CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination 2
Secondary Four

CANDIDATE NAME		( ) 4/___
CENTRE NUMBER		INDEX NUMBER

MATHEMATICS

4048/01

Paper 1

15 August 2016

2 hours

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name 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.
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.

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
80

This document consists of 17 printed pages.

[Turn over

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

For Examiner's Use

Answer **all** the questions.

For Examiner's Use

1 Each interior angle of a $n-$sided regular polygon exceeds its exterior angle by $100°$.
Find the value of n.

Answer $n =$ _____ [2]

---

2 $x = 0.14931493....$ ..., where x is a recurring decimal.

(a) Find the value of $10\,000x - x$.

(b) Hence express x as a rational number in the form of $\frac{p}{q}$ where p and q are integers.

Answer (a) _____ [1]

(b) $x =$ _____ [1]

For Examiner's Use

For Examiner's Use

3 Expressed as a product of their prime factors,

$270 = 2\times3^3\times5$,

$306 = 2\times3^2\times17$.

Find

(a) the highest common factor of 270 and 306,

(b) the smallest integer value of p such that $270p$ is a multiple of 306,

(c) the smallest positive integer m for which $\sqrt[3]{306\times51\times m}$ is a whole number.

Answer *(a)* _____ [1]

(b) $p =$ _____ [1]

(c) $m =$ _____ [1]

---

4 Simplify $\dfrac{(2ab)^{-2}(a^3b^2)^3}{-3a^2b^0}$.

Answer _____ [3]

For Examiner's Use

For Examiner's Use

5 The volume of a cylinder X with radius r cm and height h cm is 270 cm^3.

(a) Find the volume of cylinder Y whose radius is $\frac{2}{3}r$ cm and height is $4h$ cm.

(b) Cylinder Z, which is geometrically similar to cylinder X, has a radius 30% smaller than cylinder X.
Write down the ratio of the mass of cylinder Z to the mass of cylinder X.

Answer (a) _____ cm^3 [2]

(b) _____ : _____ [2]

---

6 During an Year-End Sale, Mr Tan sold an item at a discount of 25% on the marked price.
He made a profit of 10% on the cost price of $360.
Calculate the marked price.

Answer $ _____ [3]

For Examiner's Use

For Examiner's Use

7 **(a)** Factorise $p^3+7p^2-4p-28$ completely.

(b) Hence solve the equation $p^3+7p^2=4p+28$.

Answer *(a)* _____ [2]

(b) _____ [2]

---

8 A bag contains 60 red, blue and yellow clips.
The probabilities of drawing a red clip and a blue clip are $\frac{1}{3}$ and $\frac{1}{5}$ respectively.

(a) Find the number of yellow clips.

(b) If x yellow clips are added to the bag so that the probability of drawing a yellow clip from the bag becomes $\frac{2}{3}$, find the value of x.

Answer *(a)* _____ [1]

(b) _____ [2]

For Examiner's Use

For Examiner's Use

9 Given that $A = \pi r\sqrt{h^2 - r^2}$, express h as the subject of the equation.

Answer $h =$ _____ [2]

10 If $3p = 5q$ and $8p = 7r$, find the ratios

(a) $p : q$ and $q : r$,

(b) $p : q : r$.

Answer (a) $p : q =$ _____ : _____ [1]

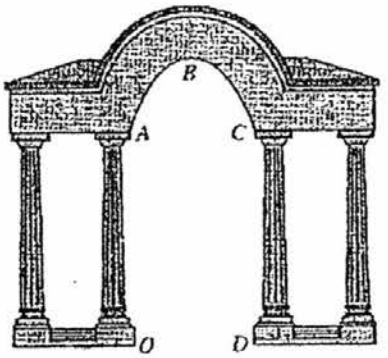
$q : r =$ _____ : _____ [1]

(b) $p : q : r =$ _____ : _____ : _____ [1]

For Examiner's Use

For Examiner's Use

11 In the diagram, an arch ABC in a building is supported by two vertical columns OA and DC of equal heights, where O and D are points on the level ground.
The arch ABC can be modelled by the equation $y = 6 + 8x - x^2$, where O is the origin, OD is the x-axis and y is the height (in metres) of any point on the arch above the ground OD.



(a) What is the height of the column OA?

(b) Find the distance OD.

(c) Express $6 + 8x - x^2$ in the form $k - (x - h)^2$, where h and k are constants.

(d) Hence, state the coordinates of B, if B is the highest point of the arch.

Answer (a) _____ m [1]

(b) _____ m [1]

(c) _____ [1]

(d) B (_____ , _____) [1]

For Examiner's Use

For Examiner's Use

12 (a) $A = \{(x, y) : 2y = 7 - 3x\}$,
$B = \{(x, y) : y = mx + c\}$.
Given that $A \cap B = \phi$, write down the value of m and a possible value of c.

Answer $m =$ _____ [1]

c _____ [1]

(b) ε = {students in Secondary Four},
C = {students who read Chinese novels},
E = {students who read English novels}.
Given that $n(\varepsilon) = 1350$, $n(C) = 1100$ and $n(E) = 900$,

(i) find the largest possible value of $n(C \cup E)'$,

(ii) describe $E \subseteq C$ in words.

Answer (b)(i) _____ [1]

(b)(ii) $E \subseteq C$ denotes _____

_____ [1]

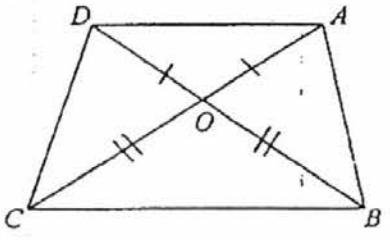
For Examiner's Use

For Examiner's Use

13 If p is directly proportional to the cube of q, find the percentage increase in p when q is increased by 20 %.

Answer _____ % [3]

14 In the quadrilateral $ABCD$, AC and BD meet at O.
$AO = DO$ and $BO = CO$.
Prove that triangles AOD and COB are similar.



Answer _____

_____

_____

_____ [2]

For Examiner's Use

For Examiner's Use

15 (a) The n^{th} term of a sequence is given by $(n+2)^2 - 1$.

(i) Find the third term of the sequence.

(ii) Explain clearly, whether 399 is a term of the sequence.

Answer *(a)(i)* _____ [1]

(a)(ii) _____

_____ [1]

(b) Study the patterns in the following table.

Row	Column P	Column Q	Number of '4's in number in Column
1	2×11	22	0
2	22×11	242	1
3	222×11	2442	2
4	2222×11	a	b
5	22222×11	c	d

(i) Find the values of a, b, c and d.

(ii) Write down an expression, in terms of n, for the number of '4's that appear in the number in the n^{th} row of Column Q.

(iii) Hence, find the value of 222 222 222 222 $\times$ 11.

Answer *(b)(i)* $a =$ _____

$b =$ _____

$c =$ _____

$d =$ _____ [2]

(b)(ii) _____ [1]

(b)(iii) _____ [1]

For Examiner's Use

For Examiner's Use

16 (a) $\overrightarrow{OP} = \begin{pmatrix} 4 \\ 3 \end{pmatrix}$, $\overrightarrow{OQ} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$, $\overrightarrow{OR} = \begin{pmatrix} -2 \\ -4 \end{pmatrix}$ and $\overrightarrow{OS} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}$.

The translation of the point S to the point R is represented by a column vector $\begin{pmatrix} a \\ b \end{pmatrix}$.

Find this column vector.

(b) A point $T(2, c)$ is such that $2\left|\overrightarrow{QT}\right| = \left|\overrightarrow{PS}\right|$.

Find the possible values of c.

Answer (a) _____ [2]

(b) $c =$ _____ [3]

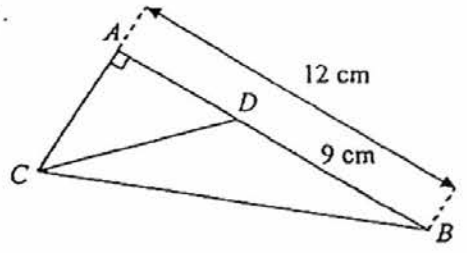
For Examiner's Use

For Examiner's Use

17 In the figure below, ABC is a triangle with angle $BAC = 90°$.

$AB = 12$ cm and $\cos \angle ABC = \frac{15}{17}$.

D is a point on AB such that $BD = 9$ cm.



(a) Find the length of BC.

(b) Find the exact value of $\tan \angle BDC$.

(c) Find the perpendicular distance of D to BC.

