# Anglo-Chinese School (Barker Road)

## PRELIMINARY EXAMINATION 2017

## SECONDARY FOUR EXPRESS / FIVE NORMAL ACADEMIC

## MATHEMATICS 4048
## PAPER TWO

### 2 HOURS 30 MINS

Additional Materials: Answer Paper (7 sheets)
Graph Paper (1 sheet)

READ THESE INSTRUCTIONS FIRST

**Do not open this booklet until you are told to do so.**

Write your class and candidate number on the cover sheet.
Write in dark blue or black pen on both sides of the paper.
You may use a soft 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.
[illegible]sential working will result in loss of marks.
[illegible]uld be used where appropriate.
[illegible] accuracy is not specified in the question, and if the answer is not exact, give the answer to [illegible] figures. Give answers in degrees to one decimal place.
For $\pi$, use either the 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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1 The first three terms in a sequence of numbers, $T_1, T_2, T_3, \ldots$ are given below.

$$T_1 = 1 \times 2 + 10 = 12$$
$$T_2 = 2 \times 3 + 6 = 12$$
$$T_3 = 3 \times 4 + 2 = 14$$

**(a)** Find $T_4$. [1]

**(b)** Show that $T_n = n^2 - 3n + 14$. [2]

**(c)** Evaluate $T_{50}$. [1]

**(d)** Explain why every term in the sequence is even. [2]

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**2 (a)** It is given that $v^2 = u^2 - 2gh$.

**(i)** Evaluate $v$ when $u = 30$, $g = 9.8$ and $h = 24$. [2]

**(ii)** Express $u$ in terms of $g$, $h$ and $v$. [2]

**(b)** Factorise $(x+1)^2 - (y-1)^2$. [2]

**(c)** Simplify $\dfrac{x^2 - 1}{8 - 3x - 5x^2}$. [3]

**(d)** Solve the simultaneous equations. [3]

$$1\frac{1}{2}x - 3y = 12$$
$$4y = 3x - 19$$

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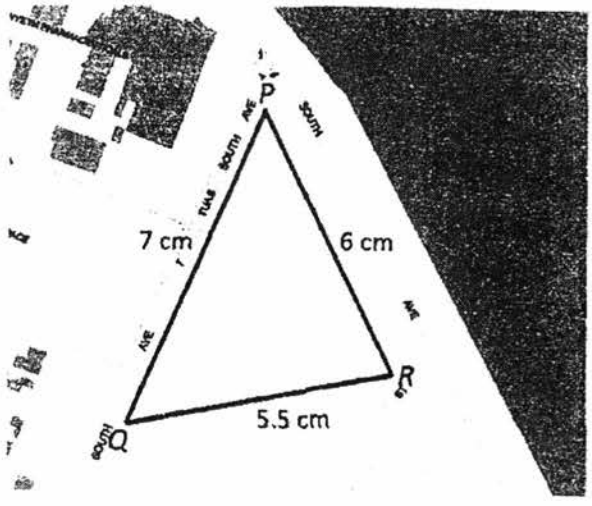
3 (a) The scale of a map is 1 : 7500.

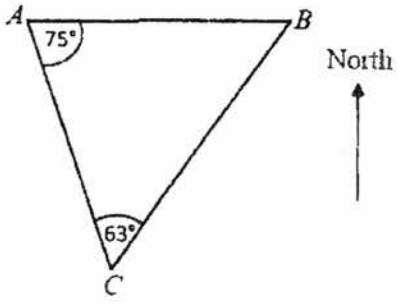
(i) The length of a road on the map is 20.5 cm.
Find the actual length, in kilometres, of the road. [1]

(ii)




On the map, an area formed by a triangle $PQR$ with sides 5.5 cm, 6 cm and 7 cm, is slated for commercial development.
Calculate, in square metres, the actual area. [5]

(b)



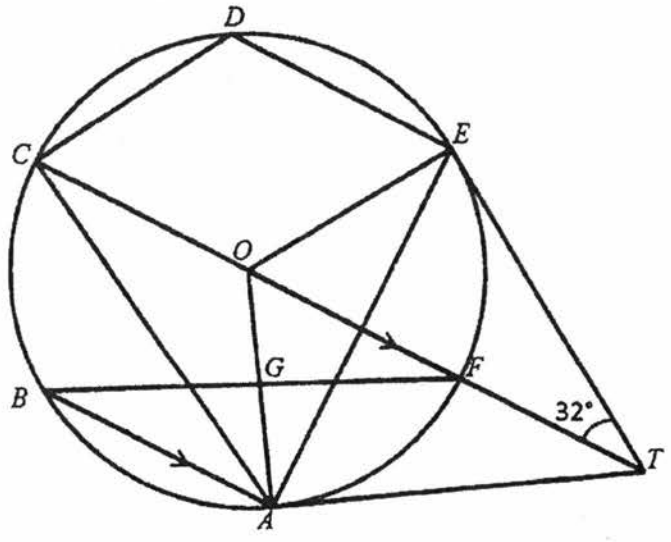

In the diagram, $AB$ is the shoreline. $B$ is due east of $A$. A boat is at $C$.
$C = 75°$, angle $ACB = 63°$ and $AB = 35$ m.

