# CEDAR GIRLS' SECONDARY SCHOOL
## Mid-Year Examination
## Secondary Three

CANDIDATE
NAME

CLASS

INDEX
NUMBER

# MATHEMATICS
**Sections A and B**

Students are advised to spend 45 minutes on Section A
and 1 hour 15 minutes on Section B.

**4048**

4 May 2016

**2 hours**

**Section A**
Candidates answer on the Question Paper.

For Examiner's Use

30

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**READ THESE INSTRUCTIONS FIRST**

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

Answer all the questions.
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 $\pi$, use either your calculator value or 3.142, unless the question requires the answer in terms of $\pi$.

At the end of the examination, fasten all your work securely.
**Hand in Section A and Section B separately.**
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for **Section A** is 30.
The total of the marks for **Section B** is 50.

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Section A consists of 8 printed pages.

[Turn over

Answer all the questions.

1 (a) Solve the inequalities

$$\frac{2x}{3} < \frac{x+7}{5} \le \frac{4x+5}{2}.$$

Illustrate your solution on the number line below.

(b) Hence, state the smallest possible integer value of $x$.

*Answer (a)* _____ [3]

$\longleftrightarrow$

*(b)* Smallest $x =$ _____ [1]

2 (a) Write down the smallest possible integer $k$ such that $\sqrt{21600k}$ is a positive integer.

(b) 3 traffic lights along a street turn red at regular intervals of 35 seconds, 48 seconds and 1 minute 12 seconds respectively. Occasionally, all three traffic lights will turn red simultaneously. If all traffic lights turn red simultaneously at 0830 for the first time, find the next time when they turn red simultaneously again.

*Answer* *(a)* _____ [2]

*(b)* _____ [2]

**3** The table below shows the number of hours of exercise by a group of 90 adults in a week.

| Number of hours of exercise in a week (hours) | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Number of adults | 22 | $x$ | 20 | $y$ |

(a) Given that the mean number of hours of exercise by each adult in a week is 3 hours, show that $3x + 5y = 146$.

*Answer (a)*

[2]

(b) Find the value of $x$ and of $y$.

*Answer* (b) $x = $ _____

$y = $ _____ [2]

(c) Find the median number of hours of exercise by each adult in a week.

(c) _____ h [1]

4  The table shows the depth of water, $h$ cm, when the same amount of water is poured into cylindrical containers with different base radii, $r$ cm.

| Base radius ( $r$ cm) | 1 | 2 | 4 | 10 |
|---|---|---|---|---|
| Depth of water ( $h$ cm) | 6 | 1.5 | 0.375 | 0.06 |

(a)  Explain clearly why $h$ is inversely proportional to $r^2$, using the values in the table.
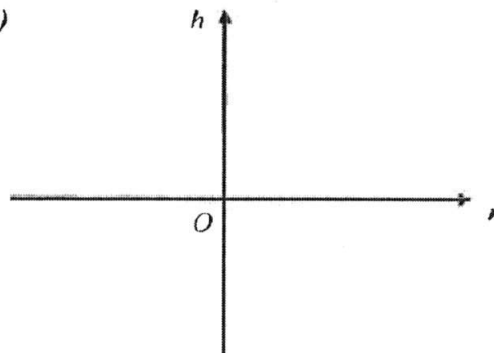
_____

_____

_____ [1]

(b)  Write down an equation connecting $h$ and $r$.

(c)  Sketch the graph using your answer in (b) in the diagram below.

(d)  Find the base radius of the cylinder when the depth of water in the cylinder is 2.4 cm.

*Answer (c)*



[2]

*Answer (b) and (d)*

*Answer* (b) _____ [1]

(d)  Base radius = _____ cm [2]

5  Diagrams I and II show the graphs of $y = ka^x$ and $y = bx^m$
   respectively, where $k$, $a$, $b$ and $m$ are constants. The point $(1, 1)$ has
   also been identified on **Diagram II**.
   Write down a possible equation for each graph, indicating clearly
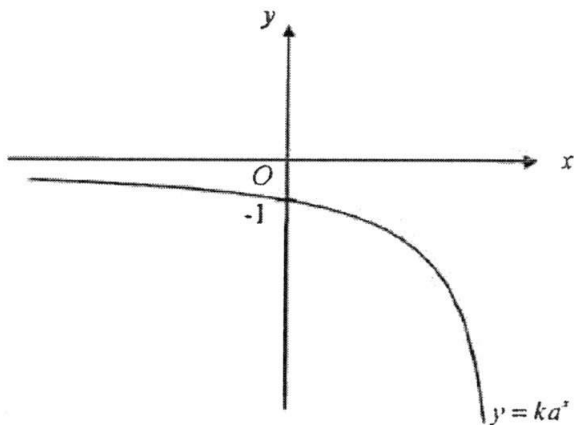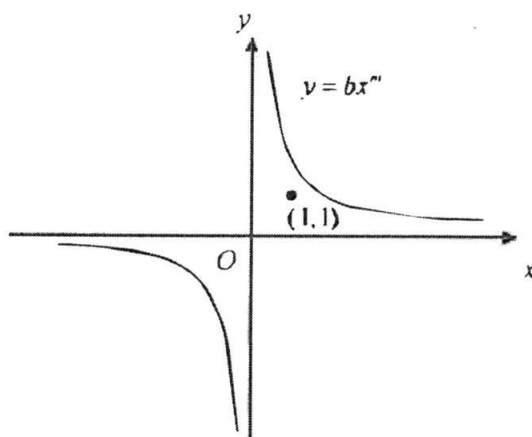   the specific values of $k$, $a$, $b$ and $m$.

