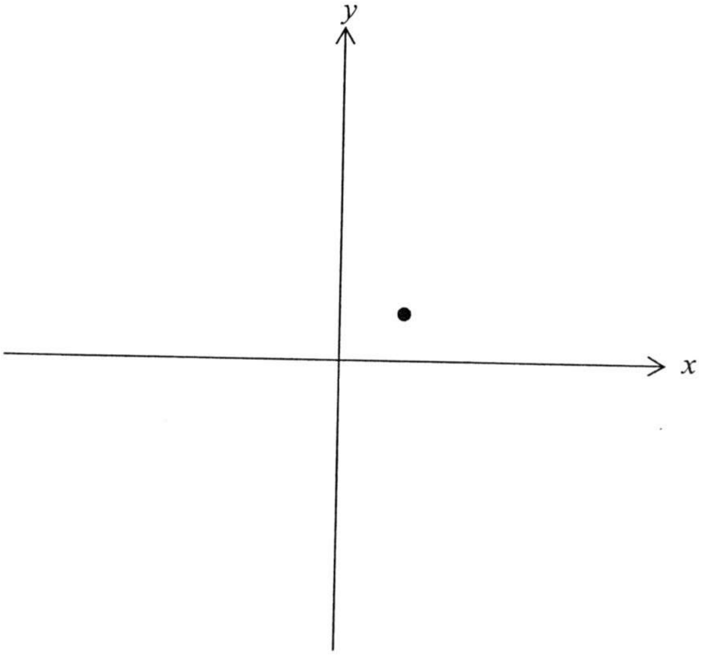
14 The point $(1, 1)$ is marked on the diagrams below.
Sketch the following graphs, indicating any x and/or y intercepts with the axes,

(a) $y = 3(4^x)$,



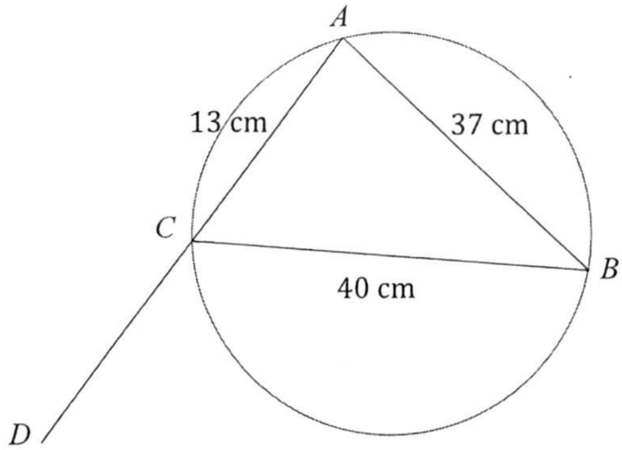
[2]

(b) $xy = 4x - 3$.



[2]

15 In the diagram, A, B and C lie on the circumference of the circle.
Given $AC = 13$ cm, $AB = 37$ cm, $BC = 40$ cm and ACD is a straight line.



(a) Explain why BC is not a diameter of the circle.

....

....

....

.... [2]

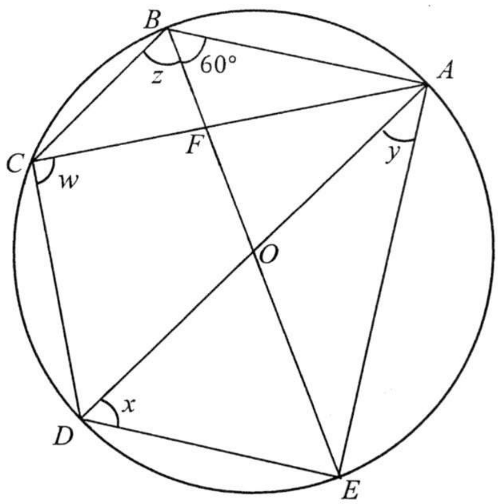
(b) Find the **exact value** of
(i) $\cos B\hat{C}D$,

Answer (b) (i) .... [3]

(ii) the shortest distance of A to BC.

Answer (b) (ii) .... cm [3]

16



In the diagram, the points A, B, C, D, E lie on a circle with centre O.
Lines AC and BE intersect at F such that $BC = FC$.
AOD and $BFOE$ are straight lines and $\angle OBA = 60^\circ$.

Find

(a) w,

(b) x,

(c) y,

(d) z.

Answers (*a*) $w =$ ....° [1]

(b) $x =$ ....° [1]

(*c*) $y =$ ....° [1]

(*d*) $z =$ ....° [2]

17 During Keven's recent holiday to Western Maryland (United States of America), he chanced upon a magnificent Brush Tunnel, shown in the figure 1.

Being a leading civil engineer, Keven decided to construct a similar railway tunnel in Singapore, to contribute as one of the tourism attraction.

In figure 2, he modelled the uniform cross-section of the Brush Tunnel, into a shape of a major segment $ABCD$, removed from a circle with centre O and radius 12 m.
Given BOD is a straight line and $BD = 17$ m. Angle $ABD = 90°$.

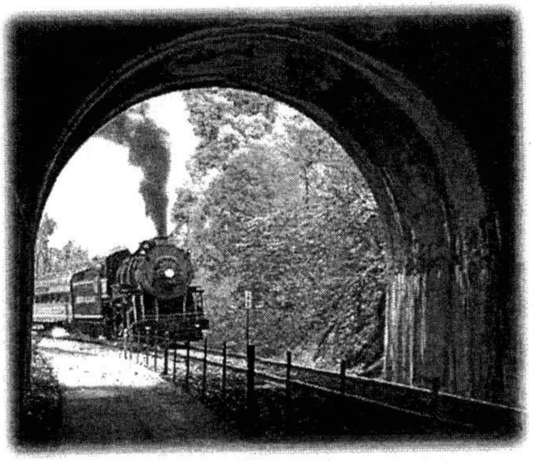


Figure 1

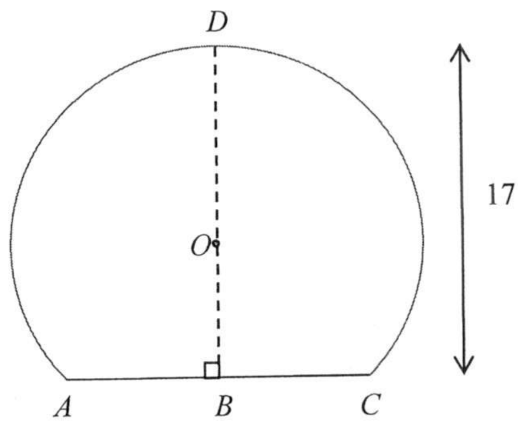
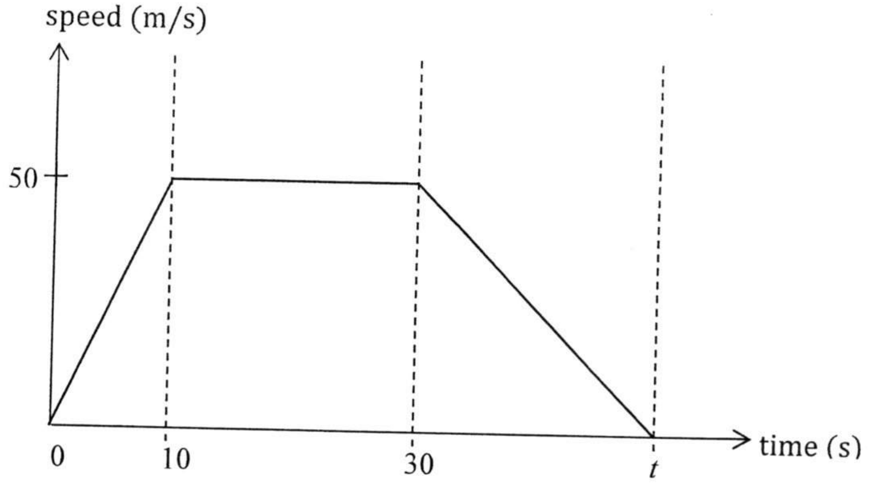


Figure 2

Calculate the volume of the tunnel that Keven has constructed if the length of the tunnel is 0.5 km long.

Answer .... m^3 [5]

18 The diagram shows the speed-time graph for a car journey.



(a) Calculate the acceleration of the car at 5 seconds.

Answer (a) .... ms^{-2} [1]

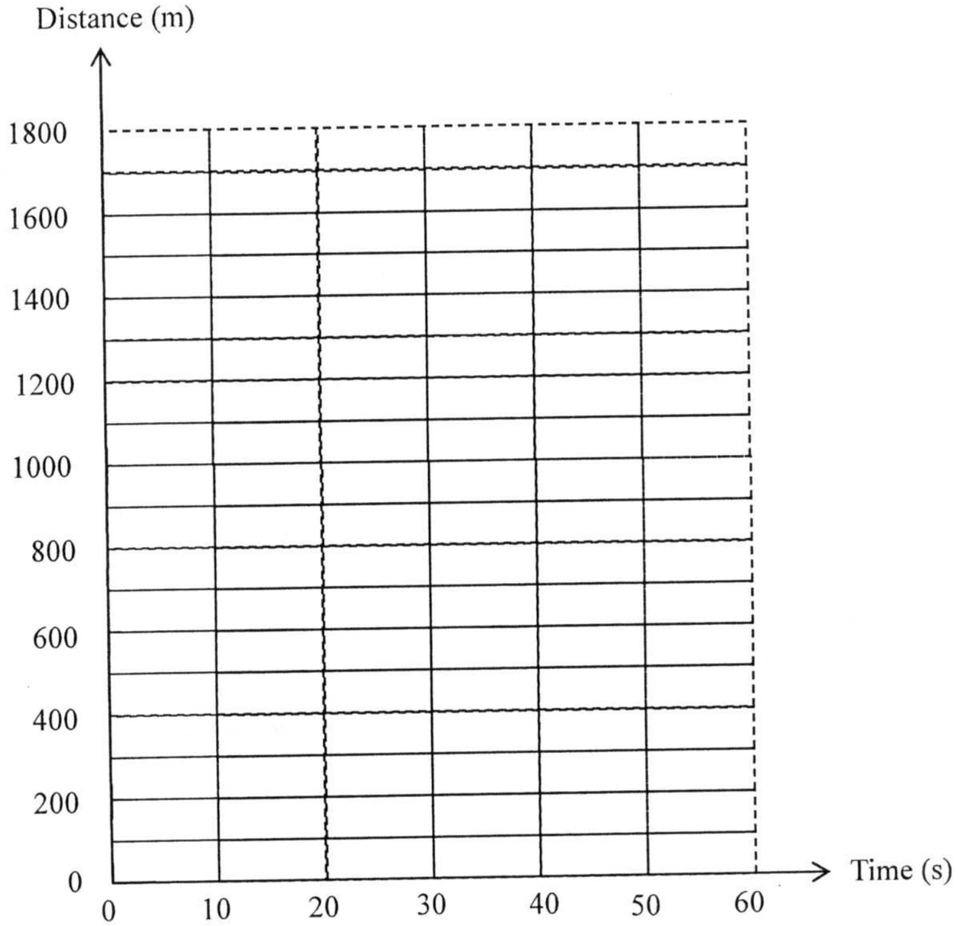
(b) Find the value of t, which the car comes to rest if its retardation is $2\frac{1}{2}$ m/s^2.