(i) Find the bearing of $B$ from $C$. [2]

(ii) The area of triangle $ABC$ is 444 m$^2$. Calculate the shortest distance from the boat to the shore. [1]

(iii) A turtle is crawling along the shoreline. An eagle is at a vertical height of 40 m above $C$. It notices the turtle.
Calculate the greatest angle of depression of the turtle as seen from the eagle. [2]

4 In the diagram, $O$ is the centre of the circle.
$TA$ and $TE$ are tangents to the circle. $OA$ and $OE$ are radii of the circle. $COT$ is a straight line.
$OA$ intersects $BF$ at $G$. $CT$ is parallel to $BA$.
Angle $OTE = 32°$.




**(a)** Find

**(i)** angle $AOF$, [2]

**(ii)** angle $CDE$, [2]

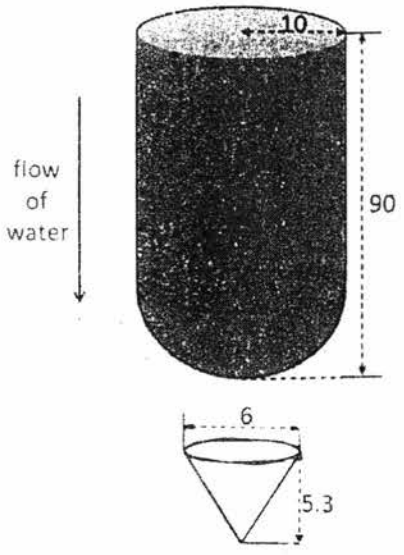
**(iii)** angle $OFG$, [2]

**(iv)** angle $AGB$. [1]

**(b)** Explain why points $OETA$ can also be points on the circumference of another circle. [1]

5 The diagram shows a water dispenser that is made up of a cylinder and a hemisphere both of radius 10 cm. The height of the dispenser is 90 cm.

Conical cups of diameter 6 cm and height 5.3 cm are provided to drink the water from the container.




(a) Water is filled to the brim of the dispenser.
Find the amount of water in the dispenser. [2]

(b) Find the capacity of one conical cup.
Give your answer to the nearest $cm^3$. [2]

(c) Find the external curved surface area of the cup. [2]

(d) Find the height of the water remaining in the dispenser after 250 cups of water has been dispensed. [4]

6 A container can hold 2400 litres of water.

(a) A large tap alone can fill the container in $x$ hours.
Write down an expression, in terms of $x$, for the amount of water that the large tap can dispense per minute. [1]

(b) A small tap alone will take 1 hour longer than the large tap to fill the container. Write down an expression, in terms of $x$, for the amount of water that the small tap can dispense per minute. [1]

(c) When both taps are turned on at the same time, they can fill the container in 3 hours.
Form an equation in $x$ and shows that it reduces to $x^2 - 5x - 3 = 0$. [3]

(d) Solve the equation $x^2 - 5x - 3 = 0$, giving your solutions correct to 2 decimal places. [4]

(e) Find the rate of water flow, in litres per minute, of the small tap. [2]

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

A stone is thrown from the top of a cliff next to the sea. The height, $h$ metres, of the stone above sea level $t$ seconds after it is released can be modelled by the equation

$$h = 40 + 8t - \frac{5}{2}t^2$$

Some corresponding values of $t$ and $h$, correct to 1 decimal place, are given in the table below.

| $t$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| $h$ | 40 | 45.5 | 46 | 41.5 | 32 | 17.5 | $p$ |

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

(b) Using a scale of 2 cm to represent 1 second, draw a horizontal $t$-axis for $0 \le t \le 6$.
Using a scale of 1 cm to represent 5 metres, draw a vertical $h$-axis for $-10 \le h \le 50$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]

