## ANG MO KIO SECONDARY SCHOOL
## MID-YEAR EXAMINATION 2018
## SECONDARY THREE EXPRESS

**MATHEMATICS**
Paper 1

**4048/01**

**Tuesday**          **08 May 2018**          **2 hours**

Candidates answer on the Question Paper.

**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, 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 $\pi$, 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 together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is **80**.

| For Examiner's Use |
|:---:|
| **80** |

This document consists of **18** printed pages.

## Mathematical Formulae

**Compound interest**

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

**Mensuration**

$$\text{Curve surface area of a cone} = \pi r l$$

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

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

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

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

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

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

**Trigonometry**

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

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

**Statistics**

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

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

**[Turn Over**

1  (a)  Calculate $\dfrac{\sqrt{10.99}-2}{4.1^2+\dfrac{3}{5}}$ . Write down all the digits shown on your calculator display.

*Answer*   *(a)*   ................................................... [1]

(b)  Give your answer to part **(a)** correct to 2 significant figures.

*Answer*   *(b)*   ................................................... [1]

2  A printer can print 500 books in an hour. Each book contains 30 pages. Assuming that the printer prints at the same constant rate, calculate the time needed to print 300 books containing 18 pages. Give your answer in minutes and seconds.

*Answer* ................ minutes ................ seconds [2]

3  The temperature, in °C, at noon, on three successive days was −4, 9 and $k$. Given that the temperature has been increasing for the past 3 days, find an expression in terms of $k$, for

(a)  the difference in temperature between the first and third days,

*Answer* ................................................... °C [1]

(b)  the mean temperature for the three days.

*Answer* ................................................... °C [1]

4    Given that $\dfrac{5^p}{5^q} = \dfrac{1}{5}$, express $p$ in terms of $q$.

*Answer* ................................................................ [2]

5    The length of a road is 2.8 km. The length of this road on a map is 7 cm.

(a)    The length of a river is represented by 20 cm on the map. Calculate the actual length of the river.

*Answer*  *(a)*  ................................. km    [1]

(b)    The river flows into a lake of area 6.4 km². Calculate the area, in cm², of the lake represented on the map.

*Answer*  *(b)*  ................................. cm²    [2]

**6**    Given that $m = 2^3 \times 3^2 \times 5^4$ and $n = 2^2 \times 3^4 \times 5^5$,

**(a)**    write down, in index notation, the highest common factor of $m$ and $n$,

*Answer   (a)*    ........................................    [1]

**(b)**    find the smallest positive integer, $k$, such that $kmn$ is a perfect square.

*Answer   (b)*    $k =$ ........................................    [1]

---

**7**    Factorise completely

**(a)**    $x^3 - 16xy^2$,

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

**(b)**    $x^2 - 5x + 6$.

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

**8** **(a)** Represent $-1 < x \leq 2$ on the number line below.

*Answer (a)*

$$\begin{array}{cccccc} -2 & -1 & 0 & 1 & 2 & 3 \end{array}$$

[1]

**(b)** Solve the inequalities $-9 \leq 4x - 7 < 9$.

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

---

**9** Given that the line $2x + hy = k$ cuts the $x$-axis at $x = 3$ and cuts the $y$-axis at $y = 6$, find

**(a)** the values of the constant $h$ and $k$,

*Answer (a)* $h =$ ...................................

$k =$ ................................... [2]

**(b)** the gradient of the line.

*Answer (b)* ................................................... [1]

---

10 (a) Simplify

(i) $8a^0 \div (2a)^2$,

*Answer* *(a)(i)* ................................................ [2]

(ii) $\left(\dfrac{8}{x^6}\right)^{-\frac{1}{3}}$,

*Answer* *(a)(ii)* ................................................ [2]

(iii) $y^2 \times \sqrt{y^3}$.

*Answer* *(a)(iii)* ................................................ [2]

(b) The sine of an angle is 0.9. Give two possible values of the angle.

*Answer* *(b)* ............ ° or ............ ° [2]

11 The storage capacity of a portable hard disk is 1 terabyte.

(1 terabyte $= 10^{12}$ bytes)

**(a)** If the average file size of a picture is 25 megabytes, how many picture files can be stored in the portable hard disk?

(1 megabyte $= 10^6$ bytes)

*Answer* *(a)* ............................... files [2]

**(b)** The rate of transfer of data from the portable hard disk to a computer is 4.5 megabytes per second. Find, in gigabytes, the amount of data transferred in 20 minutes.

(1 gigabyte $= 10^9$ bytes)

*Answer* *(b)* ............................... gigabytes [2]

12     Kerts Electronic Store purchases television sets from a wholesaler at $2560 each.

The store sells the television set at 70% higher than the price it paid for it.

(a)     Find the selling price of the television set.

*Answer*  *(a)*       $ ................................. [1]

(b)     Kerts Electronic Store members are given $x$ % discount. Kenny who is a member of the store, buys the television set at $3699.20.

(i)     Find the value of $x$.

*Answer*  *(b)*       $x =$ ................................. [2]

(ii)     Calculate the percentage profit made by Kerts Electronic Store from Kenny's purchase.

*Answer*  *(c)*       ................................. %   [2]

13   **(a)**   Simplify $9x^2 + 5 - (3x - 2)^2$.