Answer (b) .... s [2]

(c) Calculate the total distance travelled.

Answer (c) .... m [2]

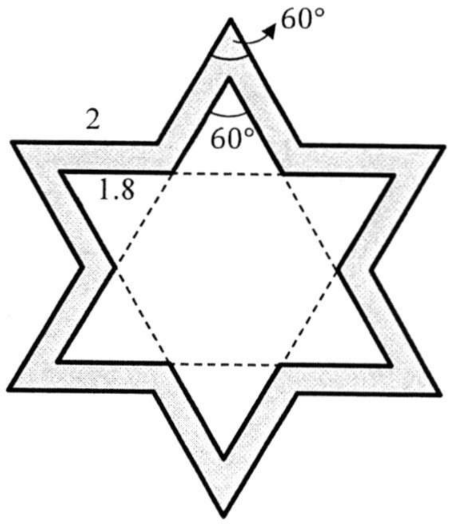
(d) Use the grid below to draw the distance-time graph for the journey.



[3]

19 The figure shows a gold pendant. The outer outline of the pendant has the shape of a regular 6-sided star and the inner outline of the pendant has the shape of another **similar** smaller regular 6-sided star.

The interior angles of both stars are 60° as shown.
The lengths of each side of outer star and inner star are 2 cm and 1.8 cm respectively.
The uniform thickness of the pendant is 0.3 cm.



Calculate the mass of the pendant if the density of gold is 19.32 g/cm^3.

Answer .... g [5]

20 Universal Studios Singapore (USS) provides an immersive entertainment experience in seven different zones as indicated on the map shown in figure 1.

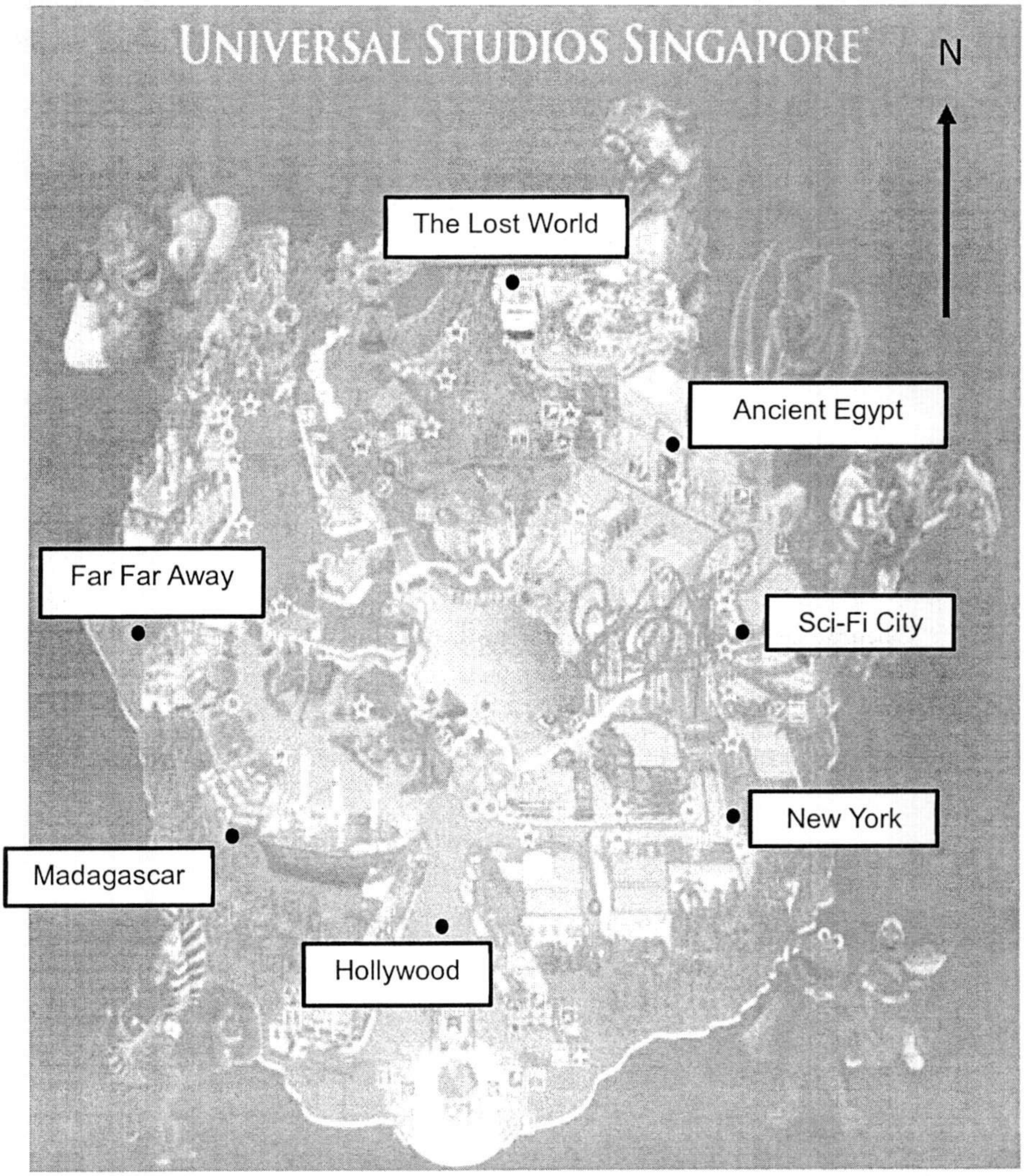


Figure 1

19

(a) In the recent Pokémon Go craze, the following information are given to locate the Pikachu Nest in USS:

- On a bearing of 205° from Ancient Egypt;
- 650 m away from Sci-Fi City .

Using the scale of 1 cm : 100 m, with appropriate constructions on figure 1, at which zone is the Pikachu Nest located?

Answer (a) .... [3]

(b) Niantic (the programming firm for Pokémon Go) builds a new gymnasium in USS, where tourists can send their Pokémons to battle virtually.

The location of the gymnasium in USS can be found with the given information:

- Equidistant from Far Far Away and Madagascar;
- Equidistant from the line which joined New York and Hollywood, and the line which joined New York and The Lost World.

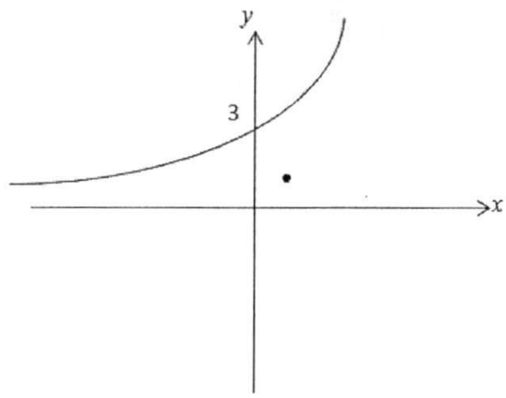
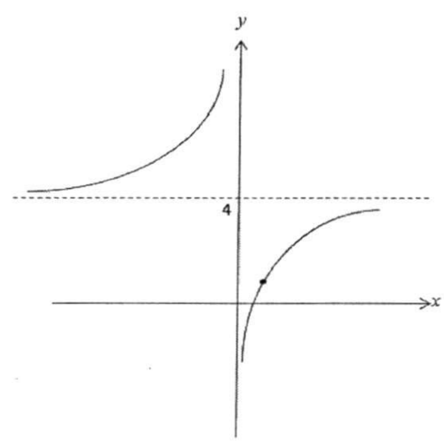
By constructing perpendicular and/or angle bisectors, locate and label the position of the gymnasium, G on figure 1. [3]

(c) Hence, estimate how far a Pokémon trainer would have to walk from the Pikachu Nest to the gymnasium, G.

Answer (c) .... m [1]

~ End of Paper ~

Answer Key

1	5.47×10^{26}
2	a) $2, 3, 5, 7$ b) $6 \leq x < 10$
3	$\$1555.56$
4	$n = 500{,}000$
5	1. The **title of the infographic** [B1] **didn't allow the readers to make their own judgement** on the leading fast-food restaurant [B1]. 2. The **size of the fast-food icon** [B1] **exaggerated the sales amount between the fast-food restaurants** [B1], for example Burger King to MacDonald's only differs in 4 times of sales but represented with almost 9 times in area.
6	$x = \pm\sqrt{\dfrac{2y-1}{y-2}}$
7	$\dfrac{y}{x} = \dfrac{4}{3}$
8	Smallest k = 911 or 1 2nd smallest k = 1821
9	a) 10 b) Greatest n = 14 Least n = 6
10	a) $N = \frac{1500}{m}$ b) 100
11	$\frac{(n-1)(n-2)}{2}$ OR $\frac{1}{2}n^2 - \frac{3}{2}n + 1$
12	a) $x = 8$ b) $y = 17, x = 9$
13	i) $=(x+1)^2 - \dfrac{9}{4}$ ii) $x = -1$ iii) $(-1, -\frac{9}{4})$
14	 
15	$BC^2 = 40^2 = 1600$; $AB^2 + AC^2 = 37^2 + 13^2 = 1538$ ($\neq BC^2$) [B1] Since $BC^2 \neq AB^2 + AC^2$ [B1] , $C\hat{A}B$ is not equal to 90° , BC is not a diameter of the circle. b) i) $-\frac{5}{13}$ ii) 12 cm
16	a) $w = 90°$ b) $x = 60°$ c) $y = 30°$ d) $z = 75°$
17	$171000\ m^3$
18	a) $5\ ms^{-2}$ b) $t = 50s$ c) $1750\ m$
19	22.9 g
20	a) Hollywood b) $4.3 \times 100 = 430\ m\ (\pm 10\ m)$

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

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

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

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

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 There is approximately 6.022×10^{-23} atoms in 12 grams of Carbon.
An average Singaporean's mass is found to be approximately 58.935 kilograms.
It is given that 18.5% of a person's body mass is composed of Carbon.
Find the number of Carbon atoms found in an average Singaporean.
Leave your answer in standard form.

