CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME		Sec 4 ( ) Reg. No: ( )

CENTRE NUMBER			INDEX NUMBER		

MATHEMATICS
Paper 1

4048/01
15 August 2018

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.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
If working is needed for any question, it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

For Examiner's Use
80

This document consists of **16** printed pages.

[Turn over

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1   (a)   Expand and simplify $(2x-1)(2-3x)-3x(2x-5)$.

Answer _____ [2]

(b)   Factorise completely $24ab-4ac+pc-6pb$.

Answer _____ [2]

2   Solve the equation $2^{3x} \times 125^x = 100$.

Answer $x =$ _____ [3]

3

$A = \{\text{points lying on the line } 2x + y = 8\}$
$B = \{\text{points lying on the line } 3x - 4y = 12\}$
$C = \{\text{points lying on the line } mx - 4y = c\}$

(a) Is $(-1,6) \in A$? Explain clearly.

Answer

_____

_____ [1]

(b) Find the element p such that $p \in (A \cap B)$.

Answer $p =$ _____ [2]

(c) Write down a possible value of m and of c such that $B \cap C = \varnothing$.

Answer $m =$ _____ [1]

$c =$ _____ [1]

4 (a) Solve the inequalities $8 + x < 10 + \dfrac{3}{2}x \leq 15.5 - 2x$.

Answer _____ [3]

(b) Write down the largest rational number that satisfies

$8 + x < 10 + \dfrac{3}{2}x \leq 15.5 - 2x$.

Answer _____ [1]

---

5 Integers P and Q, written as products of their prime factors, are
$P = 2^2 \times 3 \times k^2$ and $Q = 2^3 \times 7 \times k$, where k is a prime number.

(a) Express, in terms of k and as a product of its prime factors, the smallest integer which is divisible by both P and Q.
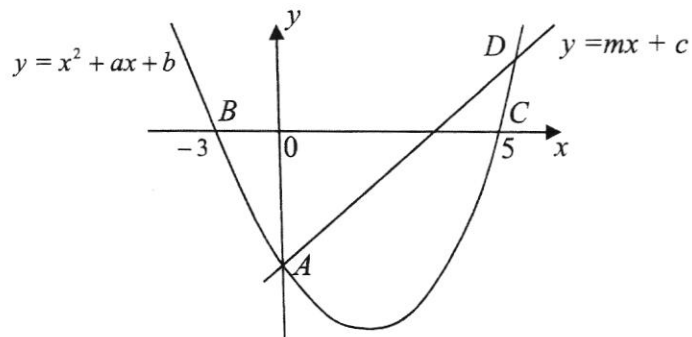
Answer _____ [1]

(b) Find the smallest integer, n, such that $(27k)n$ is a multiple of P.
Give your answer in terms of k **if necessary**.

Answer $n =$ _____ [1]

Cedar Girls' Secondary School   4048/01/S4/Prelim Exam 2018   **[Turn over**

6   The diagram shows the curve $y = x^2 + ax + b$ and the line $y = mx + c$ which intersect at A on the y-axis and D.
The curve intersects the x-axis at B and C. The coordinates of D are $(6, p)$.

(a) Find the value of a and of b.

<div style="text-align: right">

Answer $a =$ _____ [1]

$b =$ _____ [1]

</div>

(b) Find the value of p.

<div style="text-align: right">

Answer $p =$ _____ [1]

</div>

(c) Find the equation of the line parallel to BD and passing through C.

<div style="text-align: right">

Answer _____ [2]

</div>

(d) Find the coordinates of E such that $ABCE$ is a parallelogram.

<div style="text-align: right">

Answer _____ [2]

</div>

7 y is inversely proportional to the square root of x and the difference in the values of y when $x = 9$ and when $x = 16$ is 3.

Find

(a) an equation connecting x and y,

Answer _____ [3]

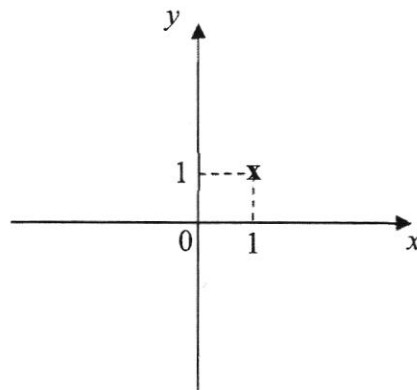**(b)** the exact value of x when $y = 5$.

Answer $x =$ _____ [1]

8 Jon travels at 20 km/h for 50% of the journey and 25 km/h for the rest of the journey.
Calculate Jon's average speed, in km/h for the whole journey.

Answer _____ km/h [3]

9 The point (1,1) is marked on each diagram in the answer space below.
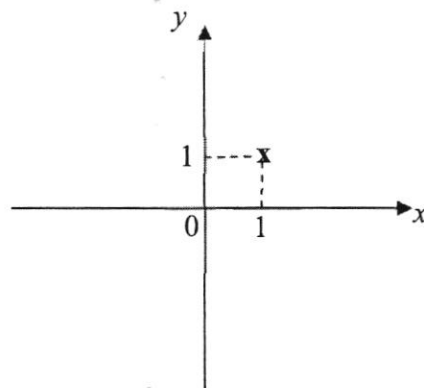Sketch, for $x > 0$, the graph of

(a) $y = 3^x$,

Answer [1]

(b) $y = \dfrac{2}{x}$.

Answer [1]

10 Vehicles approaching a crossroad may go in one of these directions: left, right or straight ahead.

If the probability of a vehicle turning left is $\frac{7}{20}$, the probability of it turning right is $\frac{9}{20}$ and the probability of it going straight ahead is $\frac{1}{5}$, calculate the probability that for any three vehicles approaching the crossroads,
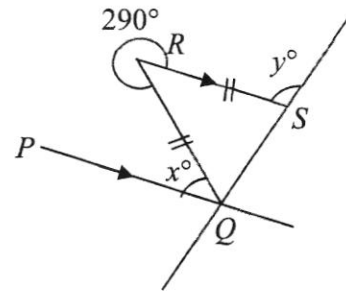
(a) all will go straight,

Answer _____ [1]

(b) at least one will turn right.

Answer _____ [2]

11 In the diagram, PQ is parallel to RS, $RQ = RS$ and reflex $\angle QRS = 290°$.
Calculate the value of

(a) x,

Answer $x =$ _____ [1]

(b) y.

Answer $y =$ _____ [2]

12 The cash price of a computer is $2 750. Mr Ong bought the computer by paying a 30% downpayment and monthly instalments of $90 over 2 years.

(a) How much is the downpayment?

Answer $ _____ [1]

(b) Calculate the total amount Mr Ong paid for the computer.

Answer $ _____ [2]

(c) Find the flat rate of interest per annum for the instalments.

Answer _____ % [3]

13 On a certain day, the exchange rate between the pound (£) and the Singapore dollar (S$) was S$1.95 = £1.

(a) Calculate the amount of pounds which May can buy with S$1170.

Answer £ _____ [1]

(b) After four weeks, she realised she has too much pounds and she now wants to change £200 back to Singapore dollars.
If the loss by this transaction is $6, what is the current exchange rate?