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

**(b)**   Express $\dfrac{3}{x+3} + \dfrac{4}{x-2}$ as a single fraction.

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

**(c)**   Given $S = \dfrac{pq - 2r^2}{q}$, express $q$ in terms of $S$, $p$ and $r$.

*Answer*   *(c)*   ............................................ [3]

**14**
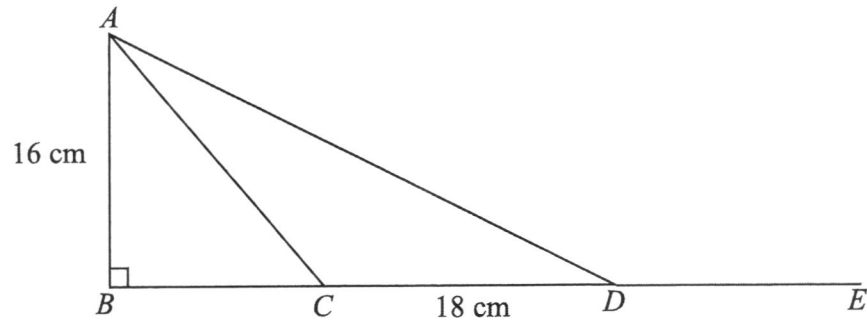


In the diagram, $AB = 16$ cm, $CD = 18$ cm, $\angle ABC = 90°$, $\tan \angle BAC = \dfrac{3}{4}$ and $BCDE$ is a

straight line. Find

**(a)** $BC$,

*Answer* *(a)* $BC =$ .......................... cm    [1]

**(b)** $AD$,

*Answer* *(b)* $AD =$ _____ cm    [1]

**(c)** $\cos \angle ADE$.

*Answer* *(c)* $\cos \angle ADE =$ ..........................    [1]

15    Solve the simultaneous equations

$$2x = 12 + 3y,$$
$$10x - 3y = 108.$$

*Answer*    $x =$ ........................................................

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

16   On a particular day, the exchange rate between pounds (£) and Singapore dollars (S$) was £1 = S$1.87. On the same day, the exchange rate between euros (€) and pounds was €1 = £0.86.

(a)   Claire changed £200 into Singapore dollars. Calculate how many dollars she received.

*Answer   (a)*      S$   ....................................... [1]

(b)   Don converted S$500 into euros. Calculate how many euros he received.

*Answer   (b)*      €   ....................................... [2]

17  (a)  A restaurant owner pays a waiter an amount of $A per week. The amount is made up of a basic wage of $60 plus 11 cents for each of the $n$ customers he serves. Find a formula connecting $A$ and $n$.

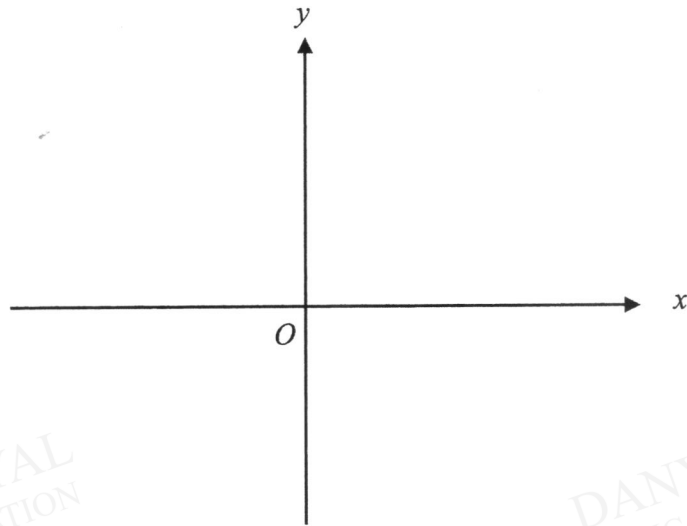*Answer* *(a)*  ................................................  [1]

(b)  After a while, the owner of the restaurant decides to decrease the waiter's basic wage to $45 but to increase the pay to 17 cents for each of the $n$ customers he serves. Write down another formula connecting $A$ and $n$.

*Answer* *(b)*  ................................................  [1]

(c)  Find the number of customers he would have to serve in a week for him to receive the same amount of money as before the changes in wage payment.

*Answer* *(c)*  .......................... customers  [2]

**18 (a) (i)** Sketch the graph of $y = (x-1)(x+5)$.



[2]

**(ii)** Write down the equation of the line of symmetry of $y = (x-1)(x+5)$.

*Answer (a)(ii)* ................................................ [1]

**(b) (i)** Express $x^2 + 6x + 7$ in the form $(x+a)^2 + b$.

*Answer (b)(i)* ................................................ [2]

**(ii) Hence** solve $x^2 + 6x + 7 = 0$, giving your answers correct to two decimal places.

*Answer (b)(ii)* $x =$ .............. or .............. [3]

19  The frequency, $f$ Hz, of a note produced by a string is proportional to the square root of the tension, $T$ newton, of the string. When the tension is 81 N the string produces a note with a frequency of 405 Hz.

(a)  Find an equation connecting $f$ and $T$.

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

(b)  The string produces a note with a frequency of 540 Hz.
Find the tension in the string.

*Answer  (b)*  ............................................ N  [1]

(c)  For two identical strings, the ratio of the frequencies of the notes produced is 3 : 1.
Find the ratio of the tensions in the strings.

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

20    Each term in this sequence is found by adding the same number to the previous term.

$$7, \quad a, \quad b, \quad 19, \quad c, \quad \ldots$$

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

*Answer*  *(a)*    $a =$ ................................................

$b =$ ................................................

$c =$ ................................................  [2]

(b)    Write down an expression, in terms of $n$, for the $n$th term.

*Answer*  *(b)*    ................................................  [1]

(c)    Write down the 25th term in this sequence.

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

21    The diagram shows the positions of 3 towns $P$, $Q$ and $R$.  $PQR$ is an isosceles triangle.
      The  bearing of $Q$ from $P$ is 123° and angle $PRQ = 46°$.
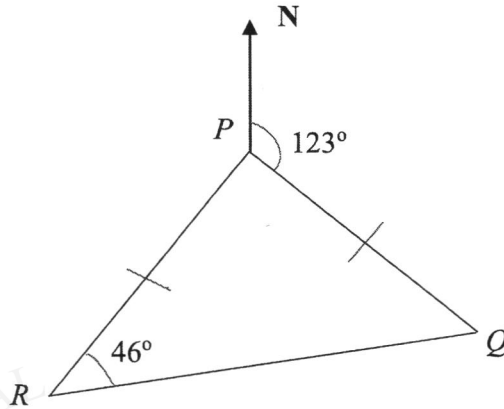


Find the bearing of

**(a)**    $R$ from $P$,

         *Answer   (a)*     .................................... °          [2]

**(b)**    $P$ from $Q$,

         *Answer   (b)*     .................................... °          [1]

**(c)**    $P$ from $R$.

         *Answer   (c)*     .................................... °          [1]

**END OF PAPER**

**ANG MO KIO SECONDARY SCHOOL**
**MID-YEAR EXAMINATION 2018**
**SECONDARY THREE EXPRESS**

**MATHEMATICS**                                                    4048/02
Paper 2

**Friday**                    **04 May 2018**        **2 hours 30 minutes**

Additional Materials:        Answer Paper

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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 on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, 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 $\pi$, 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 together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is **100**.