raph to estimate

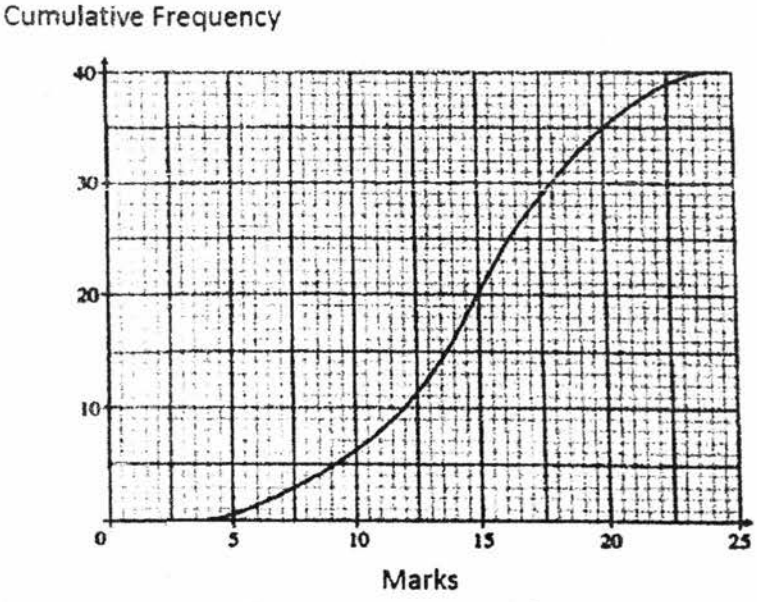
(i) the maximum height of the stone above sea level, [1]

(ii) the length of time that the stone was greater than or equal to 5 m above the top of the cliff, [2]

(iii) the time taken for the stone to hit the water. [1]

(d) By drawing a tangent, find the gradient of the curve at $t = 4$. [2]

8 (a) The marks attained by 40 students in a Mathematics test were recorded.
The cumulative frequency curve shows the distribution of the marks.



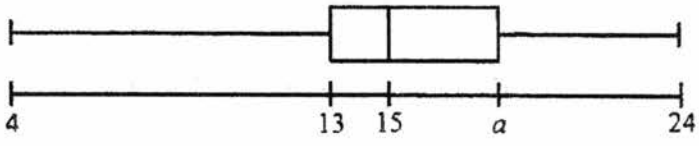

(i) Use the curve to estimate the

(a) the median mark, [1]

(b) the interquartile range. [2]

(ii) 12.5% of students achieved more than $x$ marks in this test. Estimate the value of $x$. [1]

(iii) The same group of students sat for a Chemistry test. The maximum mark for the test was also 25. The box-and-whisker plot of the distribution of the marks is shown below.




The top 25% of the students for the Chemistry test scored lower than the top 25% in the Mathematics test. Write down the possible range of marks that $a$ can take. [1]

(iv) Describe how the cumulative frequency curve for the marks attained in the Chemistry test may differ from the curve for the Mathematics test. [1]

(b) The weight of 8 students, in kilograms, are listed below:

25, 27, 32, 28, 28, 31, 26, 45

(i) Find the mean weight. [1]

(ii) Explain why the mean may not be an appropriate average to use to summarise the weights of the students. [1]

(iii) Find the standard deviation of the weights. [1]

(iv) Subsequently, it was discovered that the weight of every student was 2 kg less than the actual, due to a faulty weighing scale.
Write down the correct mean and standard deviation of the weights. [2]

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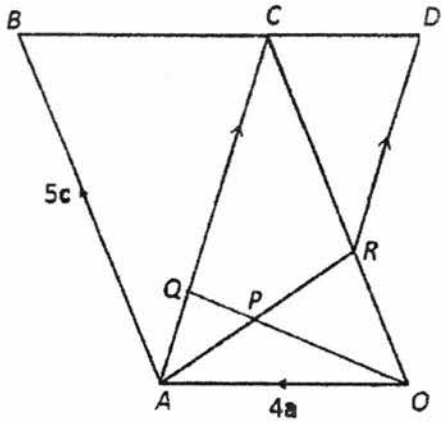


In the diagram, $OA$ is parallel to $DB$, $AC$ is parallel to $RD$ and $OABC$ is a parallelogram. $\overrightarrow{OA} = \mathbf{4a}$ and $\overrightarrow{AB} = \mathbf{5c}$ respectively. It is given that $OR : RC = 2 : 3$ and $\overrightarrow{AQ} = \frac{1}{3}\overrightarrow{QC}$.

**(a)** Find, in terms of **a** and **c**, the vectors

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

**(ii)** $\overrightarrow{AR}$, [1]

**(iii)** $\overrightarrow{OQ}$. [2]

**(b)** $P$ is a point on $OQ$ such that $OP : PQ = 8 : 3$.

**(i)** Express $\overrightarrow{AP}$ in terms of **a** and **c**. [2]

**(ii)** Hence write down two facts about $A$, $P$ and $R$. [2]

**(c)** Name a pair of congruent triangles. [1]

**(d)** Prove that $\Delta RCD$ is similar to $\Delta COA$. [2]

**(e)** Find

**(i)** $\dfrac{\text{Area of } \Delta RCD}{\text{Area of } \Delta COA}$, [1]

**(ii)** $\dfrac{\text{Area of } \Delta OQA}{\text{Area of } \Delta OCA}$. [1]

10 James has gotten a job that pays him a salary of $60 000 annually. He plans to purchase a car but calculates that he can only afford to set aside 30% of his monthly salary for the expenses incurred in owning the car.