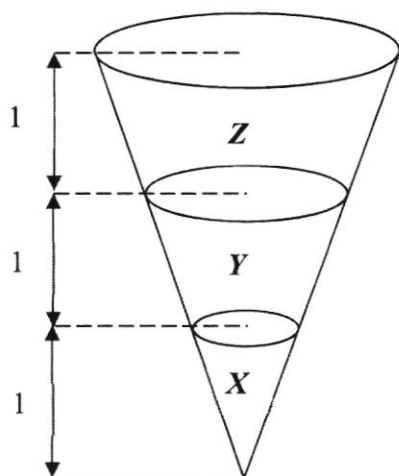Answer £1= S$ _____ [2]

For
Examiner's
Use

For
Examiner's
Use

14 (a) The perimeter of a rectangular lawn is 72 m and its area is 323 m^2.
Calculate the length of a diagonal of the lawn, without solving for its length and breadth.

Answer _____ m   [4]

(b) Another rectangular lawn is 18 m long and 7 m wide, correct to the nearest metre. Find the greatest possible area of this lawn.

Answer _____ m^2 [1]

15 A right circular cone is divided into 3 portions, X, Y and Z, as shown in the diagram below. The height of each portion is 1 unit.
Calculate volume of Y : volume of Z.

Answer _____ : _____   [3]

16 On the grid in the answer space, $\overrightarrow{OP} = \mathbf{p}$, $\overrightarrow{OQ} = \mathbf{q}$.
The point R is also marked.

(a) Draw and label clearly on the grids below, the vector, $\overrightarrow{OS}$,
such that $\overrightarrow{OS} = \mathbf{p} + 2\,\mathbf{q}$.
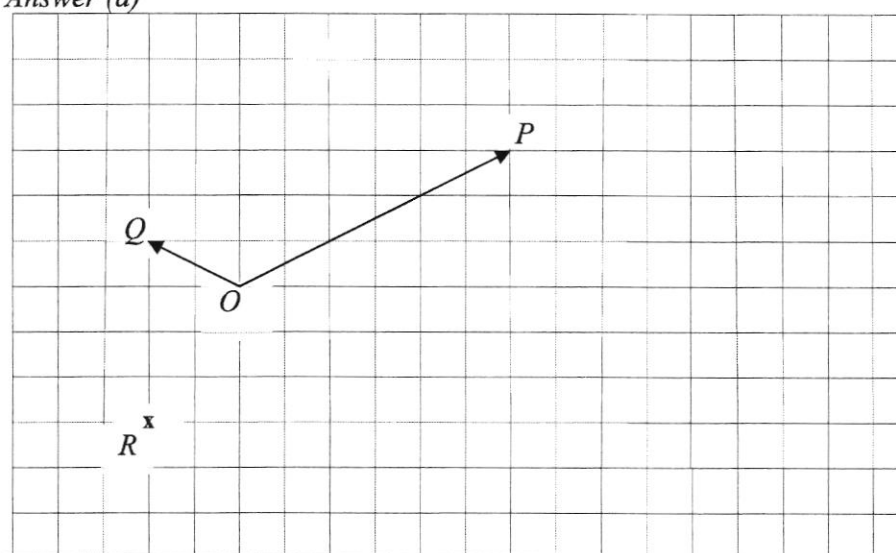
Answer (a)   [1]

(b) Express $\overrightarrow{OR}$ in terms of $\mathbf{p}$ and / or $\mathbf{q}$.

Answer _____ [1]

(c) If the length of each small square is 1 unit, calculate $\left|\overrightarrow{OS}\right|$.

Answer _____ unit [2]

17 (a) Calculate the size of an exterior angle of a regular polygon with 12 sides.

Answer _____ [1]

(b) Tile *P* is in the shape of a regular 12-sided polygon.
Explain, showing your working clearly, whether tiles *P* will fit together on the floor without gaps.

Answer

_____

_____ [2]

18 On a map, a straight road measuring 600 m is represented by a line segment of length 7.5 cm.

(a) Express the scale of the map in the ratio 1 : *r* .

Answer   1   : _____ [1]

(b) The length of a canal on the map is 25 cm. Find the actual length in km.

Answer _____ km [1]

(c) The actual area of a school is 22 400 m². Find the area of the school on the map.

Answer _____ cm² [2]

19 *ABC* is a triangle in which *AC* = 13 cm, *BC* = 11 cm and *AB* = 20 cm.
P is a point on *BC* produced, where *CP* = 5 cm and *AP* = 12 cm.

(a) Explain why $\angle APB = 90°$.

Answer

_____

_____ [2]

(b) Expressing your answer as a fraction in its simplest form, find
$$\frac{\tan \angle ABC}{\cos \angle ACB}.$$

Answer _____ [3]

20 The graph shows the number of accidents occurring at a road junction over a number of years.
State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

Increasing Accidents at Road Junction

Answer

....

.... [2]

21 The diagram shows the speed-time graph of a lorry. The lorry starts
from rest and accelerates uniformly to a speed of 15m/s in 10 seconds.
The lorry then travels at a constant speed for some time before it
decelerates uniformly at 0.75 m/s^2 until it comes to rest.
The whole journey takes one minute.

(a) Given that the speed after x seconds is v m/s, express v in terms of x.

Answer $v =$ _____ [1]

(b) For how long does the lorry travel at the maximum speed ?

Answer _____ s [2]

(c) Calculate the total distance travelled by the lorry during this 1 minute
journey.

Answer _____ m [2]

End of Paper

CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination
Secondary Four

MATHEMATICS
Paper 2

4048/02
16 August 2018

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.
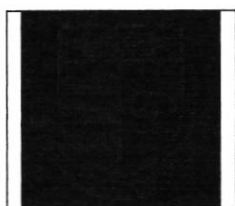Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction tape.

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.

This document consists of **12** printed pages and **1** cover page.

[Turn over

Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

$12\frac{1}{3}$

Answer **all** the questions.

1 (a) Simplify $\dfrac{24c^3d^2}{(3de^2)^3} \div \dfrac{5c^{-2}}{10df}$.   [2]

   (b) Express as a single fraction $\dfrac{7}{(6-5p)^2} - \dfrac{2p-1}{10p-12}$.   [3]

   (c) Simplify $\dfrac{6x^2-17x+5}{18x^2-2} \times \dfrac{15x+5}{10-4x}$.   [3]

   (d) It is given that $1 - \dfrac{a-b}{b+2c} = \dfrac{2a-1}{2}$.

        Express b in terms of a and c.   [3]

---

2 The diagram shows a solid prism $ABCDEFGH$ with a horizontal rectangular base $EFGH$ and a horizontal rectangular top $ABCD$.
   B is vertically above F and A is vertically above E.
   $BC = 20$ cm, $FG = 36$ cm, $BF = 12$ cm and $GH = 40$ cm.
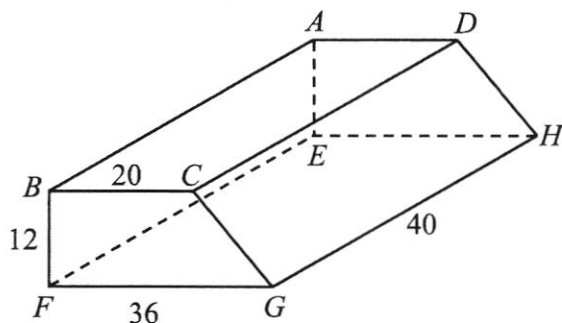
   (a) Find the length of BH.   [2]

   (b) Find the **total surface area** of the prism.   [3]

   (c) The prism is melted and recast into a right pyramid with a square base.
        The height of the pyramid is 24 cm.
        Find the length of each side of the square base.   [3]

---

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

A bakery makes a profit of y thousand dollars for selling x thousand pieces of blueberry tarts.