(a)



**Diagram I**

(b)



**Diagram II**

*Answer*   (a)   **Diagram I:** _____ [1]

           (b)   **Diagram II:** _____ [1]

6   In a quadrilateral $ABCD$, $AB = 8\,cm$, $BC = 8\,cm$, $\angle ABC = 122°$,
$\angle BAD = 58°$ and $\angle BCD = 58°$.
The side $AB$ has already been drawn in the answer space below.

(a)   Construct quadrilateral $ABCD$ in the answer space below,
showing clearly your construction arcs.   [1]

(b)   On the same diagram, construct using rulers and compass only,

(i)   the perpendicular bisector of $BC$,   [1]

(ii)   the bisector of angle $DAB$.   [1]

(c)   The two bisectors in (b)(i) and (b)(ii) intersect at point $P$.
Measure the length of $PB$.

(d)   $ABCD$ is a special quadrilateral.
State the name of this special quadrilateral.

*Answer (a), (b)(i) and (b)(ii)*

$A$                                                                 $B$

*Answer*   *(c)*   $PB =$ _____ cm   [1]

*(d)*   _____   [1]

7    The diagram shows the positions of different places located in a town. The road joining the Shopping Mall and Amusement park is parallel to the road joining the Police Station and the Hospital.
The straight road joining the Shopping Mall and the Hospital, and the straight road joining the Amusement Park and the Police Station intersect at the Town Hall.
The Town Hall is 2 km nearer to the Police Station than to the Hospital.
The Town Hall is 1 km nearer to the Hospital than to the Amusement Park.

Given that the total distance of the road from the Police Station to the Town Hall and the road from the Town Hall to the Shopping Mall is 13 km, calculate the distance of the road from the Police Station to the Town Hall.

$S, A, T, P, H$ represent the Shopping Mall, Amusement park, Town Hall, Police Station and Hospital respectively.

(Hint: Let the distance between the Police Station and Town Hall be $x$ km.
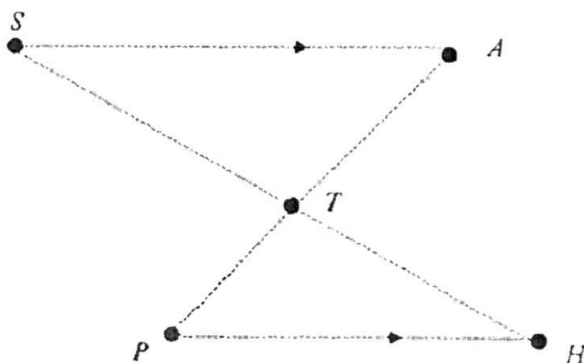


*Answer*                                                    [4]

**End of Section A**

Answer all the questions.

1 (a) Simplify $3(-2a^3b^{-7})^2 \div (\frac{3}{4}a^{-5}b^4)$, leaving your answer in positive indices. [2]

(b) Given that $2x - 3 = \frac{2}{y}\sqrt{y^2x^2 + 1}$, express $y$ in terms of $x$. [3]

(c) Factorise $4t^2 + 14t - 98$ completely. [2]

(d) Given that $2x = 3y = 7z$, find the ratio of $x : y : z$. [2]

2 In the diagram, $C$ is the point $(0, -8)$ and $B$ is a point on the $y$-axis.
The sloping line through $B$ and the horizontal line through $C$ meet at the point $A$.
The equation of the line $AB$ is $5y - 12x = 80$,
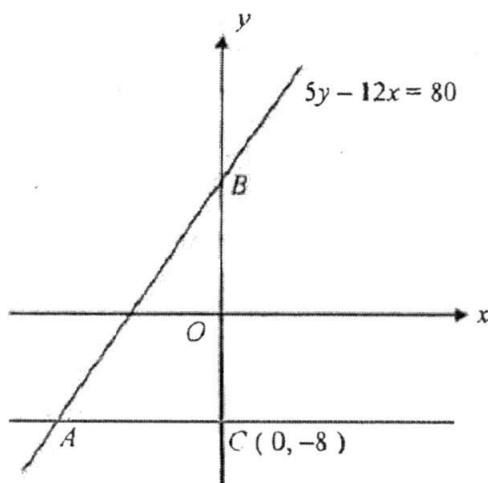