$[(58.935 \times 1000 \times 0.185) \div 12] \times 6.022 \times 10^{-23}$ -----------[M1]
$= 5.47 \times 10^{26}$ ------------[A1] or [B2]

Answer ....atoms [2]

---

2 **(a)** List all the prime numbers that satisfy $-2 \le x < 11$.

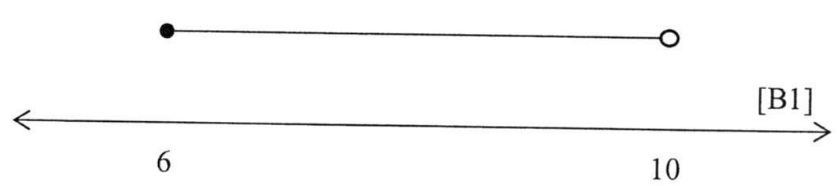
$2, 3, 5, 7$ ----------[B1]

Answer .... [1]

(b) Solve the inequality $2x - 9 < x + 1 \le 2x - 5$.
Represent the solution on a number line.

$-10 < -x \le -6$
$6 \le x < 10$ --------------[B1]

Answer



[2]

3 A salesman earns a 3% commission on the sales he makes.
He earned \$35 after selling a laptop that was on a 25% discount.
Find the original selling price of the laptop.

Sales price $= 35 \times \frac{100}{3}$ -----[M1]
Original price $= \frac{3500}{3} \times \frac{100}{75}$
$= \$1555.56$ (2d.p.) -----------[A1]

Answer \$........................ [2]

---

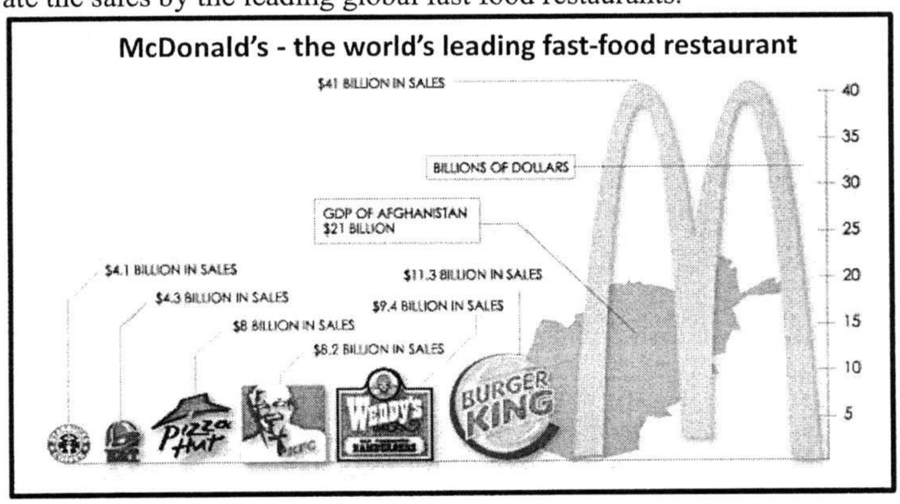
4 Singapore with an area of 719.1 km^2 is represented on a map by an area of 28.764 cm^2.
If the map has a scale of 1 : n, find the value of n.

$28.764\ \text{cm}^2 : 719.1\ \text{km}^2$
$1\ \text{cm}^2 : 25\ \text{km}^2$
1cm : 5km -----------[M1 for square root]
1 : 500,000 $n = 500{,}000$ --------[A1]

Answer .... [2]

---

5 In 2002, a study was conducted by Princeton's International Networks Archive, to illustrate the sales by the leading global fast food restaurants.



Explain one way in which the infographic is misleading.

[Misleading feature + effect] – accept any reasonable answer.

1. The **title of the infographic** [B1] **didn't allow the readers to make their own judgement** on the leading fast-food restaurant [B1].
2. The **size of the fast-food icon** [B1] **exaggerated the sales amount between the fast-food restaurants** [B1], for example Burger King to MacDonald's only differs in 4 times of sales but represented with almost 9 times in area. [2]

6 Make x the subject for the equation $y = \frac{2x^2 - 1}{x^2 - 2}$.

$y(x^2 - 2) = 2x^2 - 1$

$x^2(y-2) = 2y-1$ ----------[M1]

$x^2 = \frac{2y-1}{y-2}$

$x = \pm\sqrt{\frac{2y-1}{y-2}}$ ------------[A1]

Answer .... [2]

---

7 Given that $\dfrac{\frac{1}{x} - \frac{1}{y}}{\frac{2}{y} - \frac{1}{x}} = \frac{1}{2}$, find the exact value of $\frac{y}{x}$.

$\dfrac{\frac{y-x}{xy}}{\frac{2x-y}{xy}} = \frac{1}{2}$ -------------[M1]

$2(y-x) = 2x - y$ ---------[M1]

$3y = 4x$

$\frac{y}{x} = \frac{4}{3}$ ----------------------[A1]

Answer .... [3]

---

8 The remainder of $(k \div 13)$, $(k \div 14)$ and $(k \div 35)$ are all equal to 1.
Find the two smallest possible values of k.

$k - 1$ is a multiple of 13, 14, 35

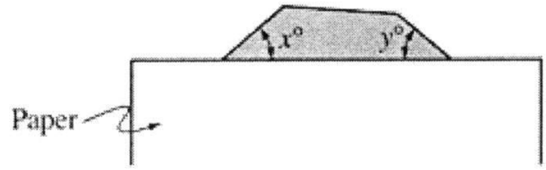
LCM of 13, 14, 35 = 910 -------------[M1]

Smallest $k = 910 + 1 = 911$ or 1 -------------[A1]
2nd smallest $k = 910 + 910 + 1 = 1821$ ---------------[A1]

Answer .... [3]

---

9 **(a)**



In the figure above, a regular polygon is partially covered with a sheet of paper.
If $x + y = 72$, find the number of sides that the polygon has.

$2 \times \textit{Interior angle} = 180 - 72 = 108$
$ext.angle = 180 - \frac{108}{2} = 36°$ -------[M1]
$Number\ of\ sides = \frac{360}{36} = 10$ ----------[A1]

Answer .... [2]

(b) In a convex n-sided irregular polygon, the largest interior angle is $160°$ while the smallest interior angle is $130°$.
Find the greatest and least possible value of n.

Smallest Ext. angle = 20°
Largest Ext. angle = 50° --------------- [M1 for either]

Greatest value of n:
Total Ext. angle $= 360 = (50 + 20 + [n - 2]20)$
$n = 14.5 = 14$ (round down) ------------[A1]

Least value of n:
Total Ext. angle $= 360 = (50 + 20 + [n - 2]50)$
$n = 5.8 = 6$ (round up) -------------[A1]

Answer .... [3]

10 **(a)** The number of push-ups done per minute, N, by an NCC cadet is inversely proportional to his mass, m. If a 50 kg cadet can do 30 push-ups per minute, find an equation connecting N and m.

$N = \frac{k}{m}$

$k = (50)(30) = 1500$ ----------[M1]

$N = \frac{1500}{m}$ ---------------------[A1]

Answer .... [2]

(b) Given that 3 NCC cadets can do a total of 12 push-ups in 5 seconds. Assuming that all the cadets do push-ups at a constant rate without getting tired, find the amount of time needed for 22 cadets to do 160 push-ups **each**.

Cadets	Push-ups	Seconds	
3	12	5	
1	4	5	----------[M1]
1	160	100	----------[A1]

Answer ....seconds [2]

---

11 The figure below shows a Pascal's Triangle.

Row 1: 1
Row 2: 1 1
Row 3: 1 2 1
Row 4: 1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 20 15 6 1
1 7 21 35 35 21 7 1
1 8 28 56 70 56 28 8 1
1 9 36 84 126 126 84 36 9 1
1 10 45 120 210 252 210 120 45 10 1
⋮
Row n: 1 n … … … n 1

Find the value of the third term from the left in the n-th row, where $n \geq 3$. Leave your answer in terms of n.

Find the value of the third term from the left in the n-th row, where $n \geq 3$.
Leave your answer in terms of n.

$\frac{(n-1)(n-2)}{2}$ OR $\frac{1}{2}n^2 - \frac{3}{2}n + 1$ ------------------[B2]

Answer .... [2]

12 **(a)** Mr Lee has five children. His eldest child is 19 years old.
The mean, median and mode of his children's ages are all equal to 15.
Find the least possible age of the youngest child.

$x, 15, 15, 18, 19$ -------------------[M1]

$\frac{x+15+15+18+19}{5} = 15$

$x = 8$ --------------[A1]

Answer .... [2]

(b) It is further given that the mean age of the three children is equal to 17.
Find the age of the youngest child.

$x, 15, 15, y, 19$

$\frac{15+y+19}{3} = 17$

$y = 17$ ------------------[M1]

$\frac{x+15+15+17+19}{5} = 15$

$x = 9$ --------------------[A1]

Answer .... [2]

---

13 **(i)** By using completing the square method, express $x^2 + 2x - \frac{5}{4}$ in the form $(x-h)^2 + k$.

$x^2 + 2x - \frac{5}{4} = (x+1)^2 - 1^2 - \frac{5}{4}$ ------------[M1]

$= (x+1)^2 - \frac{9}{4}$ -----------[A1]

Answer .... [2]

(ii) Write down the equation for the line of symmetry for $y = x^2 + 2x - \frac{5}{4}$.

$x = -1$ --------------[B1]

Answer .... [1]

(iii) Write down the coordinates of the minimum point for $y = x^2 + 2x - \frac{5}{4}$.