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This document consists of **10** printed pages.

## *Mathematical Formulae*

*Compound interest*

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

*Mensuration*

Curved surface area of a cone $= \pi r l$

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

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

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

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

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

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

*Trigonometry*

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

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

*Statistics*

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

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

Answer **all** the questions.

1  **(a)**  Expand and simplify $2x+3-4x(x-1)$.  [2]

**(b)**  Simplify $\dfrac{x-4}{3x^2-11x-4} \div \dfrac{1}{9x^2-1}$.  [3]

**(c)**  Factorise $9a^2c-b^2c+9a^2d-b^2d$ completely.  [3]

**(d)**  Solve the equation $\dfrac{5}{x+7}=1-\dfrac{4}{11-x}$.  [3]

**(e)**  Given that $2y-2x=x+y$, evaluate $\sqrt[3]{\dfrac{15y^2}{2xy-x^2}}$  [3]

2  **(a)**  Simplify the following expressions, leaving your answers in positive index where necessary.

**(i)**  $\dfrac{3x^4}{10xy^3} \div \dfrac{x}{5y}$,  [2]

**(ii)**  $4a^3b^{-2} \times \left(4a^{-2}b\right)^2$.  [2]

**(b)**  Solve the equation $16^{n+1}=16\left(2^{n-1}\right)$.  [3]

**(c)**  Simplify the following, giving your answer in radical form.

$$\dfrac{p^2 \times \sqrt[3]{p^2}}{\sqrt{p}}$$  [2]

3    Car $P$ travels $x$ km for every litre of petrol used. Car $Q$ travels 3 km more than car $P$ for every litre of petrol used. It is given that Car $P$ uses 8 litres of petrol more than Car $Q$ for a 330 km journey.

   (a)    Write down an expression, in terms of $x$, for the number of litres used to travel 330 km for

   (i)     Car $P$,                                                                                [1]

   (ii)    Car $Q$.                                                                               [1]

   (b)    Form an equation in $x$ and show that it reduces to $4x^2 + 12x - 495 = 0$.    [3]

   (c)    Solve the equation $4x^2 + 12x - 495 = 0$, giving your answers correct to one decimal place.                                                                     [3]

   (d)    Find the number of litres of petrol used by Car $Q$ for the journey.           [2]

---

4    (a)    Given that $x$ and $y$ are integers such that $-6 \le x < 2$ and $-5 < y \le -2$, find

   (i)     the smallest value of $x^2 + y^2$,                                              [1]

   (ii)    the largest value of $\dfrac{y}{x}$,                                            [1]

   (iii)   the largest value of $x + xy$.                                                 [1]

   (b)    Solve the inequality $\dfrac{x-2}{3} < \dfrac{2x+1}{5} \le 3 - x$.              [3]

   (c)    A sports club charges a monthly membership of $25 and an admission of $3 per entry. If Keith entered the club $n$ times in March,

   (i)     write an expression in terms of $n$, to represent the total amount of money Keith paid in March,                                                     [1]

   (ii)    form an inequality to find the maximum number of times Keith entered the club in March if he spent less than $54.                              [3]

5   Alicia, Benjamin and Cathy received an inheritance of $150 000 from their late uncle. They are to share the inheritance in the proportion 1 : 3 : 2 respectively.

(a)   Cathy deposited her portion of the inheritance in *ABC* bank. The bank pays a simple interest of 3% per annum. Calculate the total amount she received after 3 years.   [3]

(b)   Alicia deposited her portion of the inheritance in *XYZ* bank. The bank pays a compound interest half yearly at a rate of 3% per annum. Calculate the total amount she received after 3 years.   [2]

(c)   Benjamin decided to buy a car with his portion of the inheritance. The car cost $100 000. He borrowed the remaining amount from a bank for 3 years at simple interest of $y$ % per annum. If his monthly instalment is $800, calculate $y$.   [4]

6   The diagram below shows a rectangle *ABCD* with diagonal *AC*. *X* lies on *BC* and *Y* lies on *CD*.
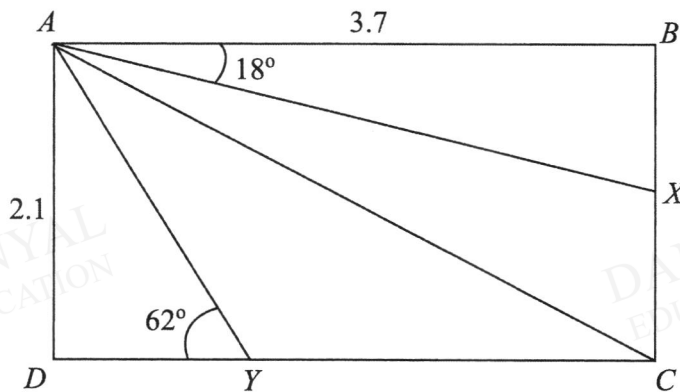


Given that *AB* = 3.7 cm, *AD* = 2.1 cm, $\angle BAX$ = 18° and $\angle AYD$ = 62°.