(a) Write down the equation of line $AC$. [1]

(b) Find the coordinates of $A$ and of $B$. [3]

(c) Find the value of the constant $k$ if the line joining the points $(4, 6)$ and $(k + 2, 2k - 1)$ is parallel to $AB$. [3]

(d) Calculate the length of $AB$. [1]

(e) Calculate the perpendicular distance from $C$ to $AB$. [2]

3  A man wants to deposit $10 000 in a bank for a period of 2 years.
   Bank $A$ offers a simple interest of 1.5% per annum.
   Bank $B$ offers a compound interest of 1.4% per annum, compounded monthly.
   Showing your reasoning clearly, indicate the bank that he should put his money in.   [4]


4  A tank can be filled with water from tap $A$ and tap $B$ at constant rates.

   (a)   If only tap $A$ is turned on, the tank can be filled in $x$ minutes. What fraction of the
         tank can be filled by tap $A$ alone in 1 minute?   [1]

   (b)   If only tap $B$ is turned on, the tank can be filled in $(x + 5)$ minutes. What fraction
         of the tank can be filled by tap $B$ alone in 1 minute?   [1]

   (c)   If taps $A$ and $B$ are turned on together, the tank can be filled in 3 minutes and
         15 seconds.
         (i)    Show that $4x^2 - 6x - 65 = 0$.   [3]

         (ii)   Solve the equation in (c) (i).   [2]

   (d)   Hence, write down the time taken to fill the tank by turning on tap $B$ only.
         Give your answer in minutes and seconds, correct to the nearest second.   [2]

5  In the diagram, points *A, B, C, D* and *E* lie on a circle with centre *O*.
  *AEF* and *CDF* are straight lines.
  *PBQ* is a tangent to the circle at *B*.
  Angle *AFD* = 40°, angle *BOC* = 60° and *AC = CF*.
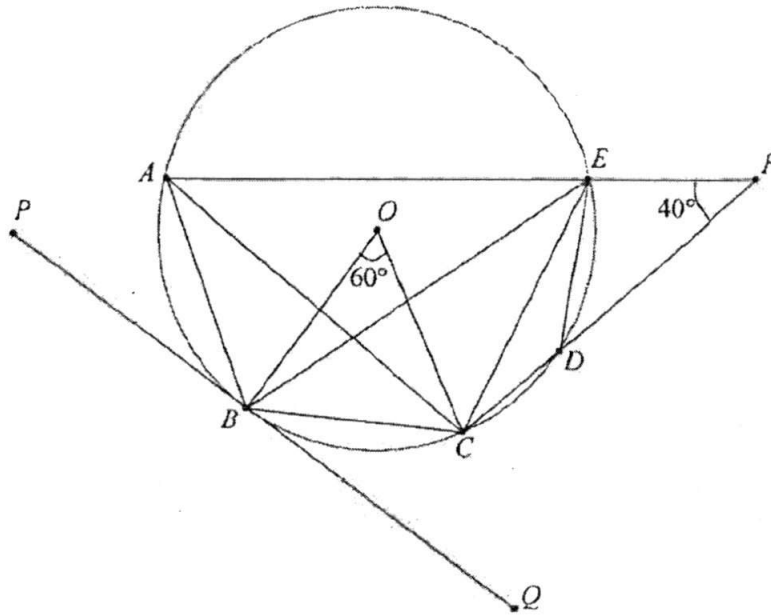


(a)  Find, showing your reasoning clearly,
  (i)  angle *EBC*,                                                                    [2]

  (ii)  angle *CBQ*,                                                                   [2]

  (iii)  angle *AED*.                                                                  [2]

(b)  Explain why triangle *DEF* is isosceles.                                          [2]

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

The variables $x$ and $y$ are connected by the equation $y = 8x^2 + \dfrac{15}{x} - 7$ .

Some corresponding values of $x$ and $y$ are given in the following table.

| $x$ | 0.2 | 0.3 | 0.5 | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 |
|-----|-----|-----|-----|---|-----|---|-----|---|-----|
| $y$ | 68.3 | 43.7 | 25 | 16 | 21 | 32.5 | 49 | $p$ | 95.3 |

**(a)** Calculate the value of $p$. [1]

**(b)** Using a scale of 4 cm to represent 1 unit, draw a horizontal $x$-axis for $0 \le x \le 3.5$ .
Using a scale of 1 cm to represent 5 unis, draw a vertical $y$-axis for $0 \le y \le 100$ .
On your axes, plot the points given in the table and join them with a smooth curve. [3]