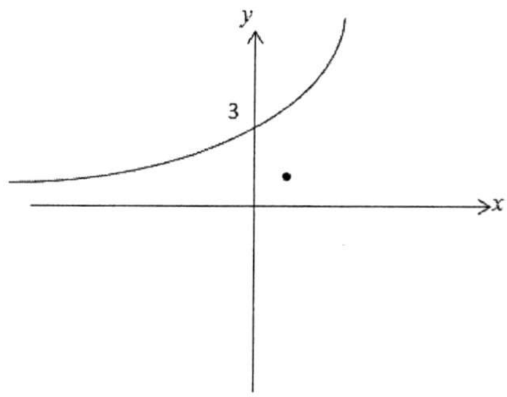
$(-1, -\frac{9}{4})$ -----------------[B1]

Answer .... [1]

---

14 The point $(1, 1)$ is marked on the diagrams below.
Sketch the following graphs, indicating any x and/or y intercepts with the axes,

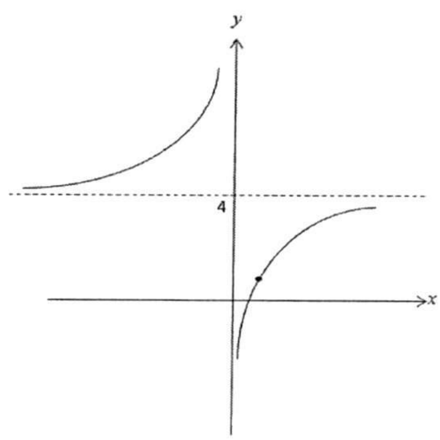
(i) $y = 3(4^x)$,



[2]

B1 – Shape
B1 – y-intercept

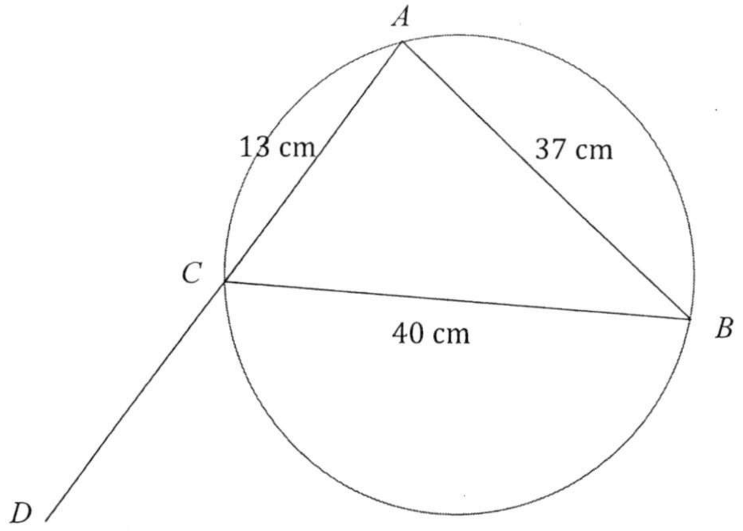
(ii) $xy = 4x - 3$.



[2]

B1- asymptote + shape
B1- graph thru (1, 1)

15 In the diagram, A, B and C lies on the circumference of the circle.
Given $AC = 13$ cm, $AB = 37$ cm, $BC = 40$ cm and ACD is a straight line.



(a) Explain why BC is not a diameter of the circle.

$BC^2 = 40^2 = 1600\ ; AB^2 + AC^2 = 37^2 + 13^2 = 1538\ (\neq BC^2)$ [B1]

Since $BC^2 \neq AB^2 + AC^2$ [B1] , $C\hat{A}B$ is not equal to 90° , BC is not a diameter of the circle.

[2]

(b) Find the **exact value** of

(i) $\cos B\hat{C}D$,

Consider ΔACB, using cosine rule,

$37^2 = 13^2 + 40^2 - 2(13)(40)\cos A\hat{C}B$ [M1]

$\cos A\hat{C}B = \frac{5}{13}$ [M1]

$\cos B\hat{C}D = -\cos A\hat{C}B = -\frac{5}{13}$ [A1]

Answer .... [3]

(ii) the shortest distance of A to BC.

$A\hat{C}B = \cos^{-1}\dfrac{5}{13}$

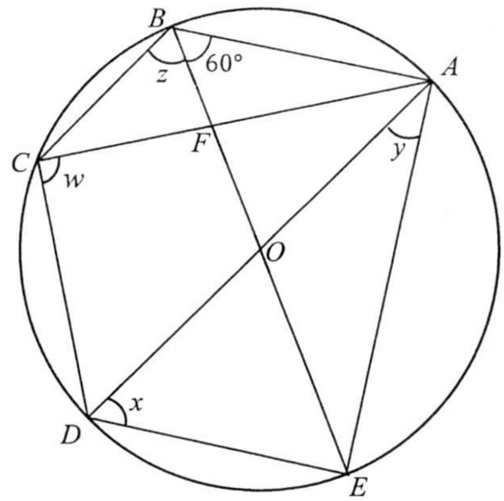
$area\ of\ \Delta ABC = \frac{1}{2}(13)(40)\sin(\cos^{-1}\frac{5}{13}) = \frac{1}{2}(shortest\ distance)(40)$

[M2]

$shortest\ distance = 12$ cm [A1]

Answer .... [3]

16



In the diagram, the points A, B, C, D, E lie on a circle, centre O.
Lines AC and BE intersects at F such that $BC = FC$.
AOD and BOE are diameters, and $\angle OBA = 60^\circ$.

Find

(a) w,

(b) x,

(c) y,

(d) z.

$w = 90^\circ$ (angle in semicircle) -------------------[B1]
$x = 60^\circ$ (angle in same segment) ---------------[B1]

$\angle DEA = 90^\circ$ (angle in semicircle)
$y = 180^\circ - 90^\circ - 60^\circ = 30^\circ$ (angle sum of triangle) --------------[B1]

$\angle OBA = \angle OAB = 60^\circ$ $(OA = OB = radius)$
$\angle BCD = 180 - 60 = 120^\circ$ (angles in opp. segment) ----------------[M1]
$\angle BCF = 120 - 90 = 30^\circ$
$z = \frac{180-30}{2}$ (base angle of isosceles triangle)
$z = 75^\circ$ -------------------------[A1]

Answers $w =$ ....$^\circ$ [1]

$x =$ ....$^\circ$ [1]

$y =$ ....$^\circ$ [2]

$z =$ ....$^\circ$ [2]

17 During Keven's recent holiday to Western Maryland (United States), he chanced upon a magnificent brush tunnel, shown in the **Figure 1**.

Being a leading civil engineer, Keven decided to initiate a project to bring railway trains into Singapore, to contribute as one of the tourism attractions.

He modelled the brush tunnel, shown in **Figure 2**, into a major segment *ABCD*, centre *O* and radius 12 m. *BD* = 17 m. Angle *ABD* = 90°.

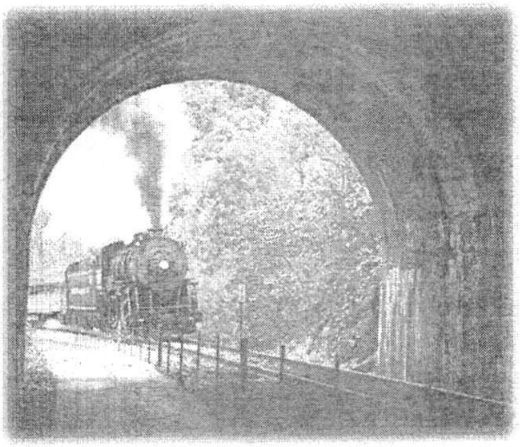


Figure 1

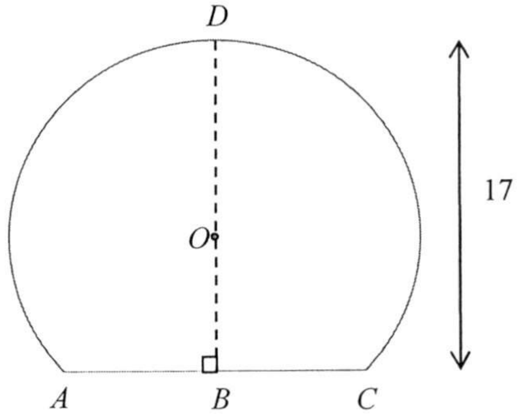


Figure 2

Calculate the area of the major segment which the railway train will be passing through.

$$BO = 17 - 12$$
$$= 5\,m$$

Consider ΔOBC,

$$\cos \angle BOC = \frac{5}{12}$$ [M1]

$$\angle BOC = 65.3757°$$

$$\text{Reflex } \angle AOC = 360° - 65.3757° \times 2 \quad (\angle at\ a\ point)$$ [M1]

$$= 229.2468°$$

$$area\ of\ sector\ AOC = \frac{229.2486°}{360°} \times \pi(12)^2$$
$$= 288.082\ m^2$$ [M1]

$$area\ of\ \Delta AOC = \frac{1}{2}(12)(12)\sin(65.3757° \times 2)$$
$$= 54.5435\ m^2$$

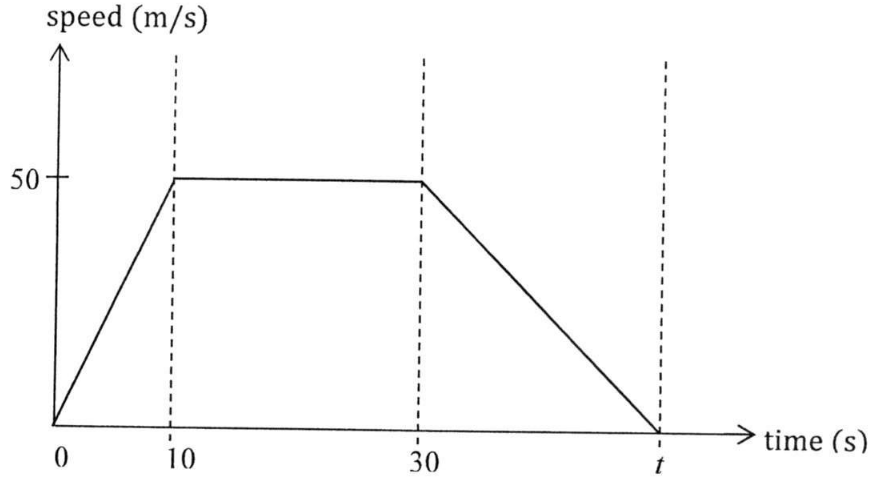
$$Volume = (288.082 + 54.5435) \times 500$$ [M1] – add area and 500 m

$$= 171313.0534\ m^3$$

$$= 171000\ m^3\ (to\ 3sf)$$ [A1]