Answer *(a)* _____ cm [2]

(b) _____ [3]

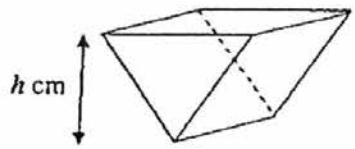
(c) _____ cm [2]

For Examiner's Use

For Examiner's Use

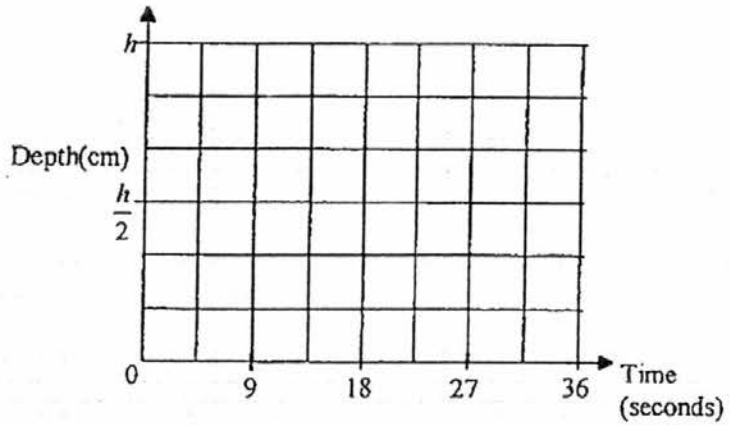
18 The diagram shows a container in the shape of an inverted triangular prism.
The height of the container is h cm.
It takes 36 seconds to fill the container to its horizontal brim at a constant rate.

(a) Find the time taken to fill the container to half its height.



Answer (a) _____ s [1]

(b) Sketch the graph to show the relationship between the depth of the water, h cm, and the time, t seconds, as the container is filled.



[2]

For Examiner's Use

For Examiner's Use

19 (a) Expand $(m+\frac{1}{m})^2$.

(b) If $m+\frac{1}{m}=\sqrt{29}$, find the value(s) of $m-\frac{1}{m}$.

Answer (a) _____ [1]

(b) _____ [3]

---

20 The masses (in grams) of 10 eggs that Ann bought are listed below in ascending order.
The range of the data is 10 g.
The median of the data is 60 g.
The interquartile range of the data is 6 g.
The mean of the data is 60 g.

a	56	57	57	*b*	62	63	*c*	*d*	65

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

(b) Calculate the standard deviation of the data.

Answer (a) $a =$, $b =$, $c =$, $d =$ [2]

(b) _____ g [2]

For Examiner's Use

For Examiner's Use

21 Given the matrices $\mathbf{A}=\begin{pmatrix}3 & -4\\ 1 & 2\end{pmatrix}$, $\mathbf{B}=\begin{pmatrix}5 & -8\end{pmatrix}$ and $\mathbf{C}=\begin{pmatrix}-9 & -1\\ 2 & 6\end{pmatrix}$, find

(a) $\mathbf{BA}$,

(b) $\mathbf{C}-\mathbf{C}^2$.

Answer (a) _____ [1]

(b) _____ [2]

For Examiner's Use

For Examiner's Use

22 (a) Construct a quadrilateral $ABCD$, whose base AB is shown in the answer space below.
A is due west of B and C is due north of B.
$BC = 8$ cm and $BD = 9$ cm.
The bearing of D from A is 350°.

(b) Find the bearing of D from C.

(c) A point P is equidistant from A and B and equidistant from the lines BC and CD.
Mark the point P and write down the length of BP.

Answer (a)

A ——— B

[2]

Answer (b) _____ ° [1]

(c) _____ cm [3]

End of Paper

CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination 2
Secondary Four

CANDIDATE NAME ( ) 4/___

CENTRE NUMBER | | | | | INDEX NUMBER | | | | |

MATHEMATICS (MARK SCHEME)

Paper 1

4048/01

15 August 2016

2 hours

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The total number of marks for this paper is 80.

For Examiner's Use
80

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

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

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

For Examiner's Use

Answer **all** the questions.

For Examiner's Use

1 Each interior angle of a n–sided regular polygon exceeds its exterior angle by $100°$.
Find the value of n.

Let $x°$: one exterior $\angle$
$x + 100 + x = 180$
$2x = 80$
$x = 40$
$n = \dfrac{360}{40}$
$= 9$

Answer (a) $n = 9$ [2]

---

2 $x = 0.14931493\ldots\ldots$, where x is a recurring decimal.

(a) Find the value of $10\,000x - x$.

(b) Hence express x as a rational number in the form of $\dfrac{p}{q}$ where p and q are integers.

(a) $x = 0.14931493\ldots$
$10000x = 1493.14931493\ldots$
$10000x - x = 1493$

(b) $9\,999x = 1493$
$x = \dfrac{1493}{9999}$

Answer (a) 1493 [1]

(b) $x = \dfrac{1493}{9999}$ [1]

For Examiner's Use

For Examiner's Use

3 Expressed as a product of their prime factors,

$270 = 2\times3^3\times5$,

$306 = 2\times3^2\times17$.

Find

(a) the highest common factor of 270 and 306,

(b) the smallest integer value of p such that $270p$ is a multiple of 306,

(c) the smallest positive integer m for which $\sqrt[3]{306\times51\times m}$ is a whole number.

(a) Highest common factor of 270 and 306 = $2\times3^2 = 18$.

(b) $270p = k306$

$2\times3^3\times5p = k(2\times3^2\times17)$

$p = 17$

(c) $\sqrt[3]{306\times51\times m} = \sqrt[3]{2\times3^2\times17\times3\times17\times m}$

$m = 17\times2^2 = 68$

Answer (a) 18 [1]

(b) $p = 17$ [1]

(c) $m = 68$ [1]

---

4 Simplify $\dfrac{(2ab)^{-2}(a^3b^2)^3}{-3a^2b^0}$.

$$\frac{(2ab)^{-2}(a^3b^2)^3}{-3a^2b^0} = \frac{a^9b^6}{4a^2b^2\times(-3a^2)}$$

$$= -\frac{a^5b^4}{12}$$

Answer $-\dfrac{a^5b^4}{12}$ [3]

For Examiner's Use

For Examiner's Use

5 The volume of a cylinder X with radius r cm and height h cm is 270 cm^3.

(a) Find the volume of cylinder Y whose radius is $\frac{2}{3}r$ cm and height is $4h$ cm.

(b) Cylinder Z, which is geometrically similar to cylinder X, has a radius 30% smaller than cylinder X.
Write down the ratio of the mass of cylinder Z to the mass of cylinder X.

(a) $\frac{V_y}{V_x} = \frac{\pi\left(\frac{2}{3}r\right)^2 4h}{\pi r^2 h}$

$\frac{V_y}{270} = \frac{16}{9}$

$V_y = \frac{16}{9} \times 270$

$= 480$

(b) $\frac{V_z}{V_x} = \frac{\pi\left(\frac{7}{10}r\right)^2 \frac{7}{10}h}{\pi r^2 h}$

$= \frac{343}{1000}$

Answer (a) 480 cm^3 [2]

(b) 343 : 1000 [2]

---

6 During an Year-End Sale, Mr Tan sold an item at a discount of 25% on the marked price.
He made a profit of 10% on the cost price of $360.
Calculate the marked price.

$Marked\ Price = \frac{100}{75} \times (\frac{110}{100} \times \$360)$

$= \$528$

Let marked price = $\$x$
Selling price = $0.75x$

Selling price $= \frac{110}{100} \times 360$

$x = \frac{110}{100} \times \frac{360}{0.75}$

Marked price = $528

Answer $ 528 [3]

For Examiner's Use

For Examiner's Use

7 (a) Factorise $p^3+7p^2-4p-28$ completely.

(b) Hence solve the equation $p^3+7p^2=4p+28$.

(a) $p^3+7p^2-4p-28$
$=p^2(p+7)-4(p+7)$
$=(p+7)(p^2-4)$
$=(p+7)(p-2)(p+2)$

(b) $(p+7)(p-2)(p+2)=0$
$p=-7$ or ± 2

Answer (a) $(p+7)(p-2)(p+2)$ [2]

(b) $p=-7$ or ± 2 [2]

---

8 A bag contains 60 red, blue and yellow clips.
The probabilities of drawing a red clip and a blue clip are $\frac{1}{3}$ and $\frac{1}{5}$ respectively.

(a) Find the number of yellow clips.

(b) If x yellow clips are added to the bag so that the probability of drawing a yellow clip from the bag becomes $\frac{2}{3}$, find the value of x.