The variables x and y are connected by the equation

$$y = 5x - x^2 - 2.$$

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

x	0	0.5	1	1.5	2	3	4
y	−2	0.25	2	3.25	4	4	2

(a)   Using a scale of 4 cm to represent 1 unit, draw a horizontal x-axis for $0 \leq x < 4$.
Using a scale of 2 cm to represent 1 unit, draw a vertical y-axis for $-3 \leq y \leq 5$.

On your axes, plot the points given in the table and join them with a smooth curve.   [3]

(b)   Use your graph to find

    (i)   the maximum profit obtained from selling the blueberry tarts,   [1]

    (ii)   the minimum number of blueberry tarts the bakery must sell in order to cover the costs of baking the tarts,   [1]

    (iii)   the range of values of x for which the profit is more than $2750.   [1]

(c)   **(i)**   On the same axes, draw the graph of $\dfrac{y}{x} = \dfrac{1}{4}$.   [1]

    (ii)   Write down the x-coordinate of the point where the two graphs intersect.   [1]

    (iii)   State briefly what the value of this x-coordinate represents.   [1]

    (iv)   The value of x in **(c)(ii)** is the solution of the equation $4x + \dfrac{A}{x} + B = 0$.

        Find each of the value of integers A and B.   [2]

123
5

4
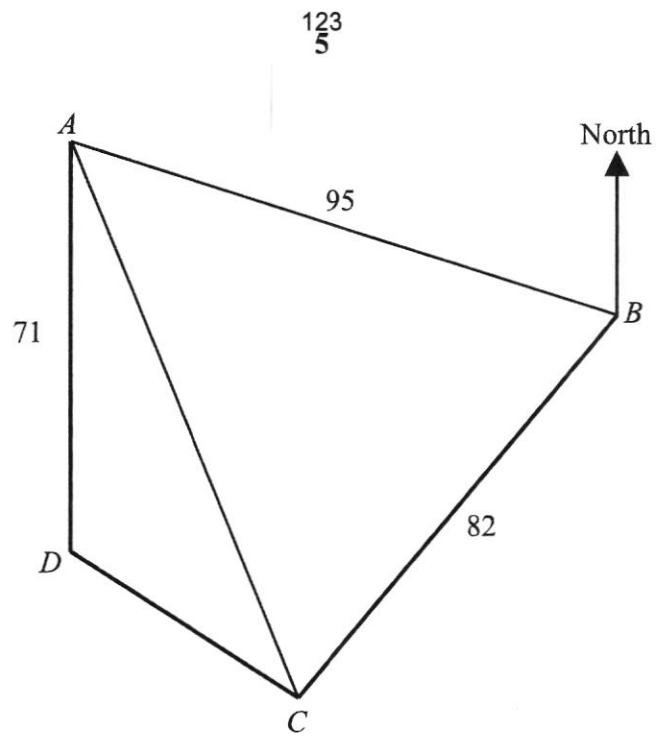
Quadrilateral *ABCD* is a field on horizontal ground.
A is 95 m from *B* on a bearing of 280°.
B is 82 m from *C* on a bearing of 025°.
D is due south and 71 m from *A*.

Calculate

(a) area of triangle *ABC*,   [2]

(b) *AC*,   [2]

(c) angle *ACB*.   [2]

A vertical tower of 67 m stands at *D*.
A man walked along *AC*.
He stopped at *E* to take a picture of the tower where the angle of elevation of the top of the tower was the greatest.

(d) Calculate the angle of elevation of the top of the tower at *E*.   [3]

5   A route up a mountain is 25 km long.
     Hwee Ling walked along this route up the mountain at an average speed of x km/h.

   (a)   Write down an expression, in terms of x, the number of hours she took to walk up
             the mountain.   [1]

   She walked down the mountain by a different route.
   The length of this route is 30 km long.
   Her average speed walking down the mountain was 3 km/h greater than her average speed
   walking up the mountain.

   (b)   Write down an expression, in terms of x, the number of hours she took to walk down
             the mountain.   [1]

   (c)   It took Hwee Ling $1\frac{1}{4}$ hours less to walk down the mountain than to walk up the
             the mountain.
             Write down an equation to represent this information and show that it simplifies to
             $$x^2 + 7x - 60 = 0.$$ [3]

   (d)   Solve the equation $x^2 + 7x - 60 = 0$.   [2]

   (e)   Find the time Hwee Ling took to walk down the mountain.   [1]

6 In a Mathematics examination, 500 students each took two papers.
Both papers were marked out of 50.
The cumulative frequency curves show the distribution of the marks for the two papers.
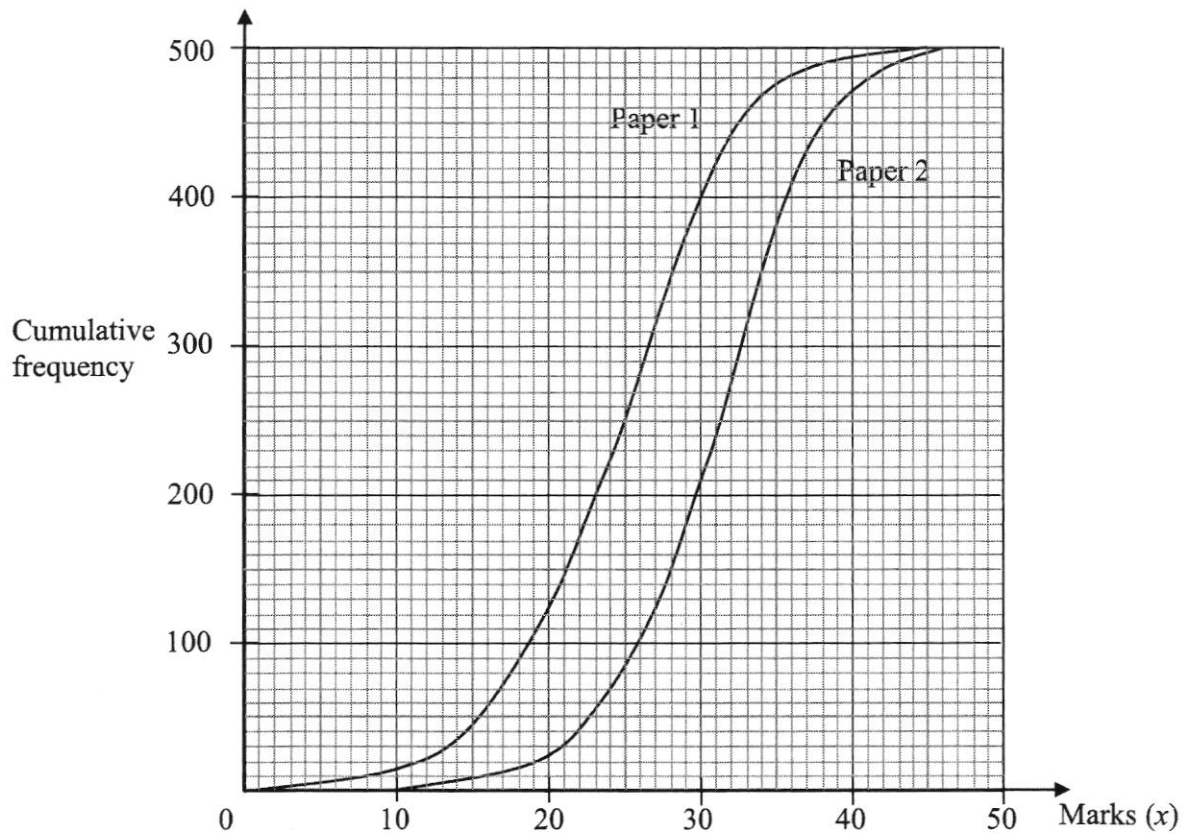
(a) For **Paper 1**, estimate the interquartile range. [2]

(b) The grouped frequency table of the marks obtained by the students for
Paper 2 is shown below.