Answer ....m^2 [5]

18 The diagram shows the speed-time graph for a car journey between two road junctions.



(a) Calculate the acceleration of the car after 5 seconds.

$$Acceleration = gradient = \frac{50}{10} = 5\ ms^{-2} \quad [B1]$$

Answer ....ms^{-2} [1]

(b) Calculate the time taken for the car to come to rest if the retardation is $2\frac{1}{2}\text{m/s}^2$.

$$-\frac{5}{2} = \frac{0 - 50}{t - 30} \quad [M1]$$

$$t = 50s \quad [A1]$$

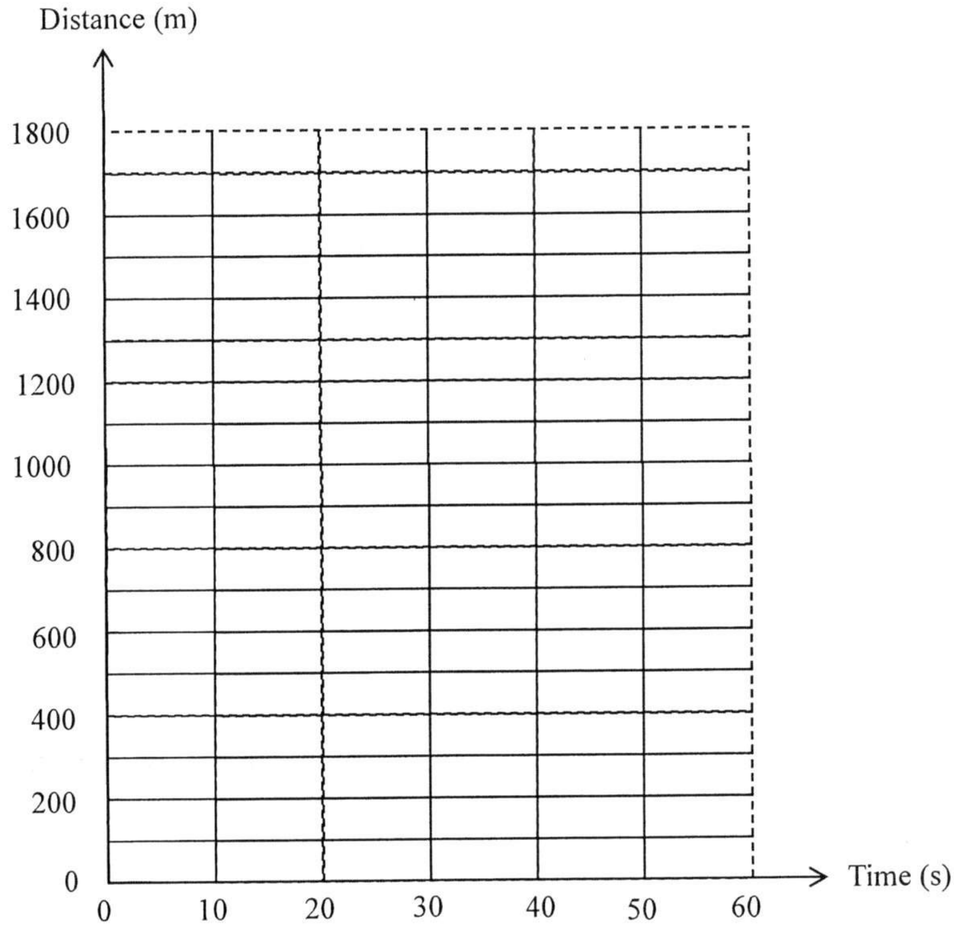
Answer ....s [2]

(c) Calculate the total distance travelled between the two road junctions.

$$total\ distance = \frac{1}{2}(50)(10) + (20)(30) + \frac{1}{2}(50 - 30)(50) \quad [M1]$$
$$= 1750\ m \quad [A1]$$

Answer ....m [2]

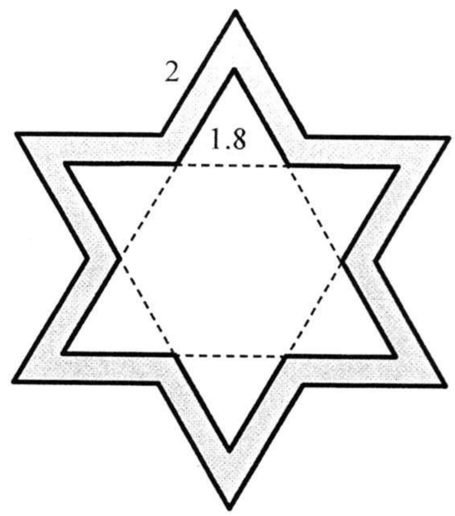
(d) Use the grid below to sketch the distance-time graph for the journey.



[3]

B1 – shape + end point of each segment

19 The shaded area in the figure below shows the cross section of a gold pendant is made up of two **similar** regular 6-sided star shape.



The outer length of the regular 6-sided star shape is 2 cm.
The inner length of the regular 6 sided star shape is 1.8 cm.
The uniform thickness of the pendant is 0.3 cm.

Calculate the mass of the pendant if the density of gold is $19.32\ \text{g/cm}^3$.

$$area\ of\ inner\ star = \frac{1}{2}(1.8)(1.8)\sin 60° \times 12 \quad \text{[M1]}$$
$$= 16.83553\ cm^2$$

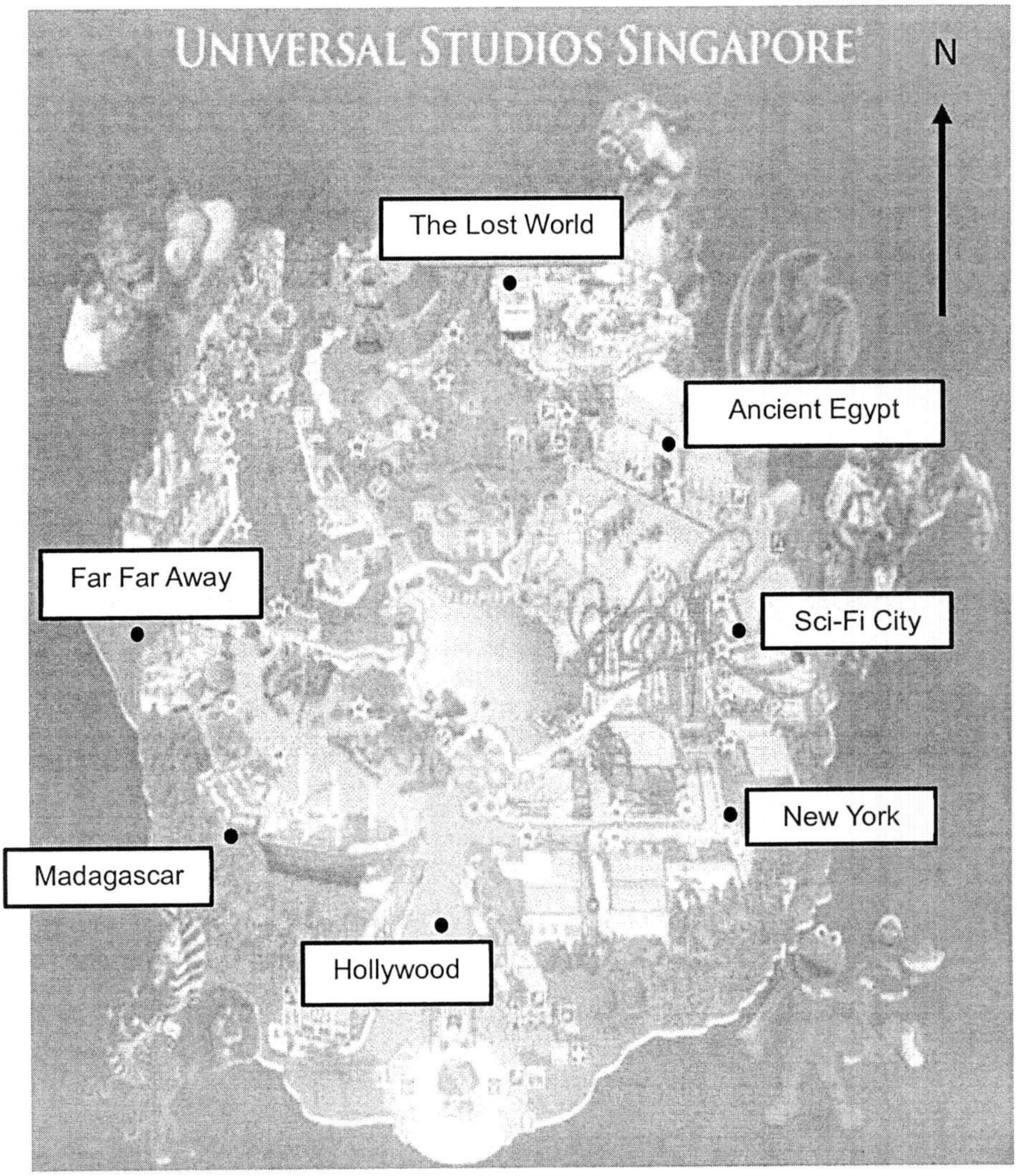
$$\frac{area\ of\ inner\ star}{area\ of\ outer\ star} = \left(\frac{1.8}{2}\right)^2$$
$$\frac{16.83553}{area\ of\ outer\ star} = \left(\frac{1.8}{2}\right)^2$$
$$area\ of\ outer\ star = 20.7846\ cm^2 \quad \text{[M1]}$$

$$volume = (20.7846 - 16.83553) \times 0.3 \quad \text{[M1]}$$

$$mass = density\ \times volume$$
$$= 19.32\ \times (20.7846 - 16.83553) \times 0.3 \quad \text{[M1]}$$
$$= 22.8888\ \text{g}$$
$$= 22.9\ \text{g (to 3sf)} \quad \text{[A1]}$$

Answer ....cm^3 [5]

20 Universal Studios Singapore (USS) provides an immersive entertainment experience in seven different zones as indicated at the map below.



(a) In the recent Pokémon Go craze, the following pieces of information are given to locate the Pikachu Nest:

- On a bearing of 205° from Ancient Egypt;
- 650 m away from Sci-Fi City .

Using 1 cm : 100m, with appropriate constructions, at which zone is the Pikachu Nest located?