(a) P(getting a yellow clip) $= 1-\frac{1}{3}-\frac{1}{5}=\frac{7}{15}$

No. of yellow clips $=\frac{7}{15}\times 60=28$

(b) $\frac{28+x}{60+x}=\frac{2}{3}$
$3(28+x)=2(60+x)$
$x=36$

Answer (a) 28 [1]

(b) 36 [2]

For Examiner's Use

For Examiner's Use

9 Given that $A = \pi r\sqrt{h^2 - r^2}$, express h as the subject of the equation.

$$A = \pi r\sqrt{h^2 - r^2}$$
$$\frac{A}{\pi r} = \sqrt{h^2 - r^2}$$
$$\left(\frac{A}{\pi r}\right)^2 = h^2 - r^2$$
$$h^2 = \left(\frac{A}{\pi r}\right)^2 + r^2$$
$$h = \pm\sqrt{\left(\frac{A}{\pi r}\right)^2 + r^2}$$

Answer $h = \pm\sqrt{\left(\frac{A}{\pi r}\right)^2 + r^2}$ [2]

---

10 If $3p = 5q$ and $8p = 7r$, find the ratios

(a) $p : q$ and $q : r$,

(b) $p : q : r$.

(a) $3p = 5q$
$p : q = 5 : 3$
$8p = 7r$
$p : r = 7 : 8$
$\frac{p}{r} = \frac{7}{8}$
$\frac{q}{r} = \frac{7}{8} \times \frac{3}{5} = \frac{21}{40}$

(b) $p : q : r = 35 : 21 : 40$

Answer *(a)* $p : q = 5 : 3$ [1]

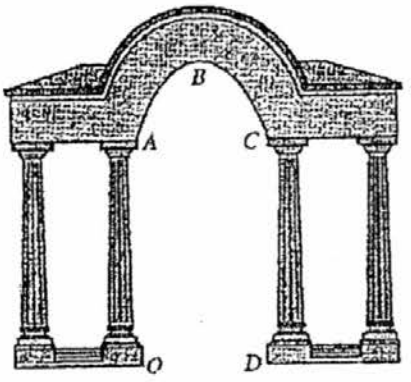
$q : r = 21 : 40$ [1]

(b) $p : q : r = 35 : 21 : 40$ [1]

For Examiner's Use

For Examiner's Use

11 In the diagram, an arch ABC in a building is supported by two vertical columns OA and DC of equal heights, where O and D are points on the level ground.
The arch ABC can be modelled by the equation $y = 6 + 8x - x^2$, where O is the origin, OD is the x-axis and y is the height (in metres) of any point on the arch above the ground OD.



(a) What is the height of the column OA?

(b) Find the distance OD.

(c) Express $6 + 8x - x^2$ in the form $k - (x - h)^2$, where h and k are constants.

(d) Hence, state the coordinates of B, if B is the highest point of the arch.

(a) When $x = 0$, $y = 6 + 8(0) - 0^2 = 6$
$\therefore$ the height of the column OA is 6 m.

(b) Distance $OD = AC$
Equation of the line AC is $y = 6$.
When $y = 6$, $6 + 8x - x^2 = 6$,
$x(x - 8) = 0$
$x = 0$ or $x = 8$
$\therefore$ distance $AC = 8 - 0 = 8$ m

(c) $6 + 8x - x^2 = -(x - 4)^2 + 22$

(d) $\therefore$ the coordinates of B are (4, 22).

Answer

(a) 6 m [1]

(b) 8 m [1]

(c) $22 - (x - 4)^2$ [1]

(d) $B(4, 22)$ [1]

For Examiner's Use

For Examiner Use

12 (a) $A = \{(x, y) : 2y = 7 - 3x\}$,
$B = \{(x, y) : y = mx + c\}$.
Given that $A \cap B = \phi$, write down the value of m and a possible value of c.

Answer $m = \frac{-3}{2}$ [1]

$c \in R$, $c \neq \frac{7}{2}$ [1]

(b) ε = {students in Secondary Four},
C = {students who read Chinese novels},
E = {students who read English novels}.
Given that $n(\varepsilon) = 1350$, $n(C) = 1100$ and $n(E) = 900$,

(i) find the largest possible value of $n(C \cup E)'$,

(ii) describe $E \subseteq C$ in words.

(i) Largest $n(C \cup E)' = 1350 - 1100 = 250$

Answer *(b)(i)* 250 [1]

(b)(ii) $E \subseteq C$ denotes that all students in Secondary Four who read English novels also read Chinese novels. [1]

For Examiner's Use

For Examiner's Use

13 If p is directly proportional to the cube of q, find the percentage increase in p when q is increased by 20 %.

$p = k q^3$

$k = \dfrac{p}{q^3}$

When $q_1 = 1.2q$

$p_1 = k(1.2q)^3$

$p_1 = \dfrac{p}{q^3}(1.2q)^3$

$p_1 = 1.728p$

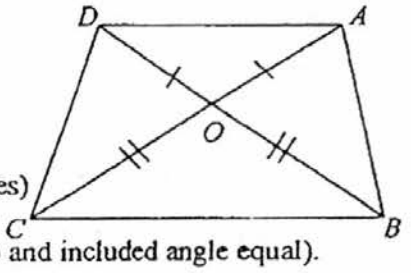
% increase in $p = \dfrac{1.728p - p}{p} \times 100$

$= 72.8\ \%$

Answer 72.8 % [3]

---

14 In the quadrilateral $ABCD$, AC and BD meet at O.
$AO = DO$ and $BO = CO$.
Prove that triangles AOD and COB are similar.



Since $AO = DO$ (Given)
and $CO = BO$ (Given)
$\dfrac{AO}{CO} = \dfrac{DO}{BO}$
$\angle AOD = \angle BOC$ (Vertically opp. angles)
$\therefore \Delta AOD$ is similar to ΔCOB
(2 pairs of corr sides have the same ratio and included angle equal).

Answer _____

_____

_____

_____ [2]

For Examiner's Use

For Examiner's Use

15 (a) The n^{th} term of a sequence is given by $(n+2)^2 - 1$.

(i) Find the third term of the sequence.

(ii) Explain clearly, whether 399 is a term of the sequence.

(i) $T_3 = (3+2)^2 - 1 = 24$

(ii) $(n+2)^2 - 1 = 399$
$(n+2)^2 = 400$
$n = 18$ or -22 (N.A.)

Answer *(a)(i)* 24 [1]

(a)(ii) Since $n = 18$ is a positive integer (whole number),
399 is a term of the sequence [1]

(b) Study the patterns in the following table.

Row	Column P	Column Q	Number of '4's in number in Column
1	2×11	22	0
2	22×11	242	1
3	222×11	2442	2
4	$2\,222 \times 11$	a	b
5	$22\,222 \times 11$	c	d

(i) Find the values of a, b, c and d.

(ii) Write down an expression, in terms of n, for the number of '4's that appear in the number in the n^{th} row of Column Q.

(iii) Hence, find the value of $222\,222\,222\,222 \times 11$.

Answer *(b)(i)* $a =$ 24 442
$b =$ 3
$c =$ 244 442
$d =$ 4 [2]

(b)(ii) $n-1$ [1]

(b)(iii) 2 444 444 444 442 [1]

For Examiner's Use

For Examiner's Use

16 (a) $\overrightarrow{OP}=\begin{pmatrix}4\\3\end{pmatrix}$, $\overrightarrow{OQ}=\begin{pmatrix}6\\-2\end{pmatrix}$, $\overrightarrow{OR}=\begin{pmatrix}-2\\-4\end{pmatrix}$ and $\overrightarrow{OS}=\begin{pmatrix}-4\\1\end{pmatrix}$.

The translation of the point S to the point R is represented by a column vector $\begin{pmatrix}a\\b\end{pmatrix}$.

Find this column vector.

(b) A point $T(2, c)$ is such that $2\left|\overrightarrow{QT}\right|=\left|\overrightarrow{PS}\right|$.

Find the possible values of c.