Marks (x)	$10 \le x < 19$	$19 \le x < 28$	$28 \le x < 37$	$37 \le x < 46$
Frequency	p	q	r	s

(i) Find each of the values of p, q, r and s. [2]

(ii) Calculate an estimate of the mean mark obtained for Paper 2. [2]

(iii) Calculate an estimate of the standard deviation for Paper 2. [2]

(c) An additional student obtained 28 marks in Paper 1, but was absent for Paper 2.
Estimate the mark she would have obtained if she had taken Paper 2. [1]

(d) Which was the more difficult paper? Justify your answer. [2]

$\dfrac{126}{8}$

7   **(a)**   The first four terms in a sequence of numbers, T_1, T_2, T_3, are given below.

$$T_1 = 3^0 - 2 = -1$$
$$T_2 = 3^1 - 5 = -2$$
$$T_3 = 3^2 - 8 = 1$$
$$T_4 = 3^3 - 11 = 16$$

   (i)   Write down an expression for T_5. [1]

   (ii)   Find an expression, in terms of n, for T_n. [3]

   (iii)   Evaluate T_{15}. [1]

   (b)   The table shows the numbers of English and Chinese copies of a book sold on a typical weekday and a weekend.

	English	Chinese
Weekday	6	8
Weekend	12	14

The cost price of an English copy and a Chinese copy of the book is $12 and $15 respectively.
The selling price of an English copy and a Chinese copy of the book is p and q respectively.

All the information can be represented by the matrices

$$\mathbf{A} = \begin{pmatrix} 6 & 8 \\ 12 & 14 \end{pmatrix}, \quad \mathbf{P} = \begin{pmatrix} 12 \\ 15 \end{pmatrix}, \quad \mathbf{S} = \begin{pmatrix} p \\ q \end{pmatrix}.$$

   (i)   Let $\mathbf{B} = \mathbf{S} - \mathbf{P}$.
   Evaluate $\mathbf{C} = \mathbf{AB}$. [2]

   (ii)   The total profits gained from selling the English and Chinese copies of the book on a typical weekday and a weekend are $92 and $170 respectively.
   Write down a 2×1 matrix $\mathbf{D}$ to represent the information and hence find the value of p and of q. [4]

8 **(a)** In the diagram, A, B and C lie on a circle, centre O.
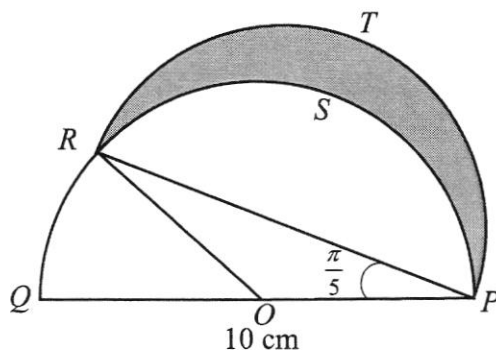The tangents at A and C meet at T.
Angle $COA = 116°$.
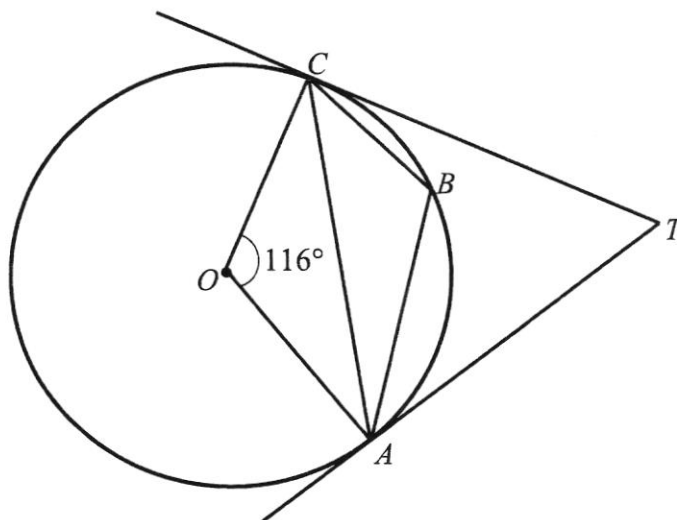
Find, stating your reasons clearly,

(i) obtuse angle ABC, [1]
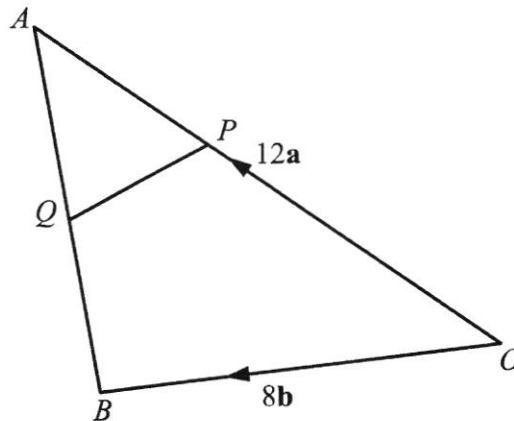
(ii) angle CAT, [1]

(iii) angle CTA. [1]

(b) The figure shows a semicircle PQS with centre O with diameter PQ and a
semicircle PRT with diameter PR.

$PQ = 10$ cm and angle $RPO = \dfrac{\pi}{5}$ radians.

(i) Show that $PR = 8.0902$ cm, correct to 5 significant figures. [2]

(ii) Find the perimeter of the shaded region. [3]

(iii) Find the area of the shaded region. [3]

9

The position vectors of A and B, relative to O, are $12\mathbf{a}$ and $8\mathbf{b}$ respectively.
$\overrightarrow{OP} = 2\overrightarrow{PA}$ and $\overrightarrow{AQ} = \overrightarrow{QB}$.

(a) Express each of the following in terms of $\mathbf{a}$ and $\mathbf{b}$

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

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

  (iii) $\overrightarrow{QP}$.   [1]

(b) Find the position vector of R such that $\overrightarrow{PR} = 4\overrightarrow{PQ}$.   [1]

(c) Make two statements about the points O, B and R.   [2]

(d) Find the position vector of S such that $PQBS$ is a parallelogram.   [1]

(e) Find $\dfrac{\text{Area of } \triangle OBP}{\text{Area of } \triangle ORA}$.   [1]

(f) Given that $\mathbf{a} = \begin{pmatrix} -1 \\ 1 \end{pmatrix}$ and $\mathbf{b} = \begin{pmatrix} -1 \\ -1 \end{pmatrix}$, find $\left| \overrightarrow{AB} \right|$.   [2]

10   The electricity tariff is the cost of electricity per kilowatt hour (kWh) and is revised every quarter of the year to reflect the actual cost of electricity.