Hollywood [B1]

Answer .... [3]

(b) Niantic (the programming firm for Pokémon Go), decided to build a new gym in USS, where tourists can send their Pokémons to battle virtually.

They have decided to locate the new gym

- equidistant from Far Far Away and Madagascar AND
- equidistant from the line along New York and Hollywood AND the line along New York and The Lost World.

By constructing perpendicular and/or angle bisectors, locate and label the position of the gym, G. [3]

© Find the distance in which a Pokémon trainer would have to walk from the Pikachu Nest to the gym, G.

$4.3 \times 100 = 430\ m\ (\pm 10\ m)\quad [B1]$

Answer .... [1]

~ End of Paper ~

Name: Register Number: Class:

南僑中學

NAN CHIAU HIGH SCHOOL

END-OF-YEAR EXAMINATION 2016
SECONDARY THREE EXPRESS

MATHEMATICS **4048/02**
Paper 2

6 October 2016, Thursday

2 hours 30 minutes

Additional Materials: Writing Papers (7 sheets)
Graph paper (1 sheet)

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 on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, 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 100.

Setter: Mrs Tan – Ng Su Peng, Mr Lee Ah Ngee

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

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

Answer **all** the questions.

1. **(a)** **(i)** Factorise completely $3x^2 - 48$. [2]

(ii) Hence simplify $\dfrac{3x^2 - 48}{3x^2 + 6x - 24}$. [2]

(b) Express as a single fraction in its simplest form [2]

$$\frac{m}{1-m} - \frac{4}{m-4}.$$

---

2. **(a)** Simplify $\left(\dfrac{2x^{-\frac{7}{18}}}{3y}\right)^{-3} \div \sqrt[3]{\sqrt{64xy^0}}$, expressing your answer in positive index form. [3]

(b) Solve the following equations.

(i) $16^x = \dfrac{1}{8}$ [2]

(ii) $\dfrac{10^{3a-1}}{\sqrt{10}} = 0.01$ [3]

---

3. **(a)** **(i)** Given that $f(x) = x^2 - 19x + b$ where $f(x)$ is a perfect square, find the value of b. [2]

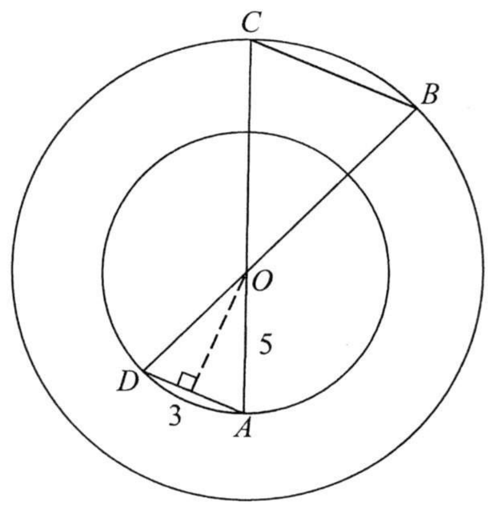
(ii) Hence, find the coordinates of the turning point of the graph of $y = f(x)$. [2]

(iii) Sketch the graph of $y = f(x)$, indicating the intercept(s) clearly. [3]

(b) Explain whether the graph of $y = f(x)$, sketched in **(a)(iii)**, will intersect the graph of $y = -(x-9.5)^2 - 1$. [2]

---

4. In the diagram, O is the centre of two concentric circles. A and D lie on the circumference of the smaller circle. B and C lie on the circumference of the larger circle. AOC and BOD are straight lines. The length of the radius, OA, of the smaller circle is 5 cm and the length of chord AD is 3 cm. It is given that $OA = \frac{5}{6} OB$.



(a) Prove that ΔOAD is similar to ΔOCB. [2]

(b) Find

(i) the perpendicular distance from O to the chord AD, [2]

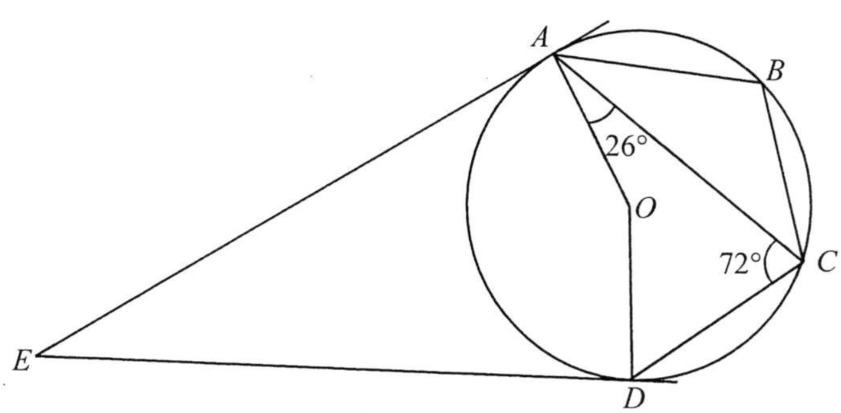
(ii) the length of CB, [3]

(iii) the distance between chords AD and BC. [2]

(c) Prove that ΔDOC is congruent to ΔAOB. [2]

---

5. The diagram shows a circle $ABCD$ with centre O. AE and DE are tangents to the circle. Given $\angle ACD = 72°$ and $\angle OAC = 26°$.



Find

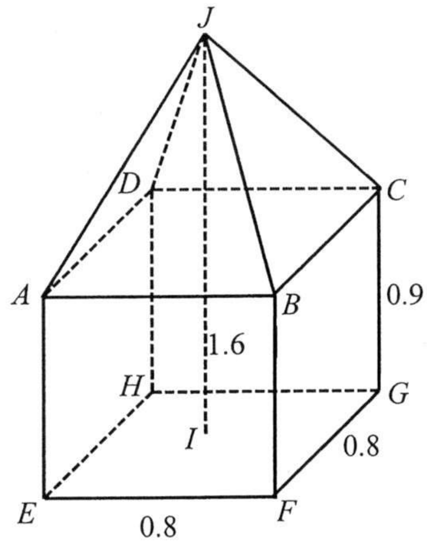
(a) $\angle AOD$, [1]

(b) $\angle OED$, [2]

(c) $\angle ADC$, [2]

(d) $\angle ABC$. [1]

6. A sculpture consists of a right pyramid, *JABCD* attached to a cuboid *ABCDEFGH* of height 0.9m. *ABCD* and *EFGH* are squares of side 0.8 m.
The vertical height, *IJ*, of the toy block is 1.6 m, and *JA*, *JB*, *JC*, *JD* are equal in length.



Calculate

(a) the volume of the sculpture, [3]

(b) the total surface area of the sculpture. [3]

---

7. Mr Ho drove a total distance of 420 km from Malacca to Kuala Lumpur.

(a) For the first $\frac{5}{6}$ of his journey, Mr Ho's average speed was x km/h. [1]
Write down an expression for the time, in hours, that Mr Ho took to travel this part of the journey.

(b) If the average speed of the remaining part of the journey is increased by 10 km/h, write down an expression for the time, in hours, that Mr Ho took for this part of the journey. [1]

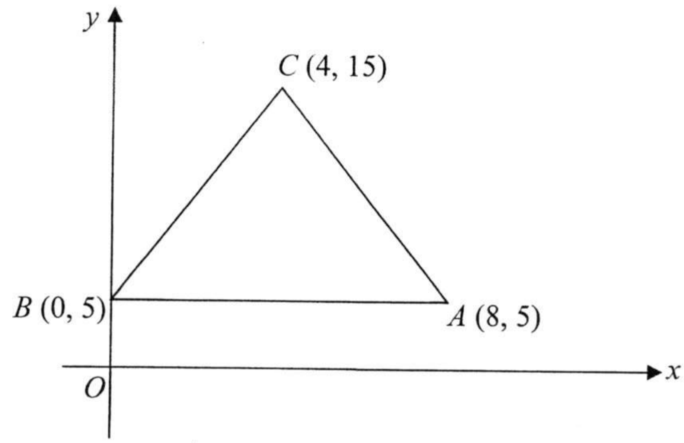
(c) Given that the total time taken for the whole journey was 5 hours and 20 minutes, form an equation in x and show that it reduces to $4x^2 - 275x - 2625 = 0$. [3]

(d) Solve the equation $4x^2 - 275x - 2625 = 0$. [3]

(e) How much time Mr Ho would have taken longer if he covers the whole journey with an average speed of x km/h? Give your answer correct to the nearest minutes. [2]

---

8. In the diagram, the points A, B and C have coordinates (8, 5), (0, 5) and (4, 15).

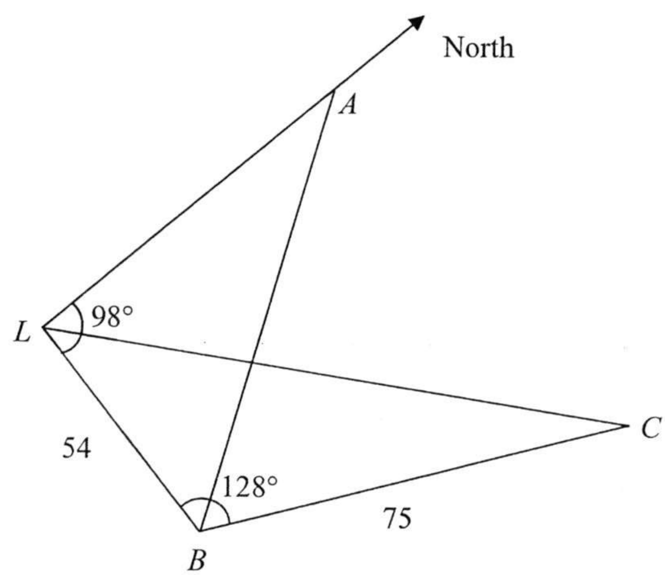


(a) Find the equation of the line passing through the midpoint of AC and parallel to the line $3y + 2x = 5$. [3]

(b) Calculate
(i) the area of the triangle ABC, [1]
(ii) the length of BC, [1]
(iii) the perpendicular distance from A to BC. [2]

---

9. The diagram shows the positions of three ships A, B and C and a lighthouse, L, which is is due south of A. The bearing of B from L is 098° and $\angle LBC = 128°$. $LB = 54$ km and $BC = 75$ km.