Calculate

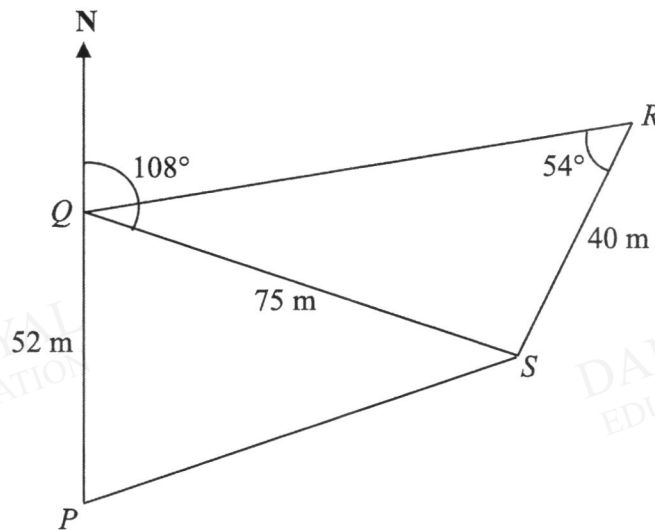(a)   *AX*,                                                                                              [2]

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

(c)   *AY*,                                                                                              [2]

(d)   area of trapezium *AXCD*.                                                      [3]

7  In the diagram below, *P*, *Q*, *R* and *S* are four corners of a horizontal plot of land. $PQ = 52$ m, $QS = 75$ m, $RS = 40$ m and $\angle QRS = 54°$. *P* is due south of *Q* and the bearing of *S* from *Q* is $108°$.



**(a)**  Find

    **(i)**    the distance *PS*,    [3]

    **(ii)**    the area of $\triangle PQS$,    [2]

    **(iii)**    the perpendicular distance from *Q* to *PS*.    [2]

**(b)**  Find

    **(i)**    $\angle SQR$,    [2]

    **(ii)**    the bearing of *Q* from *R*.    [2]

**(c)**  A rock wall is erected at *Q* and the angle of elevation of the top of the wall from *P* is $11°$. Calculate the height of the rock wall.

    [2]

**8**    The diagram shows triangle $ABC$ with coordinates $A(-6,\ 0), B(8,\ 0)$ and $C(3,\ 9)$.

The line $AC$ cuts the $y$-axis at the point $D$.
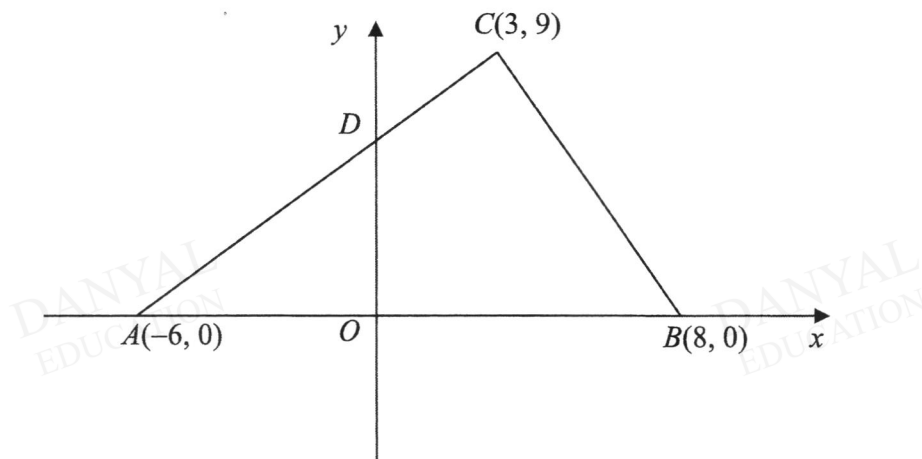


**(a)**    Find

    **(i)**    the length of $AC$,                                            [2]

    **(ii)**    the equation of $AC$,                                        [2]

    **(iii)**    the coordinates of $D$,                                    [1]

    **(iv)**    the area of quadrilateral $OBCD$.                      [2]

**(b)**    Find the equation of the line that is parallel to $BC$ and passes through the point $D$.                                            [2]

**9** The diagram below shows a series formed by the number of dots that form a triangle.



Figure 1          Figure 2          Figure 3
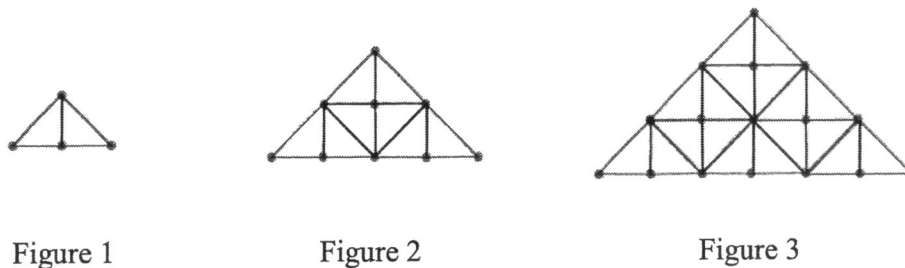
The total number of dots and the number of small right-angled triangles for each figure is shown in the table below.

| Figure | Total number of dots | Number of small right-angled triangles |
|--------|----------------------|----------------------------------------|
| 1 | 4 | 2 |
| 2 | 9 | 8 |
| 3 | 16 | 18 |
| 4 | $a$ | $b$ |
| 5 | $c$ | $d$ |
| ⋮ | ⋮ | ⋮ |
| $n$ | $y$ | $z$ |

**(a)** Write down the values of $a$, $b$, $c$ and $d$.                                            [4]

**(b)** Find the total number of dots needed to form figure 9.                      [1]

**(c)** Write down an expression, in terms of $n$, for

    **(i)** $y$, the number of dots,                                                        [1]

    **(ii)** $z$, the number of right-angled triangles.                            [1]

**(d)** Explain why the series cannot contain 300 right-angled triangles.        [2]

10    Diagram I shows a cement tank made of a hollow cone joined to an open cylinder. The diameter of the tank is 3.8 m. As a safety precaution, the tank can only be filled up to a maximum of 80% of its total volume. The mass of 1 m³ of cement varies between 1000 kg and 1200 kg.