(a) $\begin{pmatrix}-4\\1\end{pmatrix}+\begin{pmatrix}a\\b\end{pmatrix}=\begin{pmatrix}-2\\-4\end{pmatrix}$

$\begin{pmatrix}a\\b\end{pmatrix}=\begin{pmatrix}-2\\-4\end{pmatrix}-\begin{pmatrix}-4\\1\end{pmatrix}$

$=\begin{pmatrix}2\\-5\end{pmatrix}$

(b) $\overrightarrow{QT}=\overrightarrow{OT}-\overrightarrow{OQ}$

$=\begin{pmatrix}2\\c\end{pmatrix}-\begin{pmatrix}6\\-2\end{pmatrix}$

$=\begin{pmatrix}-4\\c+2\end{pmatrix}$

$\overrightarrow{PS}=\overrightarrow{OS}-\overrightarrow{OP}$

$=\begin{pmatrix}-4\\1\end{pmatrix}-\begin{pmatrix}4\\3\end{pmatrix}$

$=\begin{pmatrix}-8\\-2\end{pmatrix}$

$2\left|\overrightarrow{QT}\right|=\left|\overrightarrow{PS}\right|$

$2\sqrt{(-4)^2+(c+2)^2}=\sqrt{(-8)^2+(-2)^2}$

$4\left(16+c^2+4c+4\right)=68$

$16+c^2+4c+4=17$

$c^2+4c+3=0$

$(c+1)(c+3)=0$

$c=-1$ or $c=-3$

Answer (a) $\begin{pmatrix}2\\-5\end{pmatrix}$ [2]

(b) $c=-1$ or -3 [3]

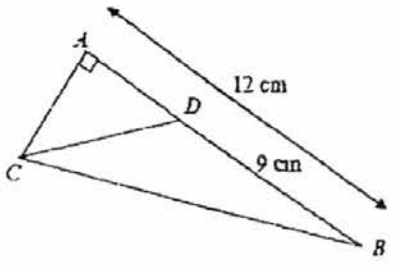
For Examiner's Use

For Examine Use

17 In the figure below, ABC is a triangle with angle $BAC = 90°$.

$AB = 12$ cm and $\cos \angle ABC = \frac{15}{17}$.

D is a point on AB such that $BD = 9$ cm.



(a) Find the length of BC.

(b) Find the exact value of $\tan \angle BDC$.

(c) Find the perpendicular distance of D to BC.

(a) $\cos \angle ABC = \frac{AB}{BC}$

$\frac{12}{BC} = \frac{15}{17}$

$BC = \frac{12}{15} \times 17$

$\therefore BC = 13.6$ cm

(b) By Pythagoras' Theorem, in ΔABC,

$AC^2 = 13.6^2 - 12^2$

$AC = \sqrt{13.6^2 - 12^2}$

$\therefore AC = 6.4$ cm

$AD = 12 - 9 = 3$ cm

$\tan \angle BDC = -\tan \angle ADC$

$= -\frac{6.4}{3}$

$= -2\frac{2}{15}$

(c) Area of $\Delta BDC = \frac{1}{2} BD \times AC$

$\frac{1}{2}(9 \times 6.4) = \frac{1}{2} BC \times h$

$h = \frac{9 \times 6.4}{13.6}$

$= 4.2352$

The height of D from $BC = 4.24$ cm.

Answer (a) 13.6 cm [2]

(b) $-2\frac{2}{15}$ [3]

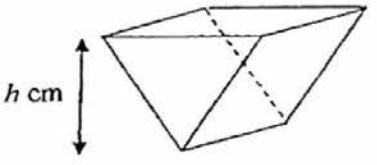
(c) 4.24 cm [2]

For Examiner's Use

For Examiner's Use

18 The diagram shows a container in the shape of an inverted triangular prism.
The height of the container is h cm.
It takes 36 seconds to fill the container to its horizontal brim at a constant rate.

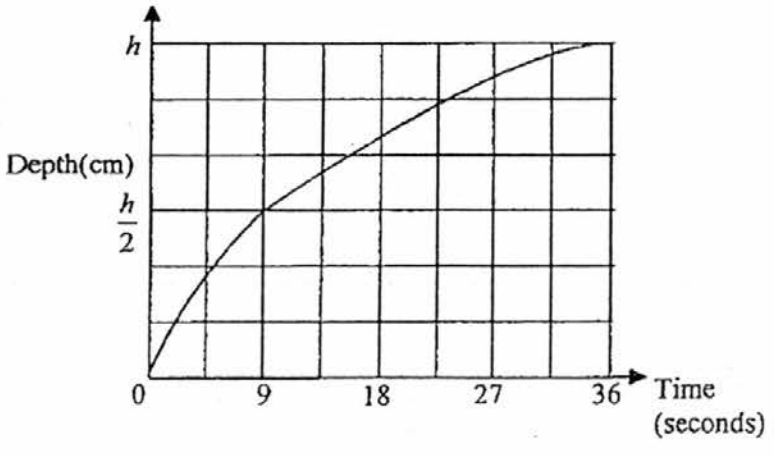
(a) Find the time taken to fill the container to half its height.



Time taken $= (\frac{1}{2})^2 \times 36$
$= 9$

Answer (a) 9 s [1]

(b) Sketch the graph to show the relationship between the depth of the water, h cm, and the time, t seconds, as the container is filled.



[2]

For Examiner's Use

For Examiner's Use

19 **(a)** Expand $(m+\frac{1}{m})^2$.

(b) If $m+\frac{1}{m}=\sqrt{29}$, find the value(s) of $m-\frac{1}{m}$.

(a) $(m+\frac{1}{m})^2 = m^2+2+\frac{1}{m^2}$

(b) $m+\frac{1}{m}=\sqrt{29}$

$(m+\frac{1}{m})^2 = 29$

$m^2+2+\frac{1}{m^2}=29$

$m^2+\frac{1}{m^2}=27$

$(m-\frac{1}{m})^2 = m^2-2+\frac{1}{m^2}$

$= 25$

$m-\frac{1}{m}=\pm 5$

Answer *(a)* $m^2+2+\frac{1}{m^2}$ [1]

(b) ± 5 [3]

---

20 The masses (in grams) of 10 eggs that Ann bought are listed below in ascending order.
The range of the data is 10 g.
The median of the data is 60 g.
The interquartile range of the data is 6 g.
The mean of the data is 60 g.

a	56	57	57	b	62	63	c	d	65

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

(b) Calculate the standard deviation of the data.

(a) $a = 65-10 = 55$

$b+62 = 2\times 60$

$b = 58$

$c-57 = 6$

$c = 63$

$d+536 = 60\times 10 \Rightarrow d = 64$

(b) S.D. $= \sqrt{\frac{36126}{10}-60^2} = 3.5496...$

$= 3.55$

Answer *(a)* $a = 55$, $b = 58$, $c = 63$, $d = 64$ [2]

(b) 3.55 g [2]

For Examiner's Use

For Examiner's Use

21 Given the matrices $\mathbf{A}=\begin{pmatrix}3 & -4\\ 1 & 2\end{pmatrix}$, $\mathbf{B}=\begin{pmatrix}5 & -8\end{pmatrix}$ and $\mathbf{C}=\begin{pmatrix}-9 & -1\\ 2 & 6\end{pmatrix}$, find

(a) $\mathbf{BA}$,

(b) $\mathbf{C}-\mathbf{C}^2$.

(a) $\mathbf{BA}=\begin{pmatrix}5 & -8\end{pmatrix}\begin{pmatrix}3 & -4\\ 1 & 2\end{pmatrix}$

$=\begin{pmatrix}7 & -36\end{pmatrix}$

(b) $\mathbf{C}-\mathbf{C}^2=\begin{pmatrix}-9 & -1\\ 2 & 6\end{pmatrix}-\begin{pmatrix}-9 & -1\\ 2 & 6\end{pmatrix}^2$

$=\begin{pmatrix}-9 & -1\\ 2 & 6\end{pmatrix}-\begin{pmatrix}79 & 3\\ -6 & 34\end{pmatrix}$

$=\begin{pmatrix}-88 & -4\\ 8 & -28\end{pmatrix}$

Answer (a) $\begin{pmatrix}7 & -36\end{pmatrix}$ [1]

(b) $\begin{pmatrix}-88 & -4\\ 8 & -28\end{pmatrix}$ [2]