(a) Calculate the sum of money that James can afford to set aside monthly for the expenses incurred in owning the car. [1]

He has set his eyes on two cars. He decides to take a loan from a bank for the purchase. He will repay the loan on a monthly basis. The details are given below:

| | **Brand A** (used car) | **Brand B** (new car) |
|---|---|---|
| Engine capacity | 1600 cc | 1400 cc |
| Cost | $80 000 | $90 000 |
| Intended loan amount | 50% of cost price | 60% of cost price |
| Intended loan period | 5 years | 5 years |
| Type of interest | compound interest at 2.5% per year, compounded yearly | simple interest at 3% per year |

The other major expenses in maintaining a car are as follows:

| | **Brand A** (used car) | **Brand B** (new car) |
|---|---|---|
| Monthly parking fees | $90 | $90 |
| Monthly petrol expenditure | $300 | $250 |
| Annual road tax | $744 | $626 |
| Annual insurance | $800 | $700 |
| Car servicing (twice a year) | $600 each round | $500 each round |

(b) Recommend the brand of car that James can purchase, based on the sum of money he can afford to set aside monthly. Justify the decision you make and show your calculations clearly. [7]

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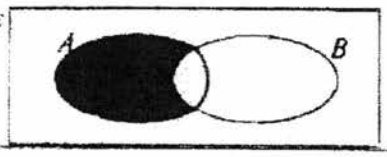
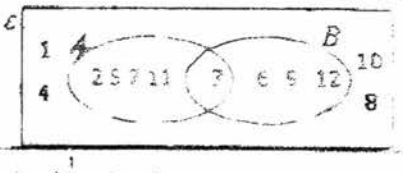
**End of Paper**

Anglo-Chinese School
(Barker Road)

Mathematics Paper 1 Marking Scheme
Secondary 4 Express / 5 Normal Academic
Preliminary Exams 2017

| Qn | | Steps/Answer | | | |
|---|---|---|---|---|---|
| 1 | | $\sqrt{0.81}$ $0.902$ $0.86^3$ $\frac{399}{441}$ | | | |
| 2 | | $(256\times10^9)\div(2.5\times10^6)$ (exact answer)<br>$=1.024\times10^5$ | | | |
| 3 | | $4c(3a+7b)-2d(3a+7b)$<br>$=(4c-2d)(3a+7b)$ or equivalent<br>$=2(2c-d)(3a+7b)$ | | | |
| 4 | | $\frac{1}{9}=\$20$<br>Total sum = $180 | | | |
| 5 | | $=\frac{7x}{(x-5)^2}-\frac{1}{x-5}$<br>$=\frac{7x-(x-5)}{(x-5)^2}$<br>$=\frac{6x+5}{(x-5)^2}$ | | | |
| 6 | | $-8\le 2-3x$ and $2-3x<8$<br>$-2<x\le 3\frac{1}{3}$ | | | |
| 7 | | 12 cooks – 6 hours – 180 people<br>8 cooks – 9 hours – 180 people<br>8 cooks – 7.5 hours – 150 people<br>Ans: 7.5 hours | | | |
| 8 | | Different scale used for the vertical axis may mislead one to think that more people prefer Brand Y to Brand X. | | | |
| 9 | (a) |  | | | |
| | (b) |  | | | |
| 10 | | $=\left(\frac{y^6}{x^6}\right)^{\frac{1}{2}}\times\left(\frac{x^{-5}}{y^{-3}}\right)$<br>$=\frac{y^3}{x^3}\times\frac{x^5}{y^3}$<br>$=\frac{x^2}{y}$ | | | |
| 11 | (a) | $6950 | | | |
| | (b) | $\frac{\$6850}{5000}$<br>US$1 = S$ | | | |

Anglo-Chinese School (Barker Road)

Mathematics Paper 1 Marking Scheme
Secondary 4 Express / 5 Normal Academic
Preliminary Exams 2017