Diagram II shows a model of the cement tank with a radius of 1.2 cm. The vertical heights of the cylindrical and the conical parts of the model is 6 cm and 2.4 cm respectively.
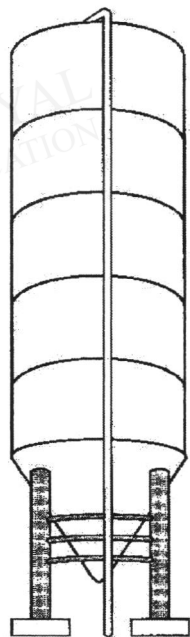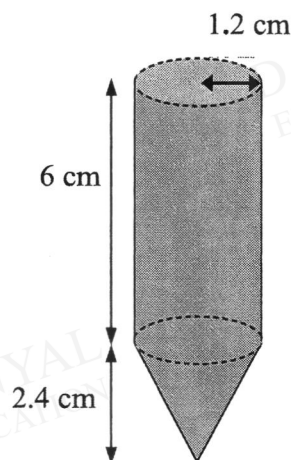


Diagram I

1.2 cm
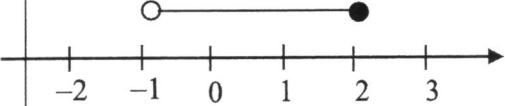
6 cm

2.4 cm

Diagram II

(a)    (i)    Show that the actual height of the cylindrical part of the tank is 9.5 m.    [1]

(ii)   Find the actual height of the conical part of the tank.    [1]

(b)    Calculate the maximum safe volume of the cement tank.    [4]

(c)    Determine if the tank can be filled with 100000 kg of cement. Explain your answer with calculations.    [2]

**END OF PAPER**

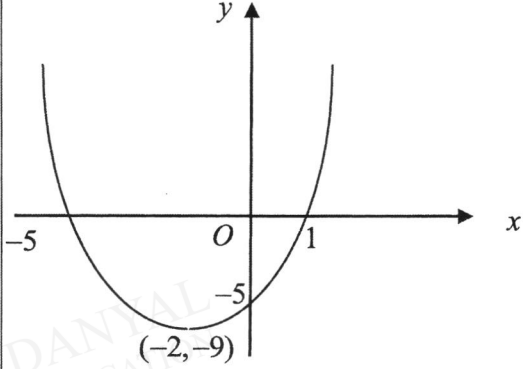**MATHEMATICS PAPER 1**

| NO | SOLUTIONS | MARKS |
|---|---|---|
| 1(a) | 0.07553801785 | B1 |
| 1(b) | 0.076 | B1 |
| | | |
| 2 | $500 \times 30$ pages ------- 60 minutes <br> $15000$ pages ------- 60 minutes <br> 1 page ------- $\dfrac{60}{15000}$ minutes <br> $300 \times 18$ pages ----- $\dfrac{60}{15000} \times 300 \times 18$ <br> 5400 pages ------- 21.6 minutes <br> $\qquad = 21$ min 36 sec | <br><br><br><br><br><br>M1 <br> A1 |
| | | |
| 3(a) | $k+4$ | B1 |
| 3(b) | $\dfrac{-4+9+k}{3} = \dfrac{5+k}{3}$ | B1 |
| | | |
| 4 | $\dfrac{5^p}{5^q} = \dfrac{1}{5}$ <br> $5^{p-q} = 5^{-1}$ <br> $p = q-1$ | <br> M1 <br><br> A1 |
| | | |
| 5(a) | 7 cm ------- 2.8 km <br> 1 cm ------- 0.4 km <br> 20 cm ------- 8 km | <br><br> B1 |
| 5(b) | 0.4 km ------- 1 cm <br> 1 km ------- 2.5 cm <br> 1 km$^2$ ---------- 6.25 cm$^2$ <br> 6.4 km$^2$ ---------- 40 cm$^2$ | <br><br> M1 <br> A1 |
| | | |
| 6(a) | $2^2 \times 3^2 \times 5^4$ | B1 |
| 6(b) | $mn = 2^5 \times 3^6 \times 5^9$ <br> Smallest integer $= k = 2 \times 5 = 10$ | <br> B1 |
| | | |
| 7(a) | $x^3 - 16xy^2$ <br> $= x(x^2 - 16y^2)$ <br> $= x(x+4y)(x-4y)$ | <br> M1 <br><br> A1 |

| | | |
|---|---|---|
| 7(b) | $x^2 - 5x + 6$<br>$= (x-3)(x-2)$ | B2 |
| | | |
| 8(a) |  | B1 |
| 8(b) | $-9 \le 4x - 7 < 9$<br>$-2 \le 4x < 16$<br>$-\dfrac{1}{2} \le x < 4$ | M1<br><br>A1 |
| | | |
| 9(a) | $2x + hy = k$<br>$2(3) + h(0) = k$<br>$k = 6$<br><br>$2(0) + h(6) = 6$<br>$h = 1$ | B1<br><br><br>B1 |
| 9(b) | $2x + y = 6$<br>$y = -2x + 6$<br>Gradient = $-2$ | B1 |
| | | |
| 10(a)(i) | $8a^0 \div (2a)^2$<br>$= \dfrac{8}{4a^2}$<br>$= \dfrac{2}{a^2}$ | M1<br><br>A1 |
| 10(a)(ii) | $\left(\dfrac{8}{x^6}\right)^{-\frac{1}{3}}$<br>$= \left(\dfrac{x^6}{8}\right)^{\frac{1}{3}}$<br>$= \dfrac{x^2}{2}$ | M1<br><br>A1 |
| 10(a)(iii) | $y^2 \times \sqrt{y^3}$<br>$= y^2 \times y^{\frac{3}{2}}$<br>$= y^{\frac{7}{2}}$  or  $\sqrt{y^7}$ | M1<br><br>A1 |
| 10(b) | $\sin x = 0.9$<br>$x = 64.2°$  or  $115.8°$ | B1, B1 |
| | | |
| 11(a) | $10^{12} \div (25 \times 10^6)$<br>$= 40000$ | M1<br>A1 |
| | | |