**(c)** Use your graph to find the values of $x$ when $y = 60$. [2]

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

**(e)** By drawing a suitable straight line, use your graph to solve
$8x^3 - 12x^2 - 37x + 15 = 0$ for $0 \le x \le 3.5$ . [2]
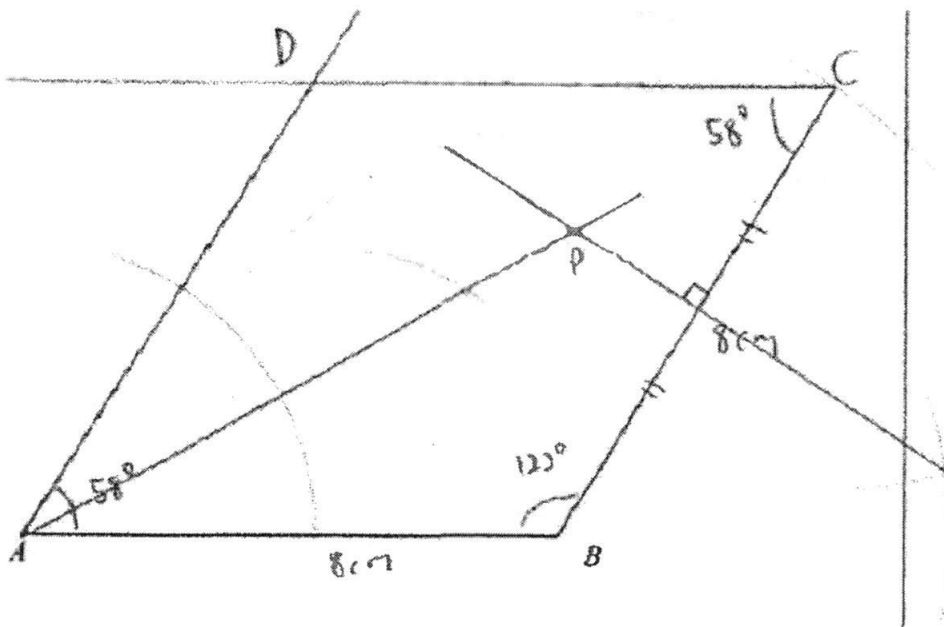
**End of Section B**

## Answer Key for Mathematics 4048

| Section A | | Section A | |
|---|---|---|---|
| 1(a) | $-\dfrac{1}{18} \leq x < 3$ | 4(b) | $hr^2 = 6$ or $h = \dfrac{6}{r^2}$ |
| 1(b) | Smallest integer = 0 | 4(c) | Graph Sketching |
| 2a | $k = 6$ | 4(d) | $r = 1.58\,\text{cm}$ |
| 2(b) | 0954 or 9:54 am | 5(a) | $y = -2^x$ $k = -1, a = 2, a > 1,$ |
| 3(a) | show that $3x + 5y = 146$ | 5(b) | $y = 3x^{-1}$ $b > 1, m = -1$ |
| 3(b) | $y = 1, x = 47$ | 6(c) | $PB = (4.6 \pm 0.1)\,\text{cm}$ |
| 3(c) | 3 hours | 6(d) | Rhombus |
| 4(a) | Since $hr^2 = 6$, for all values in the table, h is inversely proportional to $r^2$. | 7 | $x = 1$ or $x = 3$ |

Question 6 (a). (b)(i) and (b)(ii)



1

## Answer Key for Mathematics 4048 Section B

| | | | |
|---|---|---|---|
| 1a | $\dfrac{16a^{11}}{b^k}$ | 4b | $\dfrac{1}{x+5}$ |
| 1b | $y = \pm\dfrac{2}{\sqrt{9-12x}}$ | 4c(i) | To be shown |
| 1c | $2(2t-7)(t+7)$ | 4c(ii) | 4.85 or $-3.35$ |
| 1d | $x:y:z = 21:14:6$ | 4c(iii) | 9 mins 51 sec |
| 2a | $y = -8$ | 5a(i) | 40° |
| 2b | $A = (-10, -8)$ | 5a(ii) | 30° |
| 2c | $k = -5.5$ | 5a(iii) | 80° |
| 2d | 26 units | 5b | $\therefore \angle EDF = 40° = \angle EFD$ (base $\angle$s of isosceles triangle) |
| 2e | 9.23 units | 6a | $p = 70$ |
| 3 | He should put his money in Bank A | 6c | Draw the line $y = 60$ $x = 0.25$ or $x = 2.80$ ($\pm 0.05$) |
| 4a | $\dfrac{1}{x}$ | 6d | Gradient $= 28$ ($\pm 3$) |
| | | 6e | Draw $y = 12x + 30$ $x = 0.37$ ($\pm 0.1$) or $x = 2.87$ ($\pm 0.1$) |
| 6b, 6c, 6d, 6e |  | | |