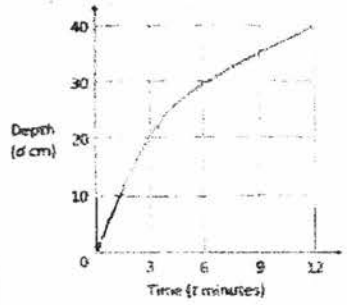
| Qn | | Steps/Answer | | | |
|---|---|---|---|---|---|
| 12 | (a) | Cost price of watch for Jimmy $= \frac{80}{100} \times 210$<br>$= \$168$<br>Price that Jimmy should sell at $= \frac{120}{100} \times \$168$<br>$= \$201.60$<br>Marked price $= \frac{100}{90} \times \$201.60 = \$224$ | | | |
| 13 | | angle $FDB$ = angle $CBD$ = 56° (alternate angles, $BC$ parallel to $FD$)<br>angle $ABD$ = 180 – (44+56) = 80°<br>angle $FAB$ + angle $ABD$ = 181°<br>**By the property that interior angles of parallel lines are supplementary**, AF is not parallel to BD | | | |
| 14 | (a) | 720° | | | |
| | (b) | If the 3 polygons are regular, then<br>angle IKB + angle IKF + angle BKF<br>= 108° + 108°+ 120°<br>= 336°<br>By the property that angles at a point add up to 360°, at least one of the polygons must be irregular. | | | |
| 15 | (a) | 2 x 7 | | | |
| | (b) | 10 | | | |
| | (c) | LCM of 84, 90 and 2450 is 44100.<br>Next flash at 2015 | | | |
| 16 | (a) | | | | |
| | (b) | $\frac{1}{10}$ | | | |
| | (c) | $\frac{3}{5} \times \frac{2}{4} \times \frac{1}{3}$<br>$= \frac{1}{10}$ | | | |

| + | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|
| 5 | - | 11 | 12 | 13 | 14 |
| 6 | 11 | - | 13 | 14 | 15 |
| 7 | 12 | 13 | - | 15 | 16 |
| 8 | 13 | 14 | 15 | - | 17 |
| 9 | 14 | 15 | 16 | 17 | - |

17 (a) $\left(\frac{20}{40}\right)^2 \times 12$

$= 3$ min

(b)




[4]

18 (a) $\mathbf{V} = \begin{pmatrix} 320 & 120 \\ 380 & 100 \\ 410 & 130 \end{pmatrix}$

(b) $\mathbf{P} = \begin{pmatrix} 320 & 120 \\ 380 & 100 \\ 410 & 130 \end{pmatrix} \begin{pmatrix} 2 \\ 0.5 \end{pmatrix} = \begin{pmatrix} 700 \\ 810 \\ 885 \end{pmatrix}$

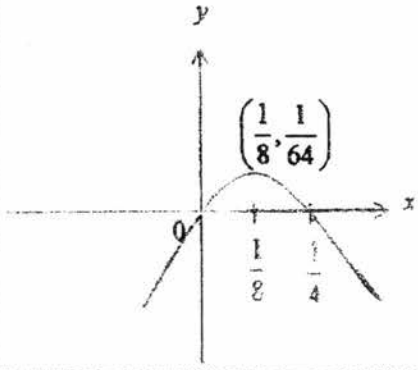
[4]

(c) **P** represents the total charges incurred by all vehicles for each respective day.

(d) $D = (1 \quad 1 \quad 1)$

19 (a) $\left(x - \frac{1}{8}\right)^2 = \frac{1}{64}$

(b)




[4]

(c) $\left(\frac{1}{8} \quad \frac{1}{64}\right)$

20 (a) $\frac{V}{50} = \frac{6}{1}$

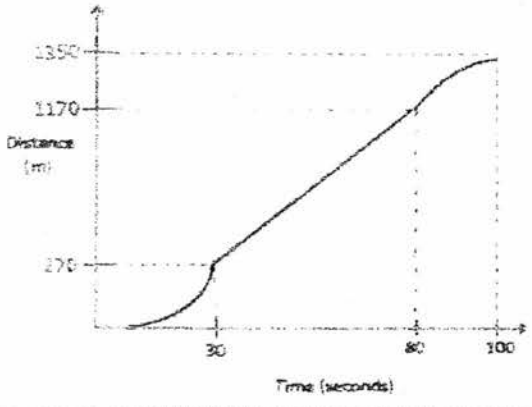
$V_{large} = 204.8$

(b)

| Small bottle | Large Bottle |
|---|---|
| 50g - \$5.10 | 204.8g - \$13.25 |
| 1g – 10.2 cents | 1g – 6.47 |