| | | |
|---|---|---|
| 11(b) | $4.5 \times 10^6 \times 1200$ <br> $= 5.4 \times 10^9$ bytes <br> $= 5.4$ GB | M1 <br><br> A1 |
| | | |
| 12(a) | $\dfrac{170}{100} \times 2560 = \$4352$ | B1 |
| 12(b)(i) | $\dfrac{4352 - 3699.20}{4352} \times 100$ <br> $= 15\%$ | M1 <br><br> A1 |
| | | |
| 12(b)(ii) | $\dfrac{3699.20 - 2560}{2560} \times 100$ <br> $= 44.5\%$ | M1 <br> A1 |
| | | |
| 13(a) | $9x^2 + 5 - (3x - 2)^2$ <br> $= 9x^2 + 5 - (9x^2 - 12x + 4)$ <br> $= 12x + 1$ | M1 <br> A1 |
| 13(b) | $\dfrac{3}{x+3} + \dfrac{4}{x-2}$ <br> $= \dfrac{3(x-2)}{(x+3)(x-2)} + \dfrac{4(x+3)}{(x-2)(x+3)}$ <br> $= \dfrac{3x - 6 + 4x + 12}{(x+3)(x-2)}$ <br> $= \dfrac{7x + 6}{(x+3)(x-2)}$ | M1 <br><br><br> A1 |
| 13(c) | $S = \dfrac{pq - 2r^2}{q}$ <br> $Sq = pq - 2r^2$ <br> $Sq - pq = -2r^2$ <br> $q(S - p) = -2r^2$ <br> $q = \dfrac{-2r^2}{S - p}$ or $q = \dfrac{2r^2}{p - S}$ | M1 <br><br> M1 <br><br> A1 |
| | | |
| 14(a) | 12 cm | B1 |
| | | |
| 14(b) | $AD = \sqrt{16^2 + 30^2}$ <br> $AD = \sqrt{1156}$ <br> $AD = 34$ cm | B1 |

| | | |
|---|---|---|
| 14(c) | $-\dfrac{30}{34} = -\dfrac{15}{17}$ | B1 |
| | | |
| 15 | $2x = 12 + 3y$ ------------ (1)<br>$10x - 3y = 108$ -------------- (2)<br><br>From (1),<br>$x = 6 + 1.5y$ ----------- (3)<br><br>Sub (3) into (2):<br>$10(6 + 1.5y) - 3y = 108$<br>$60 + 15y - 3y = 108$<br>$12y = 48$<br>$y = 4$<br><br>Sub $y = 4$ into (3),<br>$x = 6 + 1.5(4)$<br>$x = 12$ | Any correct method – M1<br><br><br>A1<br><br><br>A1 |
| | | |
| 16(a) | £1 = \$1.87<br>£200 = \$374 | B1 |
| 16(b) | $\$1 = £\dfrac{1}{1.87}$<br><br>$\$500 = £\dfrac{500}{1.87} = £267.3796791$<br><br>€1 = £0.86<br><br>$£1 = €\dfrac{1}{0.86}$<br><br>$£267.3796791 = €\dfrac{1}{0.86} \times 267.3796$<br>$\qquad\qquad\quad = €310.91$ | M1<br><br><br><br><br><br>A1 |
| | | |
| 17(a) | $A = 60 + \dfrac{11}{100}n$   or   $A = 60 + 0.11n$ | B1 |
| 17(b) | $A = 45 + \dfrac{17}{100}n$   or   $A = 45 + 0.17n$ | B1 |

| | | |
|---|---|---|
| 17(c) | $60 + 0.11n = 45 + 0.17n$<br>$0.06n = 15$<br>$n = 250$ | M1<br><br>A1 |
| | | |
| 18(a)(i) |  | B1 ---- Correct shape and x – intercepts<br>B1 ----- Correct turning points and y-intercept |
| 18(a)(ii) | $x = -2$ | B1 |
| 18(b)(i) | $x^2 + 6x + 7$<br>$= (x+3)^2 - 2$ | B2 |
| 18(b)(ii) | $(x+3)^2 - 2 = 0$<br>$(x+3)^2 = 2$<br>$x + 3 = \sqrt{2}$  or  $x + 3 = -\sqrt{2}$<br>$x = -1.59$         $x = -4.41$ | M1<br><br>A1,A1 |
| | | |
| 19(a) | $f = k\sqrt{T}$<br>$405 = k\sqrt{81}$<br>$k = 45$<br>$f = 45\sqrt{T}$ | M1<br>A1 |
| 19(b) | $540 = 45\sqrt{T}$<br>$T = 144$ | B1 |
| 19(c) | $9 : 1$ | B1 |
| | | |
| 20(a) | $a = 11$ , $b = 15$ , $c = 23$ | Any 2 – B1<br>All 3 – B2 |
| 20(b) | $4n + 3$ | B1 |
| 20(c) | 103 | B1 |
| | | |
| 21(a) | $180° - 46° - 46° = 88°$<br>$123° + 88° = 211°$ | M1<br>A1 |
| 21(b) | $360° - (180° - 123°)$<br>$= 303°$ | B1 |
| 21(c) | $\angle RPN = 360° - 123° - 88° = 149°$<br>$180° - 149° = 031°$ | B1 |