(a)   In June 2018, Mr Lim paid $148.13, inclusive of 7% GST, for an electricity consumption of 625 kWh in his household.
Calculate the electricity tariff in June 2018.   [2]

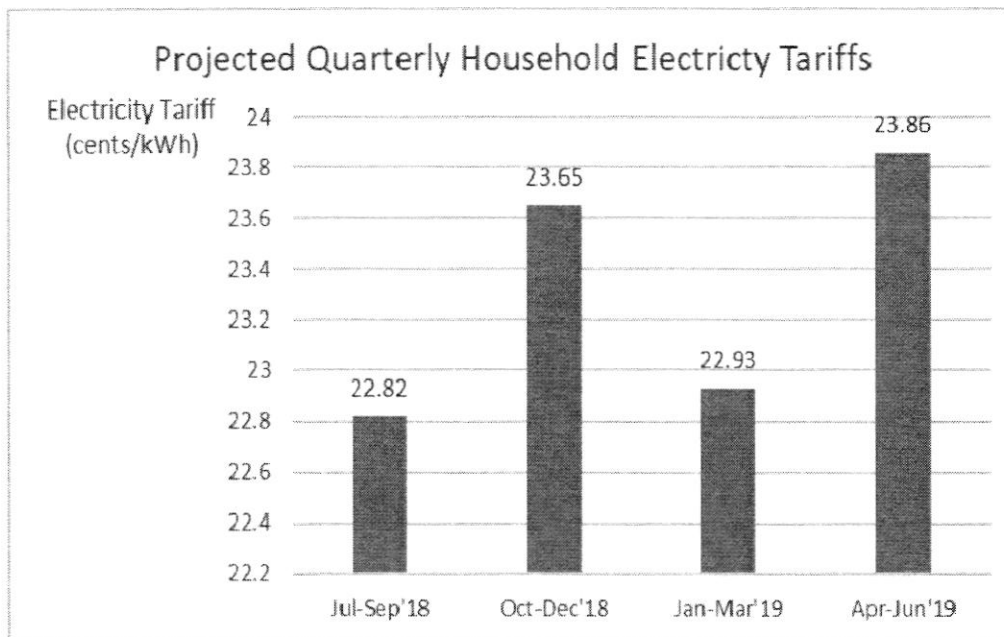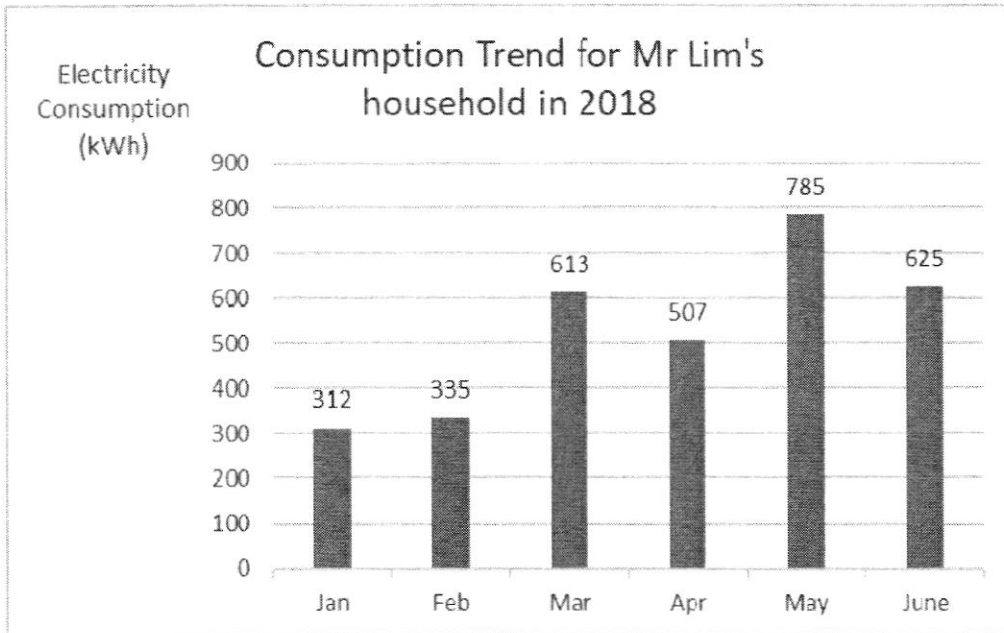From July 2018, Mr Lim decided to purchase electricity from a new supplier for a duration of 12 months.
Below are the available plans.

Company	Type of Plan	Details of Plan
Best Power	Fixed rate	• 1 year contract • $0.1667/kWh
Marco Energy	Fixed rate	• 1 year contract • $10 per month + $0.1535/kWh
Infinity Power	Fixed rate	• 6 months contract (one time 5% discount for renewal of another 6 months) • $0.1730/kWh (for first 6 months)
Rainbow Energy	Discount off tariff *	• 1 year contract • 20% off tariff
Unicorn Supply	Peak and off-peak	• Peak: $0.1685/kWh (7am to 10.59pm) • Off-peak: $0.1438/kWh (11pm to 6.59am)

* Based on the prevailing electricity tariff for that quarter

The consumption trend for Mr Lim's household and the projected quarterly household electricity tariffs for the next 12 months are on the next page.
The electricity consumption of his household during peak hours is estimated to be 3 times that during off-peak hours.

(b)   Find the average monthly electricity consumption of Mr Lim's household from January 2018 to June 2018.   [1]

(c)   Determine which electricity supplier should Mr Lim choose.
Justify your answer with relevant working and state an assumption made.   [7]

Consumption Trend for Mr Lim's household in 2018

Electricity Consumption (kWh)

Month	Consumption
Jan	312
Feb	335
Mar	613
Apr	507
May	785
June	625

Projected Quarterly Household Electricty Tariffs

Electricity Tariff (cents/kWh)

Quarter	Tariff
Jul-Sep'18	22.82
Oct-Dec'18	23.65
Jan-Mar'19	22.93
Apr-Jun'19	23.86

End of Paper

CEDAR GIRLS' SECONDARY SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME		Sec 4 ( ) Reg. No: ( )
CENTRE NUMBER		INDEX NUMBER	

MATHEMATICS(MARK SCHEME)
Paper 1

4048/01
15 August 2018

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.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
If working is needed for any question, it must be shown with the answer.
Omission of essential working will result in loss of marks.
The use of an approved scientific calculator is expected, where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 80.

For Examiner's Use
80

This document consists of **16** printed pages.

[**Turn over**

$\frac{132}{2}$

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 $= \frac{1}{3}\pi r^2 h$

Volume of a sphere $= \frac{4}{3}$

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

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

Sector area $= \frac{1}{2}r^2\theta$, where θ 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 $(2x-1)(2-3x)-3x(2x-5)$.