The larger bottle gives more value for money

[4]

| | | |
|---|---|---|
| 21 | (a) | angle $ACB = 37 - 20 = 17°$<br>$\frac{AC}{\sin 143} = \frac{400}{\sin 17}$<br>$AC = 823\text{m}$ |
| | (b) | $h = \sin 20 \times 823.356$<br>$= 282$ m |
| 22 | (a) | $QP = \frac{8}{\tan 0.7rad} = 9.4979$<br>Area of triangle $OPQ = \frac{1}{2}(8)(9.4979) = 37.992$<br>Area of sector $= \frac{1}{2}(8^2)(0.87079rad) = 27.865$<br>Area of shaded region $= 10.1\ \text{cm}^2$ |
| | (b) | $40.1°$ |
| 23 | (a) | $\frac{y-6}{x-0} = -\frac{1}{4}$<br>$4y = -x + 24$ |
| | (b) | $x = 24$<br>$(24, 0)$ |
| | (c) | 24.7 units |
| | (d) | Identify that $D$ has coordinates $(-12, 0)$<br>$x = -12$ |
| 24 | (a) | Speed $= \frac{18}{30} \times 18$<br>$= 10.8$ m/s<br>$= 38.88$ km/h |
| | (b) | Distance $= \left(\frac{1}{2} \times 30 \times 18\right) + (50 \times 18) - \left(\frac{1}{2} \times 20 \times 18\right)$<br>$= 1350$ m |
| | (c) |  |

Anglo-Chinese School (Barker Road)

Mathematics Paper 2 Marking Scheme
Secondary 4 Express / 5 Normal Academic
Preliminary Exam 2017

| Qn | | Steps/Answer | | | |
|---|---|---|---|---|---|
| 1 | (a) | $T_4 = 18$ | | | |
| | (b) | $T_n = n(n+1)+10-4(n-1)$<br>$= n^2+n+10-4n+4$<br>$= n^2-3n+14$ | | | |
| | (c) | $T_{50} = 2364$ | | | |
| | (d) | $n^2-3n+14 = n(n-3)+14$<br>When n is even n(n-3) is (even x odd) = even<br>When n is odd, n(n-3) is (odd x even) = even.<br>Adding to 14 which is also even,<br>$T_n = n^2-3n+14$ will always be even for all terms. | | | |
| 2 | (ai) | $v^2 = 30^2 - 2(9.8)(24)$<br>$v = \pm 20.7$ | | | |
| | (aii) | $v^2 = u^2 - 2gh$<br>$u^2 = v^2 + 2gh$<br>$u = \pm\sqrt{v^2+2gh}$ | | | |
| | (b) | $[(x+1)+(y-1)][(x+1)-(y-1)]$<br>$= (x+y)(x-y+2)$ | | | |
| | (c) | $\frac{(x+1)(x-1)}{(1-x)(8+5x)}$ | | | |
| | | $= \frac{(x+1)(x-1)}{-(x-1)(5x+8)}$ or $\frac{-(1-x)(x+1)}{(1-x)(5x+8)}$ | | | |
| | | $= -\frac{(x+1)}{(5x+8)}$ or equivalent | | | |
| | (d) | By substitution or elimination method<br>$x = 3$ , $y = -2.5$ | | | |

| | | | | |
|---|---|---|---|---|
| 3 | (ai) | 1.5375 km | | |
| | (aii) | Conversion from cm to m or $cm^2$ to $m^2$<br>Using cosine rule,<br>$412.5^2 = 525^2 + 450^2 - 2(525)(450)\cos(angle\,BAC)$<br>$\cos(angle\,BAC) = \sqrt{\frac{-307968.75}{-472500}}$<br>$angle\,BAC = 49.324°$ | | |
| | | Area of triangle $= \frac{1}{2}(525)(450)\sin 49.324°$<br>$= 89\,600\ m^2$ | | |
| | (bi) | Bearing of $C$ from $B = 63-(90-75)=048°$ | | |
| | (bii) | Shortest distance $= \frac{444 \times 2}{35} = 25.4$ m | | |
| | (biii) | Angle of depression $= \tan^{-1}\left(\frac{40}{25.371}\right)$<br>$=57.6°$ | | |
| 4 | (ai) | angle $OTA$ = angle $OTE = 32°$<br>(the line joining an external point to the centre of the circle bisects the angle between the tangents)<br>angle $TAO = 90°$<br>(tangent perpendicular to radius)<br>angle $AOF = (180 - 90 - 32)° = 58°$<br>(angles sum of triangle $AOT$) | | |
| | (aii) | angle $AOE = 58 \times 2 = 116°$<br>angle $AOC = 180 - 58 = 122°$<br>angle $CDE = \frac{1}{2}(58 \times 2 + 122°) = 119°$ | | |
| | (aiii) | angle $GBA = \frac{1}{2}(58°) = 29°$<br>(angle at centre is twice angle at circumference)<br>angle $OFG$ = angle $GBA = 29°$<br>(alternate angles, $OF$ parallel to $BA$) | | |
| | (aiv) | angle $OGF = (180 - 29 - 58)° = 93°$<br>angle $AGB = 93°$ (vertically opposite angles) | | |
| | (b) | By the property of 'right-angle in a semi-circle' $OT$ is a diameter and points $E$ and $A$ will lie on the circumference<br>$OETA$ are thus four points on the circumference of this circle<br>Or calculate using 'angles in opposite segments are supplementary' | | |
| 5 | (a) | volume of water $= \pi(10^2)(80) + (\frac{2}{3})(\pi)(10^3)$<br>$= [illegible]\ cm^3$ | | |