For Examiner's Use

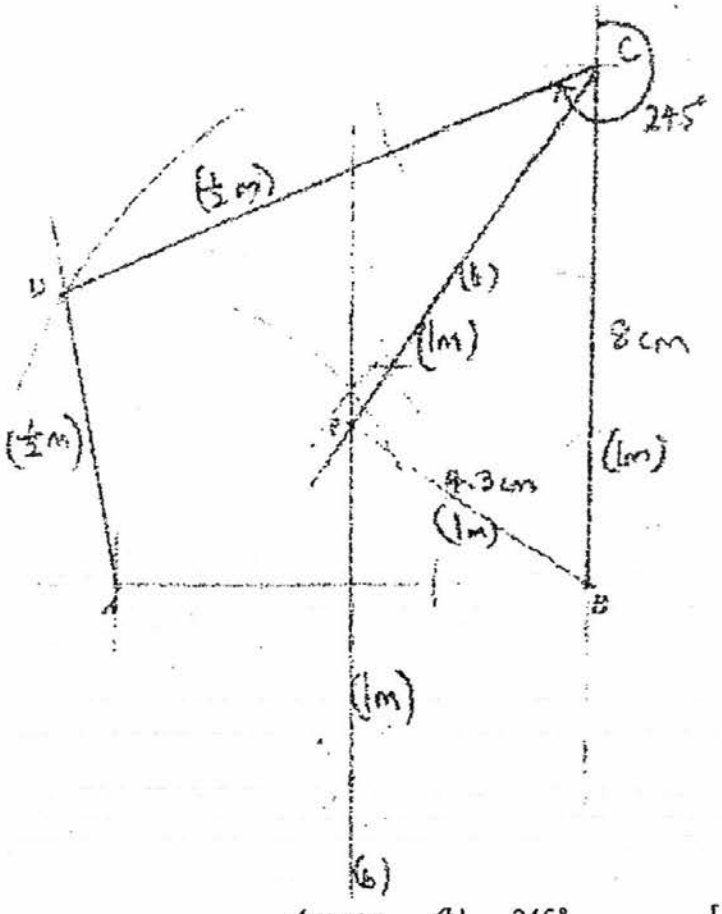
For Examiner's Use

22 (a) Construct a quadrilateral $ABCD$, whose base AB is shown in the answer space below.
A is due west of B and C is due north of B.
$BC = 8$ cm and $BD = 9$ cm.
The bearing of D from A is $350°$.

(b) Find the bearing of D from C.

(c) A point P is equidistant from A and B and equidistant from the lines BC and CD.
Mark the point P and write down the length of BP.

Answer (a)



Answer (b) 245° [1]

(c) 4.3 ± 0.1 cm [3]

End of Paper

CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination 2
Secondary Four

MATHEMATICS

Paper 2

4048/02
16 August 2016

2 hours 30 minutes

Additional Materials: Answer Paper (10 sheets)
Graph paper (1 sheet)

READ THESE INSTRUCTIONS FIRST

Write your Centre number, Index number and name 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 tape.

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.

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.

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 **(a)** Factorise $x^2 - 4y^2$. [1]

(b) If the product of two positive integers is a prime number, what must be the value of the smaller integer? [1]

(c) Given that x and y are two positive integers, solve the equation $x^2 - 4y^2 = 37$. [3]

---

2 The list price of a bottle of ***Omega 3*** is \$63.50 and a bottle of ***Vitamin E*** is \$39.50, excluding GST.

(a) Mrs Foong bought a bottle of ***Omega 3*** and a bottle of ***Vitamin E*** at the list price. In addition, she had to pay 7% GST. Calculate the total amount she paid for her purchases. [1]

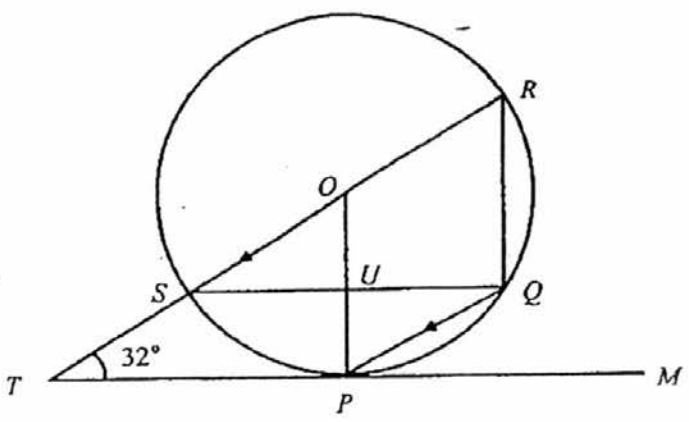
(b) During the Hari Raya Sale, a discount of p% was given. Mrs Foong paid \$216.57, inclusive of 7% GST, for 3 bottles of ***Omega 3*** and a bottle of ***Vitamin E***. Calculate the value of p. [3]

(c) Siti, a sales representative, gets a 5% commission on the list price of all the products she sold. On a particular Sunday, she sold twice as many bottles of ***Omega 3*** as ***Vitamin E***. That day, she collected \$116.55 commission. Calculate

(i) the total sales for that day, [1]

(ii) the number of bottles of ***Omega 3*** sold. [2]

3



In the diagram, $PQRS$ is a circle with centre O.
RS is a diameter of the circle.
TPM is tangent to the circle at point P and meets RS produced at T.
RT is parallel to QP and angle $RTM = 32°$.
OP intersects SQ at U.

(a) Stating your reasons clearly, calculate

(i) angle SOP, [2]

(ii) angle SQP, [1]

(iii) reflex angle POR, [1]

(iv) angle SRQ. [3]

(b) Name two similar triangles and prove their similarity. [2]

4 **Solutions to this question by accurate drawing will not be accepted.**

A is the point (0, 4) and B is the point (6, 2).

(a) Find

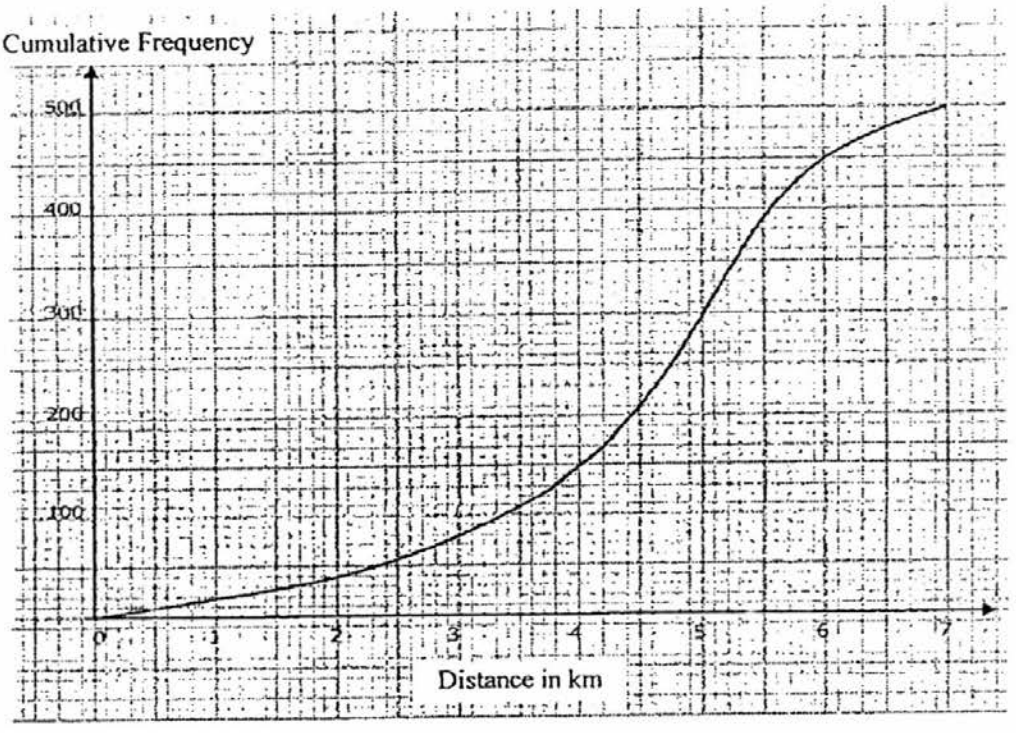
(i) the equation of the line through A with gradient 5, [1]

(ii) the area bounded by the line in **(i)**, the line passing through A and B and the y-axis. [4]

(b) The line $y = 4$ is the axis of symmetry of the triangle ABN.
Write down the coordinates of N. [1]

(c) H is the point $(3, k)$.
Given that the gradient of AH is -1, calculate the value of k. [1]

5 500 girls in Cedar Girls' Secondary School were asked the distances they travelled from home to school.
The cumulative frequency curve below shows the distribution of the distances.



(a) Copy and complete the grouped frequency table of the distance travelled by each girl. [2]

Distance (km)	$0 \le x \le 1$	$1 < x \le 2$	$2 < x \le 3$	$3 < x \le 4$	$4 < x \le 5$	$5 < x \le 6$	$6 < x \le 7$
Number of girls							

(b) Use your graph to find
(i) the number of girls who travelled 3.5 km or more, [1]

(ii) the interquartile range [2]

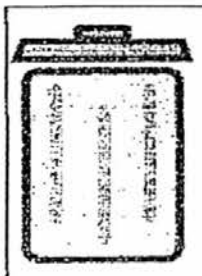
(c) Showing your method clearly, estimate
(i) mean distance travelled by each girl, [2]

(ii) the standard deviation. [2]

(d) One of the 500 girls is selected at random.
(i) Find the probability that the distance she travels is less than or equal to 3 km. [1]

(ii) If the probability that she travels more than y km is $\frac{43}{50}$, find y. [1]

6 This is a poster about FOOD WASTE in Singapore.



Food waste in 2014 can fill up 615 Olympic-sized swimming pools

The annual waste statstics from the National Environment Agency showed that Singapore Produced 789 000 tonnes of food waste in the year 2014.