$(2x-1)(2-3x)-3x(2x-5)$
$= 4x-6x^2-2+3x-6x^2+15x$
$= -12x^2+22x-2$

Answer $\underline{-12x^2+22x-2}$ [2]

(b) Factorise completely $24ab-4ac+pc-6pb$.

$24ab-4ac+pc-6pb$
$= 4a(6b-c)+p(c-6b)$
$= 4a(6b-c)-p(6b-c)$
$-(6b-c)(4a-p)$
or $(c-6b)(p-4a)$

Answer $\underline{(6b-c)(4a-p)}$ [2]

2 Solve the equation $2^{3x} \times 125^x = 100$.

$2^{3x} \times 125^x = 100$
$2^{3x} \times 5^{3x} = 10^2$
$10^{3x} = 10^2$
$3x = 2$
$x - \frac{2}{3}$

Answer $x = \dfrac{2}{3}$ [3]

134
4

3

$A = \{$points lying on the line $2x + y = 8\}$
$B = \{$points lying on the line $3x - 4y = 12\}$
$C = \{$points lying on the line $mx - 4y = c\}$

(a) Is $(-1, 6) \in A$? Explain clearly.

Answer
Substitute $(-1, 6)$, LHS $= 2(-1) + 6 = 4$, RHS $= 8$.

LHS $\neq$ RHS. $(-1, 6)$ does not satisfy the equation so $(-1, 6) \notin A$.   [1]

(b) Find the element p such that $p \in (A \cap B)$.

$2x + y = 8$ ....(1)
$3x - 4y = 12$ ....(2)
From (1): $y = -2x + 8$ into (2)
$3x - 4(8 - 2x) = 12$
$3x - 32 + 8x = 12$
$11x = 44$
$x - 4$
$v = 0$

Answer $p = $ $(4, 0)$ [2]

(c) Write down a possible value of m and of c such that $B \cap C = \varnothing$.

$y = \dfrac{3}{4}x - 3$ and $y - \dfrac{mx}{4} - \dfrac{c}{4}$

Since $B \cap C = \varnothing$
$\dfrac{m}{4} - \dfrac{3}{4}$
$m - 3$
$-\dfrac{c}{4} = -3$
$c = 12$

Answer $m = $ 3   [1]

$c = $ Any real value   [1]
$\neq 12$

$$\frac{135}{5}$$

4 **(a)** Solve the inequalities $8+x<10+\frac{3}{2}x\le15.5-2x$.

$$8+x<10+\frac{3}{2}x \quad \text{and} \quad 10+\frac{3}{2}x\le15.5-2x$$

$$8+x<10+\frac{3}{2}x \quad \text{and} \quad \frac{7}{2}x\le5.5$$

$$-\frac{1}{2}x<2 \qquad\qquad \text{and} \quad x\le\frac{11}{7}$$

$$x>-4 \qquad\qquad \text{and} \quad x\le\frac{11}{7}$$

$$-4<x\le\frac{11}{7} \text{ or } 1\frac{4}{7}$$

Answer **-4 < x = 4/7**

(b) Write down the largest rational number that satisfies
$$8+x<10+\frac{3}{2}x\le15.5-2x.$$

Greatest rational value of x is $1\frac{4}{7}$.

Answer $\quad 1\frac{4}{7}$ _____ [1]

---

5 Integers P and Q, written as products of their prime factor, are
$P=2^2\times3\times k^2$ and $Q=2^3\times7\times k$, where k is a prime number.

(a) Express, in terms of k and as a product of its prime factors, the smallest integer which is divisible by both P and Q.

LCM $=2^3\times3\times7\times k^2$

Answer $\quad 2^3\times3\times7\times k^2$ _____ [1]

(b) Find the smallest integer, n, such that $(27k)n$ is a multiple of P. Give your answer in terms of k **if necessary**.
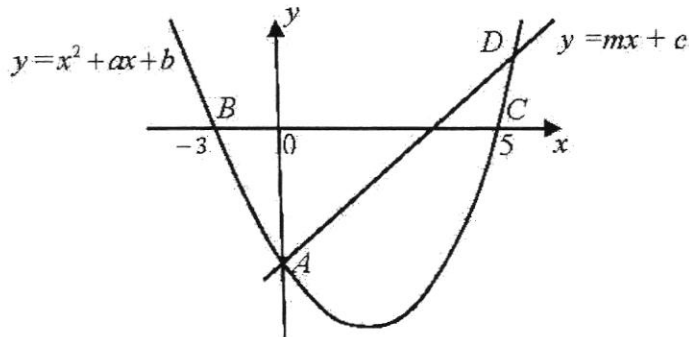
$27kn=m(2^2\times3\times k^2)$
$n=2^2\times k$
$n=4k$

Answer $\quad n=$ _____ $4k$ _____ [1]

6 The diagram shows the curve $y = x^2 + ax + b$ and the line $y = mx + c$ which intersect at A on the y-axis and D.
The curve intersects the x-axis at B and C. The coordinates of D are $(6, p)$.

(a) Find the value of a and of b.

$$y = (x+3)(x-5)$$
$$y = x^2 - 2x - 15$$

Answer $a =$ -2 [1]

$b =$ -15 [1]

(b) Find the value of p.
$$y = (x+3)(x-5)$$
At $D(6, p)$,
$$p = (6+3)(6-5) = 9$$

Answer $p =$ 9   [1]

(c) Find the equation of the line parallel to BD and passing through C.

Gradient of $BD = \dfrac{9-0}{6-(-3)} - 1$

Equation of line is $y = x + c$
At $C(5,0)$
Equation is $y = x - 5$

Answer $y = x - 5$ [2]

(d) Find the coordinates of E such that $ABCE$ is a parallelogram.
Since BC is on the x-axis, y-coordinate of E is -15
Midpoint of AC = Midpoint of BE
$$0+5 = x - 3$$
$$x = 8$$
$$E = (8, -15)$$

Answer $(8, -15)$ [2]

BP~139

7 y is inversely proportional to the square root of x and the difference in the values of y when $x = 9$ and when $x = 16$ is 3.

Find

(a) an equation connecting x and y,

$$y = \frac{k}{\sqrt{x}}$$

When $x - 9$, $y_1 - \frac{k}{3}$

When $x = 16$, $y_2 = \frac{k}{4}$

$$\frac{k}{3} - \frac{k}{4} = 3$$

$$\frac{4k - 3k}{12} = 3$$

$$k = 36$$

$$\therefore y = \frac{36}{\sqrt{x}}$$

Answer $\quad y = \dfrac{36}{\sqrt{x}}$ _____ [3]

(b) the exact value of x when $y = 5$.

$$5 - \frac{36}{\sqrt{x}}$$

$$x = \frac{1296}{25} = 51\frac{21}{25}$$

Answer $\quad x = \quad 51\dfrac{21}{25}$ _____ [1]

8 Jon travels at 20 km/h for 50% of the journey and 25 km/h for the rest of the journey.
Calculate Jon's average speed, in km/h for the whole journey.
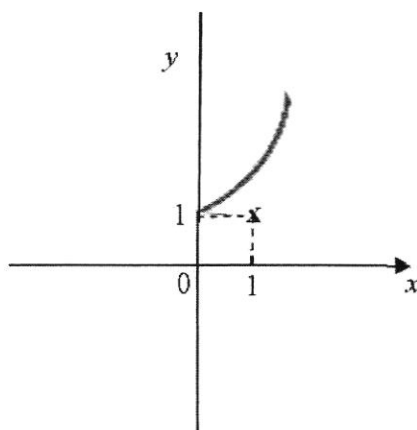
Let x km : the distance

$$\cfrac{x}{\cfrac{0.5x}{20}+\cfrac{0.5x}{25}}$$

$$=\cfrac{x}{\cfrac{2.5x+2x}{100}}$$

$$=\frac{100}{4.5}=22.2$$

<div style="text-align: right">

Answer ____22.2____ km/h [3]