**MYE 2018 3E EMath Paper 2 Marking Scheme**

| Qn | Solution | Mark |
|---|---|---|
| 1a | $2x+3-4x(x-1)$ <br><br> $=2x+3-4x^2+4x$ <br><br> $=-4x^2+6x+3$ | M1 <br><br> A1 |
| 1b | $\dfrac{x-4}{3x^2-11x-4} \div \dfrac{1}{9x^2-1}$ <br><br> $=\dfrac{x-4}{(3x+1)(x-4)} \times \dfrac{(3x+1)(3x-1)}{1}$ <br><br> $=3x-1$ | M1, M1 <br><br> A1 |
| 1c | $9a^2c-b^2c+9a^2d-b^2d$ <br><br> $=c(9a^2-b^2)+d(9a^2-b^2)$ <br><br> $=(c+d)(9a^2-b^2)$ <br><br> $=(c+d)(3a+b)(3a-b)$ | M1 <br><br> M1 <br><br> A1 |
| 1d | $\dfrac{5}{x+7}=1-\dfrac{4}{11-x}$ <br><br> $\dfrac{5}{x+7}+\dfrac{4}{11-x}=1$ <br><br> $\dfrac{5(11-x)+4(x+7)}{(x+7)(11-x)}=1$ <br><br> $55-5x+4x+28=11x-x^2+77-7x$ <br><br> $-x+83=-x^2+4x+77$ <br><br> $x^2-5x+6=0$ <br><br> $(x-2)(x-3)=0$ <br><br> $x=2$ or $x=3$ | M1 <br><br> M1 <br><br> A1 |
| 1e | $2y-2x=x+y$ <br><br> $y=3x$ <br><br> Subst $y=3x$ into $\sqrt[3]{\dfrac{15y^2}{2xy-x^2}}$ : <br><br> $\sqrt[3]{\dfrac{15(3x)^2}{2x(3x)-x^2}}$ <br><br> $=\sqrt[3]{\dfrac{135x^2}{5x^2}}=\sqrt[3]{27}=3$ | M1 <br><br> M1 <br><br> A1 |
| 2a(i) | $\dfrac{3x^4}{10xy^3} \div \dfrac{x}{5y}$ <br><br> $=\dfrac{3x^4}{10xy^3} \times \dfrac{5y}{x}$ <br><br> $=\dfrac{3x^2}{2y^2}$ | M1 <br><br> A1 |

| | | |
|---|---|---|
| 2a(ii) | $4a^3b^{-2} \times \left(4a^{-2}b\right)^2$ <br> $= 4a^3b^{-2} \times 16a^{-4}b^2$ <br> $= 64a^{-1}b^0$ <br> $= \dfrac{64}{a}$ | M1 <br><br><br> A1 |
| 2b | $16^{n+1} = 16\left(2^{n-1}\right)$ <br> $16^n = 2^{n-1}$ <br> $2^{4n} = 2^{n-1}$ <br> $4n = n-1$ <br> $3n = -1$ <br> $n = -\dfrac{1}{3}$ | M1 <br> M1 <br><br><br> A1 |
| OR | $16^{n+1} = 16\left(2^{n-1}\right)$ <br> $2^{4(n+1)} = 2^4\left(2^{n-1}\right)$ <br> $2^{4n+4} = 2^{4+n-1}$ <br> $4n+4 = n+3$ <br> $3n = -1$ <br> $n = -\dfrac{1}{3}$ | |
| 2c | $\dfrac{p^2 \times \sqrt[3]{p^2}}{\sqrt{p}} = \dfrac{p^2 \times p^{\frac{2}{3}}}{p^{\frac{1}{2}}}$ <br> $= p^{2+\frac{2}{3}-\frac{1}{2}}$ <br> $= p^{\frac{13}{6}} = \sqrt[6]{p^{13}}$ | M1 <br> (changing to fractional index) <br><br><br> A1 |
| 3a(i) | $\dfrac{330}{x}$ litres <br> *Accept $\left(\dfrac{330}{x}+8\right)$ litres | B1 |
| 3a(ii) | $\dfrac{330}{x+3}$ litres <br> *Accept $\left(\dfrac{330}{x+3}-8\right)$ litres | B1 |

| | | |
|---|---|---|
| 3b | $\dfrac{330}{x} - \dfrac{330}{x+3} = 8$ | M1 |
| | $\dfrac{330(x+3) - 330x}{x(x+3)} = 8$ | |
| | $330x + 990 - 330x = 8x(x+3)$ | M1 |
| | $8x^2 + 24x - 990 = 0$ | M1 |
| | $\Rightarrow 4x^2 + 12x - 495 = 0$ | |
| 3c | $x = \dfrac{-12 \pm \sqrt{12^2 - 4(4)(-495)}}{2(4)}$ | |
| | $= \dfrac{-12 \pm \sqrt{8064}}{8}$ | M1 |
| | $= 9.72497216 \quad$ or $\quad -12.72497216$ | |
| | $= 9.7 \qquad\qquad$ or $\quad -12.7 \ (1\text{dp})$ | A1, A1 |
| 3d | $\dfrac{330}{9.72497216 + 3}$ | M1 |
| | $= 25.9$ litres | A1 or B2 |
| 4a(i) | $0 + (-2)^2 = 4$ | B1 |
| 4a(ii) | $\dfrac{-4}{-1} = 4$ | B1 |
| 4a(iii) | $-6[1 + (-4)] = 18$ | B1 |
| 4b | $\dfrac{x-2}{3} < \dfrac{2x+1}{5} \le 3 - x$ | |
| | $\dfrac{x-2}{3} < \dfrac{2x+1}{5} \qquad\qquad \dfrac{2x+1}{5} \le 3 - x$ | |
| | $5x - 10 < 6x + 3 \qquad\qquad 2x + 1 \le 15 - 5x$ | M1, M1 |
| | $-x < 13 \qquad\qquad\qquad\quad 7x \le 14$ | |
| | $x > -13 \qquad\qquad\qquad\quad x \le 2$ | |
| | Solution is $-13 < x \le 2$ | A1 |
| 4c(i) | $25 + 3n$ | B1 |
| 4c(ii) | $25 + 3n < 54$ | M1 |
| | $\quad 3n < 29$ | |
| | $\quad n < 9\dfrac{2}{3}$ | M1 |
| | Maximum no of times $= 9$ | A1 |