(a) Calculate the distance CL. [2]

(b) Calculate the bearing of C from B. [2]

(c) The bearing of B from A is 135°. Calculate the distance AB. [3]

(d) The ship C is moving towards the lighthouse L with a constant speed of 18 km/h. If it starts at 1300, at what time would it be nearest to B? [5]

10. **(a)** In Figure 1, part of the solid cylinder is sliced along AB to produce the solid shown in Figure 2. In Figure 2, the cross-section ACB of the slice is a segment of a circle of centre O and $\angle AOB = 90^o$.

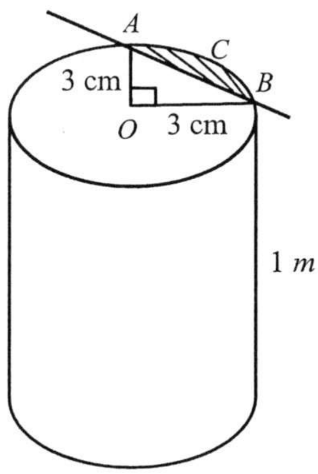


Figure 1

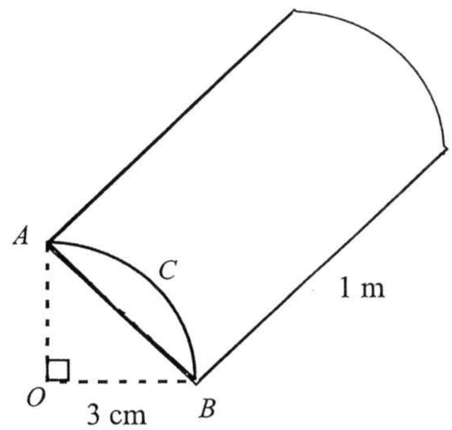


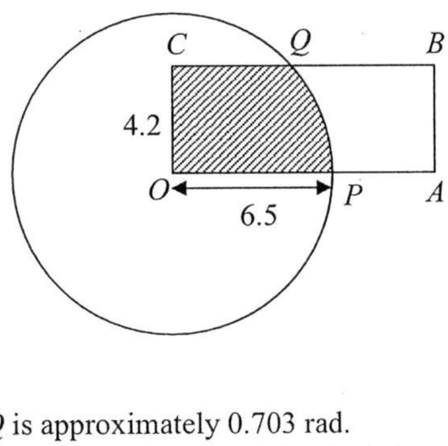
Figure 2

Find

(i) the area of the segment ACB, [2]

(ii) the total surface area of the slice in figure 2. [3]

(b) $OABC$ is a rectangle. The width, OC, of the rectangle is 4.2 cm. The radius of the circle with centre O is 6.5 cm. The rectangle intersects the circle at P and Q.



(i) Show that $\angle POQ$ is approximately 0.703 rad. [2]

(ii) Calculate the perimeter and the area of the shaded region. [6]

11. **Answer the whole of this question on a sheet of graph paper.**

The table gives some values of x and the corresponding values of y, correct to one decimal place, where $y = \frac{18}{x^2} + 3x$.

x	1	1.5	2	2.5	3	3.5	4	4.5
y	21.0	12.5	10.5	10.4	11.0	12.0	13.1	p

(a) Find the value of p. [1]

(b) Using a scale of 4 cm to represent 1 unit, draw a horizontal x-axis for $0 \le x \le 4.5$. [3]
Using a scale of 1 cm to represent 1 unit, draw a vertical y-axis for $0 \le y \le 21$.
On your axes, plot the points given in the table and join them with a smooth curve.

(c) By drawing a tangent, find the gradient of the curve at the point where $x = 2$. [2]

(d) Use your graph to find

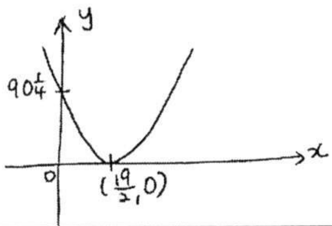
(i) the least value of y, [1]

(ii) the values of x for which $3x + \frac{18}{x^2} = 14$, [2]

(iii) the values of x for which $\frac{18}{x^2} + 3x \le 18 - 2x$. [3]

--- End of Paper ---

E Maths Paper 2 for students checking

Qn	Answer
1(a)(i)	$3(x-4)(x+4)$
1(a)(ii)	$\dfrac{x-4}{x-2}$
1(b)	$\dfrac{m^2-4}{(1-m)(m-4)}$ or $\dfrac{(m-2)(m+2)}{(1-m)(m-4)}$ or $\dfrac{m^2-4}{-x^2+5m-4}$
2(a)	$\dfrac{27y^3x}{16}$
2(b)(i)	$x=\dfrac{-3}{4}$
2(b)(ii)	$a=-\dfrac{1}{6}$
3(a)(i)	$a=\dfrac{-19}{2}\ or\ \dfrac{19}{2}$ $b=\left(\dfrac{19}{2}\right)^2=90\dfrac{1}{4}$
3(a)(ii)	$\therefore\left(\dfrac{19}{2},0\right)$
3(a)(iii)	
3(b)	The graph of y = - (x – 9.5)^2 – 1 has a maximum point at (19/2 , -1). Which is below the minimum pt of the graph of y = f(x). Hence the graphs will **not** intersect.
4(a)	$\angle AOD=\angle BOC$ (vert. opp. $\angle$) $\angle ODA=\dfrac{180°-\angle AOD}{2}$ $=\dfrac{180°-\angle BOC}{2}$ $=\angle OBC$ ΔOAD is similar to ΔOCB (AA similarity test) OR

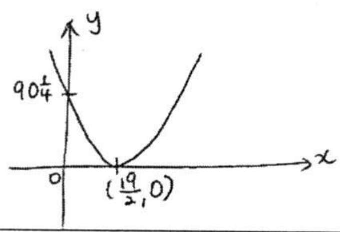
	$\angle AOD=\angle BOC$ (vert. opp. $\angle$) $\dfrac{DO}{BO}=\dfrac{AO}{CO}=\dfrac{5}{6}$ ΔOAD is similar to ΔOCB (SAS similarity test)
4bi	4.77 cm.
bii	$OA=\dfrac{5}{6}OB$ $5cm=\dfrac{5}{6}OB$ $OB=6cm$ Using similar triangles, $\dfrac{6}{CB}=\dfrac{5}{3}$ $CB=\dfrac{18}{5}cm/3\dfrac{3}{5}cm$ or 3.6 cm
(b)(ii)	10.5 cm
(b)(iii)	$\Delta DOC\equiv\Delta AOB$ (SAS)
5. (a)	144°
(b)	18°
(c)	64°
(d)	116°
6(a)	$\dfrac{272}{375}m^3$
6(b)	4.81m^2
7a	Time taken $=\dfrac{350}{x}h$
7(b)	Time taken $=\dfrac{70}{x+10}h$
7(c)	$\dfrac{350}{x}+\dfrac{70}{x+10}=5+\dfrac{20}{60}=\dfrac{16}{3}$
7(d)	6 *min*
7(e)	

E Maths Paper 2 for students checking

8(a)	$y = -\frac{2}{3}x + 14$
(bi)	40 sq units
bii	length of $BC = \sqrt{(0-4)^2 + (5-15)^2}$ $= 10.8$ units
biii	$\therefore h = 7.43\ units$
9(a)	116 km
(b)	046°
(c)	69.8km
(d)	16 53
10ai	2.57 cm^2
10ii	901 cm^2
10bI	0.703 rad (shown)
10bii	25.3 cm^2

2016 Sec 3 EOY Paper 2 marking scheme

Question	Answer	Marks
1(a)(i)	$3x^2 - 48$	
	$= 3(x^2 - 16)$	M1
	$= 3(x-4)(x+4)$	A1
1(a)(ii)	$\dfrac{3x^2 - 48}{3x^2 + 6x - 24}$	
	$= \dfrac{3(x-4)(x+4)}{3(x^2+2x-8)}$	
	$= \dfrac{(x-4)(x+4)}{(x+4)(x-2)}$	M1
	$= \dfrac{x-4}{x-2}$	A1
1(b)	$\dfrac{m}{1-m} - \dfrac{4}{m-4}$	
	$= \dfrac{m(m-4) - 4(1-m)}{(1-m)(m-4)}$	
	$= \dfrac{m^2 - 4m - 4 + 4m}{(1-m)(m-4)}$	M1
	$= \dfrac{m^2 - 4}{(1-m)(m-4)}$ or $\dfrac{(m-2)(m+2)}{(1-m)(m-4)}$ or $\dfrac{m^2-4}{-x^2+5m-4}$	A1
2(a)	$(\dfrac{2x^{-\frac{7}{18}}}{3y})^{-3} \div \sqrt[3]{\sqrt{64xy^0}}$	
	$= (\dfrac{3y}{2x^{-\frac{7}{18}}})^3 \times \dfrac{1}{\sqrt[3]{\sqrt{64x}}}$ (convert divide to multiply, power 0 = 1)	M1
	$= \dfrac{27y^3x^{\frac{7}{6}}}{8} \times \dfrac{1}{2x^{\frac{1}{6}}}$ (power 3 goes in and simplify the root)	M1
	$= \dfrac{27y^3x}{16}$	A1
2(b)(i)	$16^x = \dfrac{1}{8}$	
	$2^{4x} = 2^{-3}$	M1
	$4x = -3$	
	$x = \dfrac{-3}{4}$	A1
2(b)(ii)	$\dfrac{10^{3a-1}}{\sqrt{10}} = 0.01$	
	$10^{3a-1\frac{1}{2}} = 10^{-2}$	M1