The total population of Singapore was 5.47 million in 2014.

(a) Express in standard form,

(i) the total population of Singapore in 2014, [1]

(ii) the mass, in kg, of food waste in 2014. [1]
(1 tonne = 1000 kg)

(b) Find the average mass, in kg, of food waste per individual in 2014. [1]

(c) The food waste in 2014 constitutes 23% of all the various types of waste generated. Find the mass, in kg, of the total waste generated in 2014. Express your answer in standard form. [2]

(d)

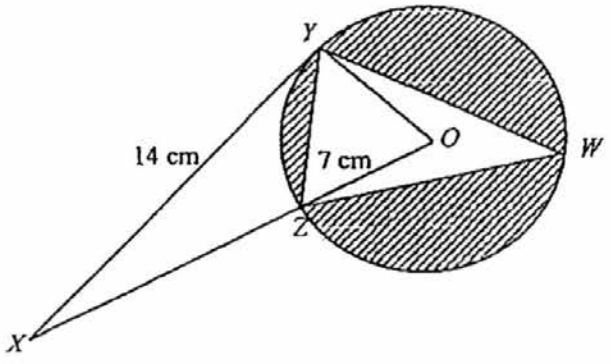
Useful information

- The completion of Phase II development of Semakau Landfill provides a capacity of 6,700 Olympic-sized swimming pools.
- Of the total waste generated, 13% are recycled, 83% incinerated* and the rest are sent to Semakau Landfill.

* Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials.

Assuming that the total waste generated remains the same every year, estimate the number of years in which Semakau Landfill will be completely filled with the waste. Justify your answer with calculations. [4]

7



In the diagram, the points W, Y and Z lie on a circle, with centre O and radius 7 cm. XY is a tangent to the circle. OZ produced meets the tangent XY at X. It is given that $XY = 14$ cm.

(a) Show that the angle $YOZ = 1.1071$ radians. [2]

(b) Using the value in **(a)**, find

(i) the area of the minor sector YOZ, [1]

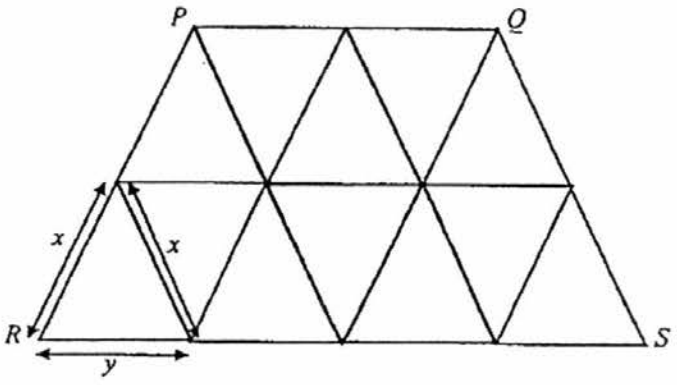
(ii) the length of major arc YWZ, [1]

(iii) angle YWZ. [1]

(c) Given that the shaded area is 106.17 cm^2, find the area of triangle YWZ. [1]

(d) Hence, find the length of WY, if $WY = WZ$. [2]

8 The diagram shows a structure, in the shape of a trapezium, $PQRS$, formed by 12 congruent isosceles triangles. The dimension of each triangle is x cm by x cm by y cm.



Given that the structure is made from a piece of wire of length 165 cm,

(a) Express y in terms of x. [1]

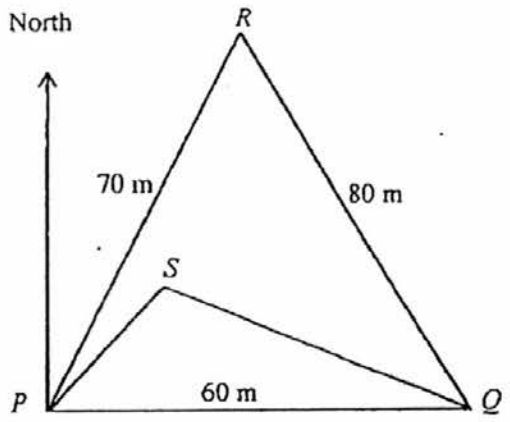
Given that the area of the trapezium $PQRS$ is 215 cm^2 and the height of the trapezium is $(x+2)$cm,

(b) form an equation in x and show that it reduces to $14x^2 - 137x + 315 = 0$, [3]

(c) solve the equation $14x^2 - 137x + 315 = 0$, giving both answers correct to 2 decimal places, [3]

(d) calculate the perimeter of the trapezium $PQRS$. [3]

9 In making a map, a surveyor notes that the three points P, Q and R are on level ground.
Q is due east of P, $PQ = 60$ m, $QR = 80$ m and $RP = 70$ m.



(a) Calculate

(i) angle RPQ, [2]

(ii) the bearing of R from P. [1]

(b) A long pole is erected at R. As a man walks from P to Q, he notes that the greatest angle of elevation of the top of the long pole is 10°.

(i) Find the distance of the man from P at that point. [2]

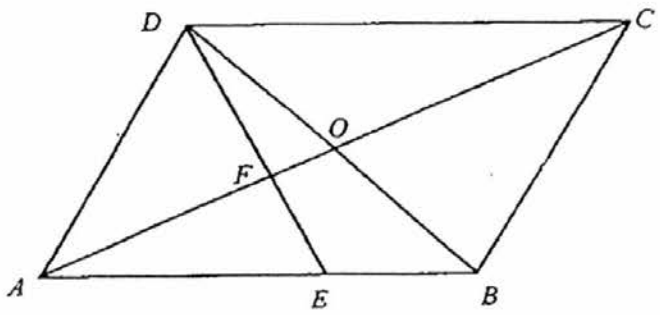
(ii) Calculate the height of the pole. [3]

(c) The point S lies inside triangle PQR such that its bearing from P is 020° and its bearing from Q is 300°. Calculate

(i) angle PSQ, [2]

(ii) the distance PS. [2]

10 $ABCD$ is a parallelogram whose diagonals, AC and AD, intersect at O. E is a point on AB such that $AE = 2EB$. DE intersects AC at F.



(a) Given that O is the point $(0, 0)$ on the coordinate plane. D is the point $(-4, 5)$ and A is the point $(-7, -5)$,

(i) express $\overrightarrow{AD}$ as a column vector, [1]

(ii) find $\left|\overrightarrow{AD}\right|$. [1]

(b) Given that $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$, express in terms of $\mathbf{a}$ and/or $\mathbf{b}$, giving each of your answers in its simplest form,

(i) $\overrightarrow{AC}$, [1]

(ii) $\overrightarrow{CD}$. [1]

(c) Show that $\overrightarrow{DE} = \frac{1}{3}(\mathbf{a} + 5\mathbf{b})$. [3]

(d) Given that $\overrightarrow{FA} = \frac{4}{5}\overrightarrow{OA}$, find $\overrightarrow{FE}$ and hence, show that D, E and F lie on the same straight line. [4]

(e) Find the numerical value of $\frac{\text{area of } \Delta DOF}{\text{area of } \Delta AEF}$. [2]

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

The variables x and y are connected by the equation $y = 16 - x^2 - \frac{16}{x^2}$.