(b) Capacity of one conical cup $= (\frac{1}{3})(\pi)(3^2)(5.3)$

$= 50\ cm^3$

(c) Slant height of cup $= \sqrt{3^2 + 5.3^2}$

$= 6.0902$

Curved surface area of cup $= \pi(3)(6.0902)$

$= 57.4\ cm^2$

(d) Volume of water remaining after dispensing 250 cups

$= 8666\frac{2}{3}\pi - (250 \times \frac{1}{3}\pi(3^2)(5.3)$

$= 4619\frac{2}{3}\pi$

Volume of water in cylinder $= 4619\frac{2}{3}\pi - \frac{2}{3}\pi(10^2) = 4025\pi$

Height of water in cylindrical section $= \frac{4025\pi}{\pi(10^2)} = 40.25$

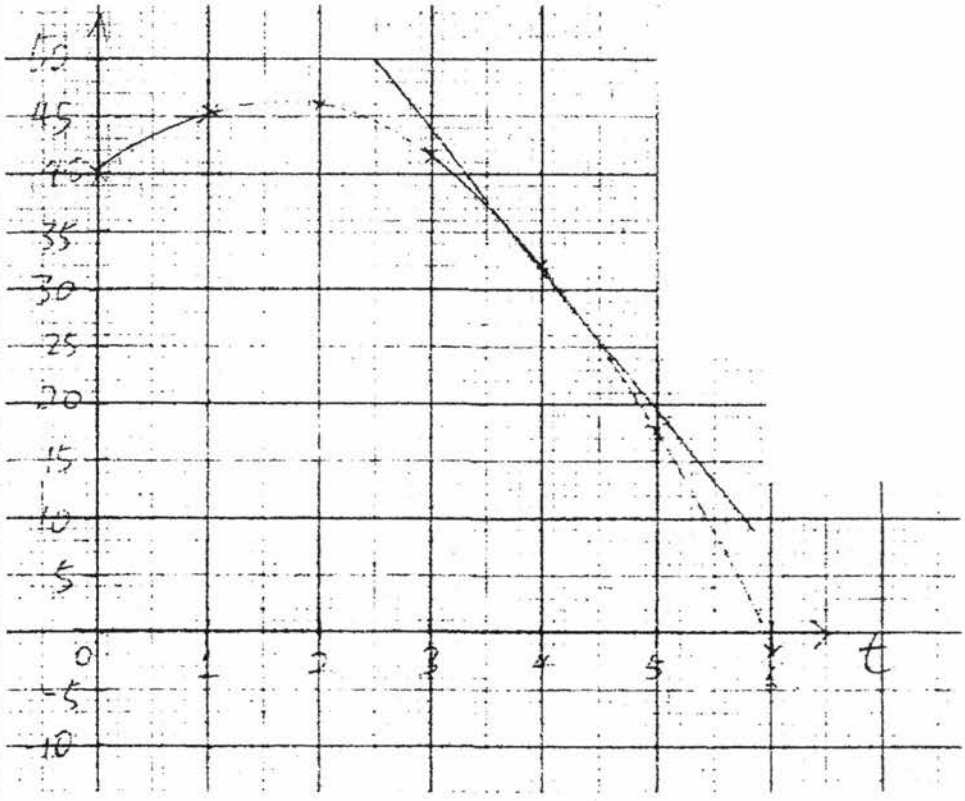
Height of water remaining in dispenser

$= 40.25+10$

$= 50.25\ cm$

| | | | | | |
|---|---|---|---|---|---|
| 6 | (a) | $\frac{40}{x}$ litres/minute | | | |
| | (b) | $\frac{40}{x+1}$ litres/mmute | | | |
| | (c) | $180\left(\frac{40}{x+1}+\frac{40}{x}\right)=2400$<br>$3[40x+40(x+1)]=40x(x+1)$<br>$40x^2-200x-120=0$<br>$x^2-5x-3=0$ (shown) | | | [11] |
| | (d) | $x=\frac{5\pm\sqrt{(-5)^2-4(1)(-3)}}{2(1)}$<br>$x=\frac{5\pm\sqrt{37}}{2}$<br>$x=5.54$ or $x=-0.54$ | | | |
| | (e) | Rate of water flow for small tap<br>$=\frac{40}{5.541+1}$<br>= 6.11 litres per minute | | | |