| | | |
|---|---|---|
| 5a | Cathy:<br>$$\frac{150000}{6} \times 2 = \$50000$$ | M1 |
| | $$\text{Interest} = \frac{3}{100} \times 50000 \times 3 = \$4500$$ | M1 |
| | Total amount $= \$54500$ | A1 |
| 5b | Alicia:<br>$$\text{Total amount} = 25000\left(1 + \frac{1.5}{100}\right)^6$$ | M1 |
| | $$= \$27336.08$$ | A1 |
| 5c | Benjamin:<br>$$\frac{150000}{6} \times 3 = \$75000$$<br><br>Borrowed amount $= \$25000$ | M1 |
| | $$\begin{aligned}\text{Interest paid} &= (800 \times 3 \times 12) - 25000\\&= \$3800\end{aligned}$$ | M1 |
| | $$\text{Interest rate, } y = \frac{3800}{3} \div 25000$$ | M1 |
| | $$= 5.07$$ | A1 |
| | $$*\text{Accept } y = 5\frac{1}{15}$$ | |
| 6a | $$\cos 18 = \frac{3.7}{AX}$$ | M1 |
| | $$\begin{aligned}AX &= \frac{3.7}{\cos 18}\\&= 3.89041023 = 3.89 \text{ cm}\end{aligned}$$ | A1 |
| 6b | $$\tan \angle ACD = \frac{2.1}{3.7}$$ | M1 |
| | $$\angle ACD = 29.6°$$ | A1 |
| 6c | $$\sin 62 = \frac{2.1}{AY}$$ | M1 |
| | $$\begin{aligned}AY &= \frac{2.1}{\sin 62}\\&= 2.378397106 = 2.38 \text{ cm}\end{aligned}$$ | A1 |
| 6d | $$\tan 18 = \frac{BX}{3.7}$$ | |
| | $$\begin{aligned}BX &= 3.7\tan 18\\&= 1.202202876\end{aligned}$$ | M1 |
| | $$\text{Area of } AXCD = (3.7 \times 2.1) - \frac{1}{2}(3.7)(1.202202876)$$ | M1 |
| | $$= 5.55 \text{ cm}^2$$ | A1 |

| | | |
|---|---|---|
| OR | $\tan 18 = \dfrac{BX}{3.7}$ <br> $\quad BX = 3.7\tan 18$ <br> $\qquad = 1.202202876$ <br> Area of $AXCD = \dfrac{1}{2}(3.7)\big[2.1 + (2.1 - 1.202202876)\big]$ <br> $\qquad = 5.55 \text{ cm}^2$ | * use area of trapezium |
| 7a(i) | $PS^2 = 52^2 + 75^2 - 2(52)(75)\cos 72$ <br> $\qquad = 8329 - 7800\cos 72$ <br> $\qquad = 5918.667444$ <br> $PS = 76.93287622 = 76.9 \text{ m}$ | M1 <br><br> M1 <br> A1 |
| 7a(ii) | Area of $\triangle PQS = \dfrac{1}{2}(52)(75)\sin 72$ <br> $\qquad = 1854.560207 = 1850 \text{ m}^2$ | M1 <br><br> A1 |
| 7a(iii) | $\dfrac{1}{2}(PS)\times h = 1854.560207$ <br> $\dfrac{1}{2}(76.93287622)h = 1854.560207$ <br> $\qquad h = 48.21242355$ <br> $\qquad = 48.2 \text{ m}$ | M1 <br><br><br><br> A1 |
| 7b(i) | $\dfrac{\sin \angle SQR}{40} = \dfrac{\sin 54}{75}$ <br> $\sin \angle SQR = \dfrac{40\sin 54}{75}$ <br> $\angle SQR = 25.6°$ | <br><br> M1 <br> A1 |
| 7b(ii) | $180 + (108 - 25.6)$ <br> $= 262.4°$ | M1 <br> A1 |
| 7c | $\tan 11 = \dfrac{h}{52}$ <br> $h = 52\tan 11$ <br> $\quad = 10.1 \text{ m}$ | M1 <br><br> A1 |
| 8a(i) | $AC = \sqrt{9^2 + 9^2}$ <br> $\quad = \sqrt{162} = 12.7 \text{ units}$ | M1 <br> A1 |
| 8a(ii) | gradient $= 1$ <br> Subst $(-6, 0)$ into $y = x + c \Rightarrow c = 6$ <br> Equation of $AC$: <br> $y = x + 6$ | M1 <br><br><br> A1 |
| 8a(iii) | $D\,(0, 6)$ | B1 |
| 8a(iv) | $\triangle ABC - \triangle AOD$ <br> $= \dfrac{1}{2}(9)(14) - \dfrac{1}{2}(6)(6)$ <br> $= 63 - 18 = 45 \text{ units}^2$ | <br> M1 <br><br> A1 |

| | | |
|---|---|---|
| 8b | gradient of $BC = \dfrac{9-0}{3-8} = -\dfrac{9}{5}$<br><br>Equation of $BC$:<br>$y = -\dfrac{9}{5}x + 6$ | M1<br><br><br><br>A1 |
| 9a | $a = 25$, $b = 32$, $c = 36$, $d = 50$ | B1 of each correct ans |
| 9b | $10^2 = 100$ | B1 |
| 9c(i) | $(n+1)^2$ | B1 |
| 9c(ii) | $2n^2$ | B1 |
| 9d | $2n^2 = 300$<br>$n^2 = 150$<br>$n = \sqrt{150} = 12.247...$<br>$\Rightarrow$ 150 is not a perfect square<br>OR<br>$n$ is not an integer | M1<br><br><br>M1 |
| 10a(i) | $\dfrac{6 \times 3.8}{2.4} = 9.5$ m (shown) | B1 |
| 10a(ii) | $\dfrac{2.4 \times 3.8}{2.4} = 3.8$ m | B1 |
| 10b | Volume of tank<br>$= \pi(1.9)^2(9.5) + \dfrac{1}{3}\pi(1.9)^2(3.8)$<br>$= 122.1063761$ m$^3$<br><br>Max safe volume<br>$= \dfrac{80}{100} \times 122.1063761$<br>$= 97.6851... = 97.7$ m$^3$ | M1, M1<br><br><br><br>M1<br>A1 |
| 10c | Since maximum weight of cement<br>$= 97.7 \times 1200 = 117240$ kg<br>Since 117240 kg $>$ 100000 kg<br>$\Rightarrow$ The tank **can be filled** with 10000 kg of cement. | M1<br><br>A1 |