The table shows some values of x and the corresponding values of y.

x	1	1.25	1.5	2	2.5	3	3.5	4
y	−1	4.20	p	8	7.19	5.22	2.44	−1

(a) Calculate the value of p, correct to 2 decimal places. [1]

(b) Draw the graph $y = 16 - x^2 - \frac{16}{x^2}$ for $1 \le x \le 4$, using a scale of 4 cm to represent 1 unit on the x axis, and 2 cm to represent 1 unit on the y axis. [3]

(c) From your graph, write down the range of values of x for which
$16 - x^2 - \frac{16}{x^2} > 6$, $1 \le x \le 4$ [2]

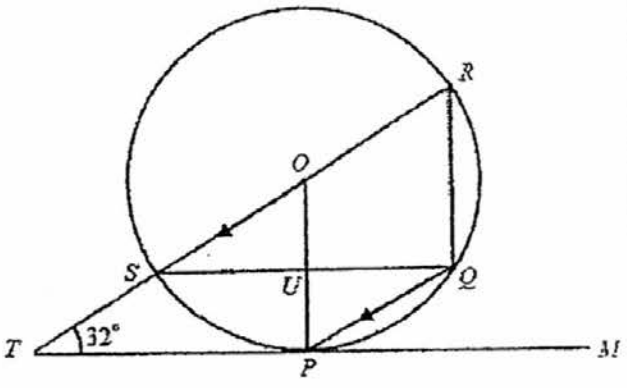
(d) By drawing a suitable straight line on the same axes, solve the equation
$\frac{3}{4}x + 2 = 16 - x^2 - \frac{16}{x^2}$, for $1 \le x \le 4$. [3]

End of Paper

CEDAR GIRLS' SECONDARY SCHOOL
MARK SCHEME FOR 2016 PRELIMINARY EXAMINATION 2 4048/2

	Solutions	Allocation of Marks	Remarks
1a	$x^2-4y^2=(x-2y)(x+2y)$	B1	
b	The value of the smaller integer is 1	B1	
c	$x^2-4y^2=37.$ $(x-2y)(x+2y)=37$ $(x-2y)=1$ -------(1) $(x+2y)=37$ -------(2)	M1	
	Solving (1) and (2) $2x=38$ $x=19$ and $y=9$	A1, A1	
	Report Students are unable to tell that $(x-2y)$ is the smaller number and $(x+2y)$ is the bigger number. $(x-2y)(x+2y)=37$ Does not imply that either $(x-2y)$ or $(x+2y)=37$!!!		
	TOTAL		[5]

Qn	Solutions	Allocation of Marks	Remarks
2			
(a)	The total amount she paid for her purchases. $(63.50 + 39.50) x1.07 = $110.21	A1	
(b)	Total amount before discount = $(3 x 63.30 +39.50) = $230 (w/o) Price paid before GST: | Price paid after GST: 107% = $216.57 | 1.07 x $230 = 246.10 100% = $202.40 % discount = $\frac{230-202.40}{230}\times 100\%$ | % discount = $\frac{246.10-216.57}{246.10}\times 100\%$ = 12% | = 12% $p = 12$	B1 M1 A1	
(c)(i)	5% (commission) = $116.55 100% (Total sales) = $116.55 x20 = $2331	B1	
(ii)	1 set of 2 Omega 3 and Vitamin E = $(2 x 63.50 + 39.50) = $166.50 No of sets sold = $\frac{2331}{166.50}$ = 14 sets Therefore no of Omega 3 sold = 14 x 2 =28 bottles	M1 A1	
	Report % discount = $\frac{230-202.40}{230}\times 100\%$ or % discount = $\frac{246.10-216.57}{246.10}\times 100\%$ Students uses amt with gst and without gst to claculate		
	TOTAL		[7]

Qn	Solutions	Allocation of Marks	Remarks
3			
(a)(i)	In ΔTOP $\angle OPT = 90°$ (tan $\perp$ rad) $\angle SOP = 180° - 32° - 90°$ ($\angle$sum of Δ) $= 58°$	B1 A1	
(ii)	$\angle SQP = \frac{1}{2}\angle SOP$ ($\angle$ at centre $= 2\angle$ at Θ^{cc}) $= 29°$	B1	
(iii)	reflex $\angle POR = 180° + 58°$ $= 238°$	B1	
3(iv)	$\angle RQS = 90°$ ($\angle$ in semi circle) $\angle SRQ = 180° - 29° - 90^0$ (int $\angle s$, $SR // PQ$) $= 61°$	B1 M1 B1	
3(b)	The special name is Trapzium	A1	
	Report Students are assuming that : $OP // RQ$ and $SQ // TM$ OU is perpendicular to SQ Hence, (ii) and (iv) are badly done		
	TOTAL		[8]

Qn	Solutions	Allocation Of Marks	Remarks
4a(i)	The equation of the line $y = 5x + 4$	B1	
(ii)	The area bounded by the lines in (i), the line through A and E and the x-axis.		
	The gradient of $AB = \frac{2-4}{6-0} = -\frac{1}{3}$		
	Equation of line : $y = -\frac{1}{3}x + 4$	B1	
	Therefore the x intercept $=12$	B0.5	
	The x intercept of the line $y = 5x + 4$ is $x = -\frac{4}{5}$	B0.5	
	Required Area $= \frac{1}{2}(12 + \frac{4}{5}) \times 4$	M1	
	$= 25.6$ unit^2	A1	
(b)	The coordinates of $N = (6, 2+4)$ $= (6, 6)$	A1	
(c)	Gradient of $LH = -1$, $\frac{k-4}{3-0} = -1$		
	$k - 4 = -3$		
	$k = 1$	A1	
	Report No major error or misconception that needs to be address		
	TOTAL		17

CEDAR GIRLS' SECONDARY SCHOOL
MARK SCHEME FOR 2016 PRELIMINARY EXAMINATION 2 4048/2

Qn	Solutions	Allocation of Marks	Remarks

5ai

Distance (km)	$x \le 1$	$1 < x \le 2$	$2 < x \le 3$	$3 < x \le 4$	$4 < x \le 5$	$5 < x \le 6$	$6 < x \le 7$
Number of girls	20	20	40	70	150	150	50
Mid value	0.5	1.5	2.5	3.5	4.5	5.5	6.5

B2 (-1 more than 1 wrong)

-1 for units

5(b)(i) Number of girls who travel 3.5 km or more $= 500 - 110$
$= 390$ — B1

(ii) Interquartile Range $= 5.4 - 3.8$
$= 1.6$km — M1 A1

5(c)(i) Mean $= \dfrac{\sum fx}{\sum f} = \dfrac{2210}{500}$
$= 4.42$ km — B1 A1

(ii) Standard Deviation $= \sqrt{\dfrac{\sum fx^2}{\sum f} - \left(\dfrac{\sum fx}{\sum f}\right)^2}$
$= \sqrt{\dfrac{10845}{500} - (4.42)^2}$ — B1
≈ 1.47 km — A1

5d(i) P(distance she travels is less than or equal to 3 km) $= \dfrac{80}{500}$
$= \dfrac{4}{25}$ — B1

5d(ii) probability that she travels more than y km $= \dfrac{43}{50}$
$= \dfrac{430}{500}$ — M1

Therefore probability that she travels less y km $= \dfrac{70}{500}$
$y = 2.8$ — B1

TOTAL	[12]

Qn	Solutions	Allocation of Marks	Remarks
6a	Using ΔXYO, $YO \perp XY$ (tan $\perp$ rad)	B1	
	$\tan \angle YOZ = \frac{14}{7}$	B1	
	$\angle YOZ = 1.1071$ (5 sf) (shown)		
6b (i)	Area of minor sector YOZ $= \frac{1}{2} r^2 \theta$		
	$= \frac{1}{2}(7)^2(1.1071)$		
	$= 27.124$ cm^2		
	≈ 27.1 cm^2	B1	
(ii)	Major Arc length of $YWZ = (2\pi - 1.11071)(7)$		
	$= 36.233$ (5 sf)		
	≈ 36.2 cm	B1	
(iii)	$\angle YWZ = \frac{1}{2}\angle YOZ$ ($\angle$ at centre $= 2\angle$ on Θ^{cc})		
	$= 0.554$ rad	B1	
(c)	Area of YWZ = area of circle – area of shaded region		
	$= \pi(7^2) - 106.17$		
	$= 47.768$ (5 sf)		
	≈ 47.8 cm^2	B1	
(d)	If $WY = WZ$, $\frac{1}{2}(WY)^2 \sin(0.5535) = 47.768$	M1	
	$WY = 13.480$		
	≈ 13.5 cm	A1	
	Report 6(a) Students did not state this reason $YO \perp XY$ (tan $\perp$ rad)		
	TOTAL	8	