</div>

---

9 The point (1,1) is marked on each diagram in the answer space below.
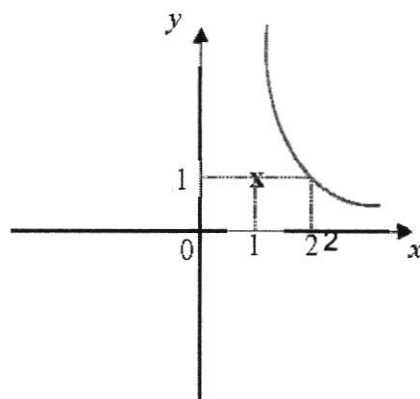Sketch, for $x > 0$, the graph of

(a) $y = 3^x$,

     Answer   [1]

(b) $y = \dfrac{2}{x}$.

     Answer   [1]

10 Vehicles approaching a crossroad may go in one of these directions:
left, right or straight ahead.

If the probability of a vehicle turning left is $\dfrac{7}{20}$, the probability of it turning right

is $\dfrac{9}{20}$ and the probability of it going straight ahead is $\dfrac{1}{5}$, calculate the probability

that for any three vehicles approaching the crossroads,

(a) all will go straight,

$$\frac{1}{5} \times \frac{1}{5} \times \frac{1}{5} = \frac{1}{125}$$

Answer $\dfrac{1}{125}$ [1]

(b) at least one will turn right.

$$1 - (\frac{11}{20})(\frac{11}{20})(\frac{11}{20})$$
$$= 0.83362$$

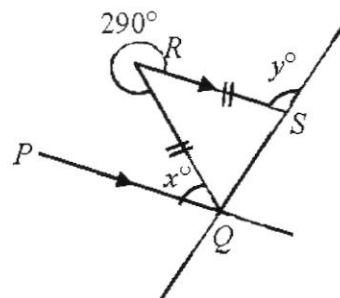*Answer* 0.834 [2]

11 In the diagram, PQ is parallel to RS, $RQ = RS$ and reflex $\angle QRS = 290°$.
Calculate the value of

(a) x,

Acute $\angle QRS = 360° - 290°$ ($\angle$s at a point)

$\qquad = 70°$

$\therefore \angle x = 70°$ (alt. $\angle$s, **RS** parallel to PQ)

Answer $x =$ 70 [1]

(b) y.

$\angle RSQ = (180° - 70°) \div 2$ (base $\angle$ of isos.$\triangle$)

$\qquad = 55°$

$\angle y = 180° - 55°$ (adj. $\angle$s on a straight line)

$\qquad = 125°$

Answer $y =$ 125 [2]

12 The cash price of a computer is $2 750. Mr Ong bought the computer by paying a 30% downpayment and monthly instalments of $90 over 2 years.

(a) How much is the downpayment?

$$\text{Downpayment} = \frac{30}{100} \times 2750$$
$$= \$825$$

Answer $ _____ 825 _____ [1]

(b) Calculate the total amount Mr Ong paid for the computer.

$$\text{Total amount paid} = 825 + 90(12)(2)$$
$$= 825 + 2160$$
$$= \$2\,985$$

Answer $ **2 985** [2]

(c) Find the flat rate of interest per annum for the instalments.

Loan = $ (2750 − 825) = $1 925
Interest = $ (2160 − 1925) = $235

$$\text{S. I.} = \frac{1925 \times R \times 2}{100}$$
$$R = \frac{235 \times 100}{1925 \times 2}$$
$$= 6.1038$$
$$= 6.10 \text{ (3sf)}$$

Answer _____ 6.10 _____ % [3]

---

13 On a certain day, the exchange rate between the pound (£) and the Singapore dollar (S$) was S$1.95 = £1.

(a) Calculate the amount of pounds which May can buy with S$1170.
$1.95 = £1
$1170 = £$\frac{1170}{1.95}$ = £600

Answer £ _____ 600 _____ [1]

(b) After four weeks, she realised she has too much pounds and she now wants to change £200 back to Singapore dollars.
If the loss by this transaction is $6, what is the current exchange rate?
Old rate : £200 = $200 ×1.95 = $ 390
If new rate is £1 = $x, £200 = $200x
390 − 200x = 6
x = 1.92

Answer £1 = S$ _____ 1.92 _____ [2]

14 (a) The perimeter of a rectangular lawn is 72 m and its area is 323 m². Calculate the length of a diagonal of the lawn, without solving for its length and breadth.

$$2(L + B) = 72$$
$$L + B = 36$$
$$LB = 323$$
$$(L+B)^2 = L^2 + B^2 + 2(LB)$$
$$36^2 = L^2 + B^2 + 2(323)$$
$$L^2 + B^2 = 1296 - 646$$
$$= 650$$

Length of diagonal $= \sqrt{650} = 25.495\,\text{m}$

Answer **25.5** m [4]

(b) Another rectangular lawn is 18 m long and 7 m wide, correct to the nearest metre. Find the greatest possible area of this lawn.

$$18.5 \times 7.5 = 138.75$$

Answer 138.75 m² [1]

15 A right circular cone is divided into 3 portions, X, Y and Z, as shown in the diagram below. The height of each portion is 1 unit.
Calculate volume of Y : volume of Z.
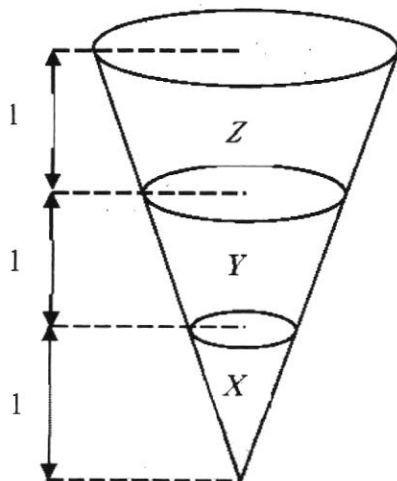
$$\frac{\text{volume of } X}{\text{volume of } X+Y} = (\frac{1}{2})^3 = \frac{1}{8}$$

$$\frac{\text{volume of } X}{\text{volume of } X+Y+Z} = (\frac{1}{3})^3 = \frac{1}{27}$$

$$\frac{\text{volume of } Y}{\text{volume of } Z} = \frac{7}{19}$$

Answer 7 : 19 [3]

16 On the grid in the answer space, $\overrightarrow{OP} = \mathbf{p}$, $\overrightarrow{OQ} = \mathbf{q}$.
The point R is also marked.