	$3a-1\frac{1}{2}=-2$	M1
	$3a=-\frac{1}{2}$	
	$a=-\frac{1}{6}$	A1
3(a)(i)	$x^2-19x+b$ $=(x+a)^2 or (x-a)^2$ $x^2+2ax+a^2=x^2-19x+b$ $x^2-2ax+a^2=x^2-19x+b$ $a=\frac{-19}{2} or \frac{19}{2}$ ------M1 $b=\left(\frac{19}{2}\right)^2=90\frac{1}{4}$ ----A1 Or $f(x)=\left(x-\frac{19}{2}\right)^2+b-\left(\frac{19}{2}\right)^2$ $b-\left(\frac{19}{2}\right)^2=0$ --------- M1 $b=\left(\frac{19}{2}\right)^2=90\frac{1}{4}$ -------- A1	shown
3(a)(ii)	$f(x)=x^2-19x+90\frac{1}{4}=\left(x-\frac{19}{2}\right)^2$	
	$\therefore\left(\frac{19}{2},0\right)$	B1 – correct x B1 – correct y
3(a)(iii)	 G1 - shape G1 - y-intercept G1 - turning pt at correct position	
3(b)	The graph of y = - (x – 9.5)² – 1 has a maximum point at (19/2 , -1). Which is below the minimum pt of the graph of y = f(x). Hence the graphs will **not** intersect.	M1 A1
	OR	
	Equate - (x – 9.5)² – 1 = (x – 9.5)² and derive the discriminant to be -8. No real roots – no intersections	M1 A1
	OR	
	Try to solve - (x – 9.5)² – 1 = (x – 9.5)² and realise that (x – 9.5)² < 0 which is not possible. No solutions for x – no intersections.	M1 A1
	OR	
	Max value of y for graph of y = - (x – 9.5)² – 1 is -1 while m value of y = f(x) is 1.	
	OR	
	Graph of y = - (x – 9.5)² – 1 is a reflection of y = f(x) about the x-axis followed by shifting downwards by 1 unit / reflection about y = -.05. Hence, the graphs will not intersect.	M1 A1
	OR	
	Graph of y = - (x – 9.5)² – 1 is always negative while graph of y = f(x) is never negative (cannot say always positive as it sits on x- axis). Hence no intersection.	M1 A1
4(a)		M1

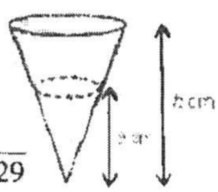
	$\angle AOD = \angle BOC$ (vert. opp. $\angle$) $\angle ODA = \dfrac{180° - \angle AOD}{2}$ $= \dfrac{180° - \angle BOC}{2}$ $= \angle OBC$	$\angle AOD = \angle BOC$ (vert. opp. $\angle$) $\dfrac{DO}{BO} = \dfrac{AO}{CO} = \dfrac{5}{6}$	
	ΔOAD is similar to ΔOCB (AA similarity test)	ΔOAD is similar to ΔOCB (SAS similarity test)	A1
(b)(i)	Perpendicular distance = $\sqrt{5^2 - \left(\dfrac{3}{2}\right)^2}$		M1
	= 4.77 cm.		A1
(b)(ii)	$OA = \dfrac{5}{6} OB$		
	$5cm = \dfrac{5}{6} OB$		
	$OB = 6cm$		M1
	Using similar triangles,		
	$\dfrac{6}{CB} = \dfrac{5}{3}$		M1
	$CB = \dfrac{18}{5} cm / 3\dfrac{3}{5} cm$ or 3.6 cm		A1
(b)(iii)	Perpendicular distance from O to CB		
	$= \sqrt{6^2 - (\dfrac{18}{5} \div 2)^2}$		M1
	$= \sqrt{32\dfrac{19}{25}}$		
	= 5.7236 cm		
	Distance between chords		
	= 5.7236 + 4.7697		M1
	= 10.5 cm (to 3 sf)		A1
(c)	OC = OB (isos Δ)		M1
	$\angle DOC = \angle AOB$ (vert.opp. $\angle$)		
	OD = OA (isos Δ)		
	$\Delta DOC \equiv \Delta AOB$ (SAS)		A1
5.			
(a)	$\angle AOD = 2 \times 72° = 144°$		B1
(b)	$\angle ODE = 90°$ (tan $\perp$ *rad*)		M1
	$\angle EOD = 144° \div 2 = 72°$		
	$\angle OED = 180° - 90° - 72° = 18°$		A1
(c)	$\angle OAD = \dfrac{180° - 144°}{2} = 18°$		M1
	$\angle ADC = 180° - 26° - 72° - 18° = 64°$		A1
(d)	$\angle ABC = 180° - 64° = 116°$		B1
6(a)	Height of pyramid = 1.6 – 0.9 = 0.7 m		

	Volume of pyramid = $\frac{1}{3}\times 0.8\times 0.8\times 0.7=\frac{56}{375}m^3$	M1
	Volume of cuboid = $0.8\times 0.8\times 0.9=\frac{72}{125}m^3$	M1
	Total volume = $\frac{56}{375}+\frac{72}{125}=\frac{272}{375}m^3$	A1
6(b)	Let the centre of base of pyramid be O.	
	Let the midpt of AB be M.	
	$JM=\sqrt{0.7^2+0.4^2}=\sqrt{\frac{13}{20}}$	M1
	Surface area of one slanted side of pyramid	
	$=\frac{1}{2}\times 0.8\times\sqrt{\frac{13}{20}}=0.32249m^2$	M1
	Total surface area = 4 X 0.32249 + (0.8 X4)(0.9) + 0.8 X 0.8	
	= 4.80996 = 4.81m^2	A1
7a	First $\frac{5}{6}$ distance = $\frac{5}{6}$ x 420 = 350 km Time taken = $\frac{350}{x}h$	
7(b)	Remaining journey = 420 – 350 = 70 km Time taken = $\frac{70}{x+10}h$	
7(c)	$\frac{350}{x}+\frac{70}{x+10}=5+\frac{20}{60}=\frac{16}{3}$ $3(420x+3500)=18x(x+10)$ $1260x+10500=16x^2+160x$ $16x^2-1100x-10500=0$ $8x^2-550x-5250=0$ $4x^2-275x-2625=0$	
7(d)	$x=\frac{275\pm\sqrt{275^2-4(4)(-2625)}}{2(4)}$ $=77.2 \quad or \quad -8.49$	
7(e)	Extra time taken = $\frac{420}{77.2}-5\frac{1}{3}$ = 0.10708 *h* = 6 *min*	
8(a)	Midpoint of *AC* = $\left(\frac{4+8}{2},\frac{15+5}{2}\right)$ = (6, 10) For line 3*y* + 2*x* = 5 $y=-\frac{2}{3}x+\frac{5}{3} \Rightarrow m=-\frac{2}{3}$ With $m=-\frac{2}{3}, pt\ (6,10)$	

	Equation of the line is $y-10=-\frac{2}{3}(x-6)$ $y=-\frac{2}{3}x+14$	
(bi) bii biii	area of ΔABC $=\frac{1}{2}\begin{vmatrix}0 & 8 & 4 & 0\\ 5 & 5 & 15 & 5\end{vmatrix}$ = 40 sq units length of *BC* = $\sqrt{(0-4)^2+(5-15)^2}$ = 10.8 units let h be the perpendicular distance $\frac{1}{2}\times 10.77\times h=40$ $\therefore h=7.43\ units$	
9(a) (b) (c) (d)	$CL=\sqrt{54^2+75^2-2\times 54\times 75\times\cos 128°}$ = 116.309 = 116 *km* $\theta = 180°-98°=82°$ $\alpha=128°-82°=46°$ $\therefore bearing\ of\ C\ from\ B\ is\ 046°$ $\beta=180°-135°=45°$ $\frac{AB}{\sin 98°}=\frac{54}{\sin 45°}$ $AB=\frac{54\times\sin 98°}{\sin 45°}=75.624=75.6\ km$ $\frac{\sin\delta}{54}=\frac{\sin 128}{116.309}$ $\delta=\sin^{-1}(\frac{54\times\sin 128}{116.309})=21.46^0$ $\therefore d=75\times\cos 21.46°=69.80049=69.8km$ Time taken = $\frac{69.80049}{18}=3hrs53\min$ At time it would be nearest to *B* is 13 00 + 3 hrs 53 min = 16 53	
10ai 10ii	area of segment = $\frac{1}{4}\times\pi\times 3^2-\frac{1}{2}\times 3\times 3$ $=2.57\ cm^2$ total surface area of the slice = $2.569\times\frac{1}{4}(2\pi)(3)(100)+\sqrt{3^2+3^2}\times 100$ = 5.138 + 471.239 + 424.264 = 900.641 = 901 cm^2	
10bI	$\cos\theta=\frac{4.2}{6.5}$ ϑ = 0.86826 *rad* $\angle POQ=\frac{\pi}{2}-0.86826$ = 0.703 *rad* (shown)	
10bii	Arc length *PQ* =6.5 x 0.7025 = 4.56625 *cm*	

	CQ $= \sqrt{6.5^2 - 4.2^2}$ $= 4.96085$ *cm* Perimeter of the shaded region = 6.5 + 4.2 + 4.96085 + 4.56625 = 20.2 *cm* Area of the shaded region $= \frac{1}{2} \times 4.2 \times 4.96085 + \frac{1}{2} \times 6.5^2 \times 0.703$ $= 25.3\ cm^2$	
11		

3(b)	44 marks	5(b)	10.25 cm or $10\frac{1}{4}$ cm
3(c)	57.1%	6(a)	$25(20)-2x(x+1)$

6(b)	$25(10)+x(2x+1)$	8(b)(iv)	301°
6(c)(i)	$\$(50x^2+25x+6250)$	9(a)	12.8m
6(c)(ii)	$\$25(2x^2+x+250)=\$7500$	9(b)	51.3°
6(c)(iii)	4.76 or −5.26(3sf)	9(c)	17.5 or 17.6 m
6(c)(iv)	\$11 131.22 (2dp)	9(d)	27.1°
7(a)	Radius of *A*: Radius of *B* = 3: 8 Height of *A*: Height of *B* =12: 32 = 3:8 The corresponding dimensions of the cylinders are in the same ratio. Therefore, cylinders A and B are similar.	9(e) 10(a)	72.2° 95.0 cm^3
7(b)	64 : 9	10(b)	239
7(c)	$31\frac{23}{28}$ or $\frac{891}{28}$ or 31.8 (3sf) cm^2	10(c)	$476\,028\text{ cm}^2$ (to next whole number)
7(d)	6.827 kg (3dp)	11(a)	$p=0.75$ or $\frac{3}{4}$
8(b)(i)	4.81 km	11(ci) (cii)	When $x=-1.5$, $y=0.7$ When $y=-2.2$, $x=1.65$
8(b)(ii)	8.41 km^2	11(d)	$-2.83\le m\le-3.13$
8(b)(iii)	3.37 km	11(e)	$x=0.375$
10(d)	Using similar figures, $\frac{V_1}{V_2}=\left(\frac{h}{9}\right)^3$  $\frac{2}{1}=\frac{h^3}{729}$ $h=\sqrt[3]{2\times729}$ $=11.339$ Ht. of frustum = 11.339 − 9 = 2.34 cm Height of frustum is smaller than the height of conical cup.	11(b)