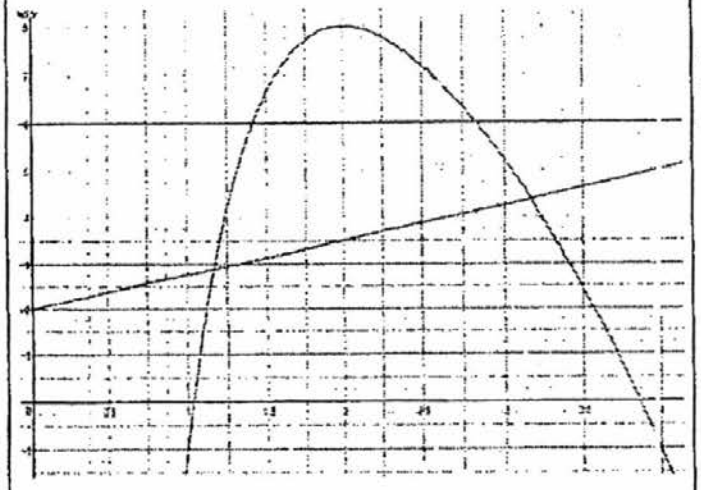
Qn	Solutions	Allocation of Marks	Remarks
7(a)	$14x + 9y = 165$ $y = \frac{165-14x}{9}$ ----------(1)	B1	
7(b)	$\frac{1}{2}(2y + 4y)(x + 2) = 215\ cm^2$	M1	
	$3y\,(x+2) = 215\ cm^2$ ------ (2)		
	Sub (1) into (2)	M1	
	$3[\frac{1}{9}(165 - 14x)](x + 2) = 215$	M1	
	$x(165 - 14x) + 2(165 - 14x) = 645$ $165x - 14x^2 + 330 - 28x = 645$ $14x^2 - 137x + 315 = 0$ (shown)		
7(c)	$x = \frac{-(-137) \pm \sqrt{(-137)^2 - 4(14)(315)}}{(2)(14)}$	M1	
	$= \frac{137 \pm \sqrt{1129}}{28}$ $= 6.09288$ or 3.6928 ≈ 6.09 or 3.69 (2 dp)	A2	
7(d)	Sub $x = 6.09288$ into (3) $y = \frac{1}{9}(165 - 14(6.09288)$	M1	
	$y = 8.85552$ Perimeter $= 4x + 6y$ $= 4(6.09288) + 6(8.85552)$ $= 77.50464$ ≈ 77.5 cm	A1	**Report: Most did not check whether x=3.69 is acceptable or not.**
	$x = 3.69$ is rejected as if $x = 3.69$, $y = 12.558$, it is not possible to form a triangle as $2x < y$	B1	
	TOTAL	**10**	

CEDAR GIRLS' SECONDARY SCHOOL
MARK SCHEME FOR 2016 PRELIMINARY EXAMINATION 2 4048/2

Qn	Solutions	Allocation of Marks	Remarks
8ai	$80^2 = (70)^2 + (60)^2 - 2(70)(60)\cos \angle RPQ°$ $\cos \angle RPQ° = \frac{70^2 + 60^2 - 80^2}{2(70)(60)}$	M1	
	$\angle RPQ° = 75.52 \approx 75.5°$ (3 sf)	A1	
(ii)	Bearing of R from $P = 90° - 75.52°$ $\approx 014.5°$	B1	
8b(i)	Let the perpendicular from R to PQ be X $\cos 75.52° = \frac{PX}{70}$ $PX = 17.503$	M1	
	≈ 17.5 m (3sf)	A1	
(ii)	Let the height of the pole be RH $\sin 75.52° = \frac{RX}{70}$ $RX = 70 \sin 75.52°$ $= 67.776$ m	B1	
	$\tan 10° = \frac{RH}{RX}$ $\tan 10 = \frac{RH}{67.776}$ $RH = 11.951$ m	M1	
	$RH \approx 12.0$ m (3 sf)	A1	
8c(i)	$\angle RPQ° = 90° - 20° = 70°$		
	$\angle SQP° = 300° - 270° = 30°$	M1	
	$\angle PSQ° = 180° - 70° - 30° = 80°$	A1	
(ii)	$\frac{PS}{\sin \angle SQP} = \frac{60}{\sin \angle PSQ}$	M1	
	$PS = \frac{60 \sin 30°}{\sin 80°} = 30.5$ m	A1	
	TOTAL	**12**	

CEDAR GIRLS' SECONDARY SCHOOL
MARK SCHEME FOR 2016 PRELIMINARY EXAMINATION 2 4048/2

Qn	Solutions	Allocation of Marks	Remarks
9a(i)	$\overrightarrow{AC} = -2\mathbf{a}$	B1	
a(ii)	$\overrightarrow{CD} = \overrightarrow{BA}$		
	$= \overrightarrow{OA} - \overrightarrow{OB}$		
	$= \mathbf{a} - \mathbf{b}$	B1	
9b	$\overrightarrow{DE} = \overrightarrow{DA} + \overrightarrow{AE}$ $3\overrightarrow{DE} = (\mathbf{a} + 5\mathbf{b})$	M1	
	$= \overrightarrow{CB} + \frac{2}{3}\overrightarrow{AB}$		
	$= \overrightarrow{OB} - \overrightarrow{OC} + \frac{2}{3}(-\overrightarrow{CD})$	M1	
	$= \mathbf{b} + \mathbf{a} + \frac{2}{3}(\mathbf{b} - \mathbf{a})$	B1	
	$= \frac{1}{3}\mathbf{a} + \frac{5}{3}\mathbf{b} = \frac{1}{3}(\mathbf{a} + 5\mathbf{b})$ Shown		
9d	$\overrightarrow{FE} = \overrightarrow{FA} + \overrightarrow{AE}$		
	$\overrightarrow{FE} = \frac{4}{5}\mathbf{a} + \frac{2}{3}(\mathbf{b} - \mathbf{a})$	B1	
	$\overrightarrow{FE} = \frac{2}{15}(\mathbf{a} + 5\mathbf{b})$ (o.e.)	A1	
	$\overrightarrow{FE} = \frac{2}{15}(\mathbf{a} + 5\mathbf{b})$		
	$= \frac{2}{5}[\frac{1}{3}(\mathbf{a} + 5\mathbf{b})]$		
	$\overrightarrow{FE} = \frac{2}{5}\overrightarrow{DE}$	B1	
	$\overrightarrow{FE} // \overrightarrow{DE}$ and E is common point, therefore D, E and F lie on the same straight line. (o.e.)	B1/2, B1/2	
9e(i)	Since ΔAFE is similar to ΔCFD		
	$\frac{\text{area of } \Delta AEF}{\text{area of } \Delta CDF} = \left(\frac{EF}{DF}\right)^2 = \left(\frac{2}{3}\right)^2$	M1	
	$= \frac{4}{9}$	A1	
9e	$\frac{\text{area of } \Delta DOF}{\text{area of } \Delta AEF} = \frac{\text{area of } \Delta DOF}{\text{area of } \Delta DAF} \times \frac{\text{area of } \Delta DAF}{\text{area of } \Delta AEF}$	M1	
	$= \frac{1}{4} \times \frac{3}{2}$		
	$= \frac{3}{8}$	A1	
	TOTAL	13	

Qn	Solutions	Allocation of Marks	Remarks
10a	$p = 6.64$	B1	
10b		Correct axes and scales [B1] Plot all given points [B1] Smooth curve through all points [B1]	
10c	From Graph, bt drawing a line $y = 6$	M1	
	$1.4 < x < 2.823$	A1	
10d	Draw $y = \frac{3}{4}x + 2$	M1	
	$x = 1.166$ and $y = 3.167$	A2	
	TOTAL	9	

CEDAR GIRLS' SECONDARY SCHOOL
MARK SCHEME FOR 2016 PRELIMINARY EXAMINATION 2 4048/2

Qn	Solutions	Allocation of Marks	Remarks
11a(i)	Total population = 5.47×10^6	B1	
(ii)	Mass of food waste = 789 000 × 1000 = 7.89×10^8 kg	B1	
(b)	Av. mass of food waste = $\frac{7.89\times10^8}{5.47\times10^6}$ = 144 kg per indiv.	B1	
11(c)	Given that 23% = 7.89×10^8 Mass of all waste generated in 2014 = $\frac{7.89\times10^8}{23}\times100$ $= 3.43 \times 10^9$ kg	M1 A1	
11(d)	Using comparison using mass Percentage of waste sent to Semakau = (100 - 13 - 83)% = 4% Mass with 4% of total waste sent to landfill $= 3.43\times10^9\times4\%$ $= 1.372\times10^8$ kg	M1	Accept alternative method
	Mass of waste per swimming pool $=\frac{7.89\times10^8\ kg}{615\ pools} = 1.2829\times10^6$ kg per swimming pool	M1	
	Capacity of Semakau Landfill $= 6700 \times 1.2829\times10^6$ $= 8.5954\times10^9$ kg	M1	
	Number of years Semakau Landfill will be filled up $= \frac{8.5954\times10^9}{1.372\times10^8} = 62.6 \approx 63$ years	A1	
	Report 11(d) Some students uses food waste. Misreading of the question		
	TOTAL	[9]	