| | | | | | |
|---|---|---|---|---|---|
| 7 | (a) | $p = -2$ | | | |
| | | Please refer to graph | | | [10] |




| | | | | | |
|---|---|---|---|---|---|
| | (ci) | Maximum height = 46 m | | | |
| | (cii) | Length of time = 2.4 – 0-9<br>= 1.5 s | | | |
| | (ciii) | Time taken to hit water = 5 95s | | | |
| | (d) | Tangent drawn correctly.<br>Gradient = $\frac{50-0}{2.5-5,8}$<br>= −12.1 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 8 | (aia) | 15 marks | | | [11] |
| | (aib) | 18 – 12<br>= 6 marks | | | |
| | (aii) | 20 marks | | | |
| | (aiii) | $15 \leq a < 18$ | | | |
| | (aiv) | The curve will be steeper before the median mark of 15 and less steep after the median. | | | |
| | (bi) | 30.25 kg | | | |
| | (bii) | There is an outlier 45 kg which would cause the mean to be skewed. | | | |
| | (biii) | Standard deviation = 5.99 | | | |
| | (biv) | Correct mean = 32.25 kg<br>Standard deviation remains the same | | | |

| | | | | | |
|---|---|---|---|---|---|
| 9 | (ai) | $\overrightarrow{OR} = \frac{2}{5}\overrightarrow{OC}$<br>$= 2\mathbf{c}$ | | | [13] |
| | (aii) | $\overrightarrow{AR} = \overrightarrow{OR} - \overrightarrow{OA}$<br>$= 2\mathbf{c} - 4\mathbf{a}$ | | | |
| | (aiii) | $\overrightarrow{OQ} = \overrightarrow{OA} + \overrightarrow{AQ}$<br>$= 4\mathbf{a} + \frac{1}{4}\overrightarrow{AC}$<br>$= 4\mathbf{a} + \frac{1}{4}(5\mathbf{c} - 4\mathbf{a})$<br>$= 3\mathbf{a} + \frac{5}{4}\mathbf{c}$ | | | |
| | (bi) | $\overrightarrow{AP} = \overrightarrow{AO} + \overrightarrow{OP}$<br>$= AO + \frac{8}{11}\overrightarrow{OQ}$<br>$= -4a + \frac{8}{11}(3\mathbf{a} + \frac{5}{4}\mathbf{c})$<br>$= \frac{20}{11}\mathbf{a} + \frac{10}{11}\mathbf{c}$ | | | |
| | (bii) | $AP = \frac{5}{11}AR$<br>As point $A$ is common, $A$, $P$ and $R$ are collinear (i.e. lie on the same straight line). | | | |
| | (c) | triangle $ABC$ is congruent to triangle $COA$ | | | |
| | (d) | $\angle DCR = \angle AOC$ (alt. $\angle$s, $DC \parallel OA$)<br>$\angle DRC = \angle ACO$ (alt. $\angle$s, $DR \parallel CA$)<br>$\Delta RCD$ is similar to $\Delta COA$ (AA property) | | | |
| | (di) | $\frac{\text{Area of } \Delta RCD}{\text{Area of } \Delta COA} = \left(\frac{RC}{CO}\right)^2$<br>$= \left(\frac{3}{5}\right)^2$<br>$= \frac{9}{25}$ | | | |
| | (dii) | $\frac{\text{Area of } \Delta OQA}{\text{Area of } \Delta OCA} = \frac{QA}{CA} = \frac{1}{4}$ | | | |

(b)

| | Brand A | | |
|---|---|---|---|
| loan | 40000 | 50% of cost | [8] |
| Compound amount | $40000(1+\frac{2.5}{100})^5$ | | |
| total loan amount | = $45256.33 | | |
| monthly instalment | $754.2721419 | Divide by 60 months | |
| Monthly cost of road tax + Insurance + Servicing | $(\frac{744+800+1200}{12})$ =228.67 | | |
| Total monthly cost of maintenance | 300+90+228.67 =618.67 | Adding on monthly petrol and parking costs | |
| monthly installment + cost of maintenance | 1372.94 | | |

| | Brand B | |
|---|---|---|
| loan | 54000 | 60% of cost |
| Simple interest | 8100 | |
| total loan amount | 62100 | |
| monthly instalment | 1035 | Divide by 60 months |
| road tax (r) | 626 | |
| Insurance (i) | 700 | |
| Servicing (s) | 1000 | |
| Monthly cost of road tax + Insurance + Servicing | $\frac{626+700+1000}{12}$ =193.83 | |
| | $\frac{250+90+193.83}{12}$ | Adding on monthly petrol and parking costs |
| Total monthly cost of maintenance | $533.83 | |
| monthly installment + cost of maintenance | 1568.83 | |

James can afford Brand A as it is within the sum of money that he can set asside monthly