(a) Draw and label clearly on the grids below, the vector, $\overrightarrow{OS}$,
such that $\overrightarrow{OS} = \mathbf{p} + 2\,\mathbf{q}$.
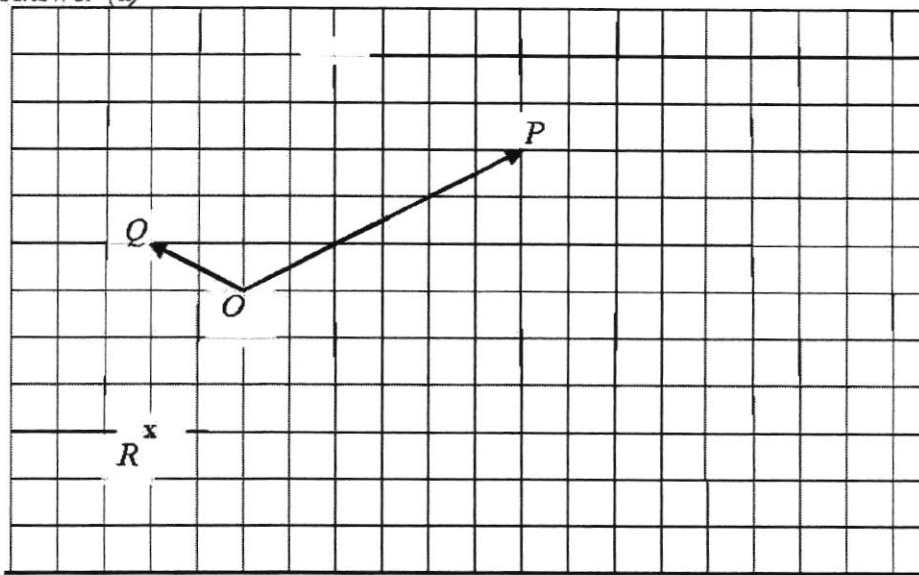
Answer (a)   [1]

(b) Express $\overrightarrow{OR}$ in terms of $\mathbf{p}$ and / or $\mathbf{q}$.

Answer $-\dfrac{2}{3}\mathbf{p} - \mathbf{q}$ [1]

(c) If the length of each small square is 1 unit, calculate $\left|\overrightarrow{OS}\right|$.

$\left|\overrightarrow{OS}\right| = \sqrt{2^2 + 5^2}$
     $= 5.3851$
     $= 5.39$ unit

Answer   5.39   unit   [2]

17 (a) Calculate the size of an exterior angle of a regular polygon with 12 sides.

$$1 \text{ exterior angle} = \frac{360}{12} = 30°$$

Answer   30°_____ [1]

(b) Tile P is in the shape of a regular 12-sided polygon.
Explain, showing your working clearly, whether tiles P will fit
together on the floor without gaps.

Answer
1 interior angle $- 180 - 30 = 150°$

$\frac{360}{150} - 2.4$ which is not a positive integer so the tiles will not fit.
_____

together on the floor without gaps.   [2]

18 On a map, a straight road measuring 600 m is represented by a line
segment of length 7.5 cm.

(a) Express the scale of the map in the ratio $1:r$.

7.5 cm : 60 000cm
1   :   8000

Answer   1   :   8000_____ [1]

(b) The length of a canal on the map is 25 cm. Find the actual length in km.

1 cm : 8000 cm
25 cm : 200 000 cm

Answer   2_____ km   [1]

(c) The actual area of a school is 22 400 m². Find the area of the school
on the map.

80 m : 1 cm
6400 m² : 1 cm²
22 400 m² : 22400/6400 = 3.5 cm²

Answer   3.5_____ cm²   [2]

19 ABC is a triangle in which $AC = 13$ cm, $BC = 11$ cm and $AB = 20$ cm. P is a point on BC produced, where $CP = 5$ cm and $AP = 12$ cm.
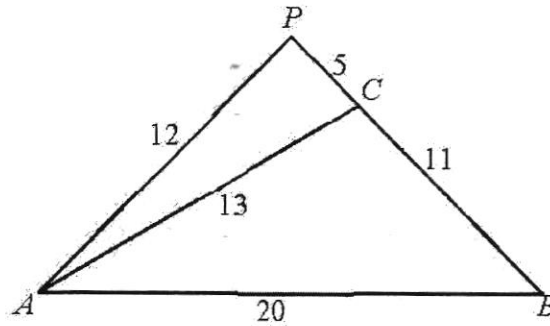
(a) Explain why $\angle APB = 90°$.

Answer

$AP^2 + PC^2 = 12^2 + 5^2$

$= 13^2$

$\therefore AP^2 + PC^2 = AC^2$

By converse of Pythagoras' Theorem, $\triangle APC$ is a right-angled $\triangle$. So $\angle APB = 90°$ [2]

(b) Expressing your answer as a fraction in its simplest form, find

$$\frac{\tan \angle ABC}{\cos \angle ACB}.$$

$\dfrac{\tan \angle ABC}{\cos \angle ACB}$

$= \dfrac{12/16}{-5/13}$ B2

$= -\dfrac{39}{20}$ A1

Answer $-\dfrac{39}{20}$ [3]

20 The graph shows the number of accidents occurring at a road junction over a number of years.
State one aspect of the graph that may be misleading and explain how this may lead to a misinterpretation of the graph.

Increasing Accidents at Road Junction
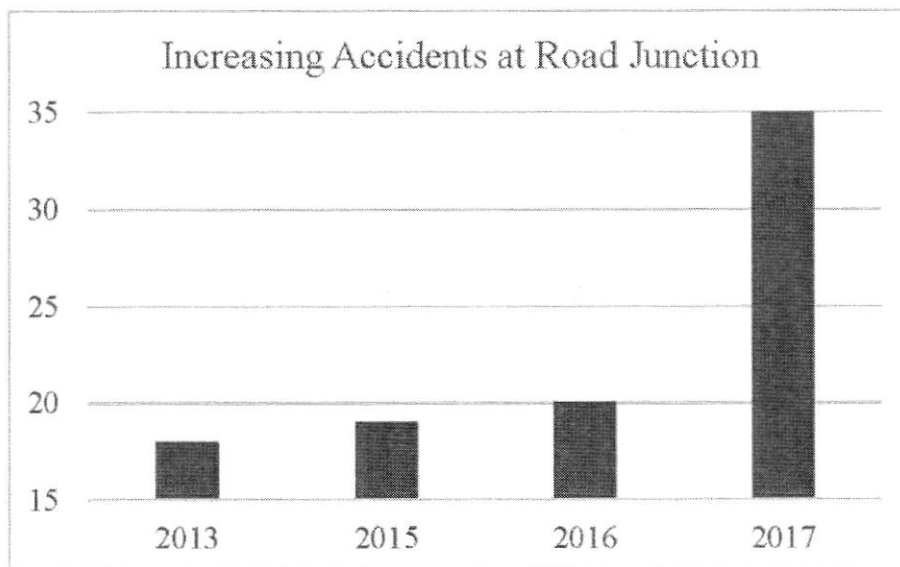
Answer

Title is biased and misleading. It does not allow the reader to form their

own opinion. _____ [2]

The year 2014 is left out. The number of accidents may be higher or lower.

The vertical axis did not start from 0, giving an exaggerated difference between the bars.

21 The diagram shows the speed-time graph of a lorry. The lorry starts from rest and accelerates uniformly to a speed of 15m/s in 10 seconds. The lorry then travels at a constant speed for some time before it decelerates uniformly at 0.75 m/s^2 until it comes to rest. The whole journey takes one minute.
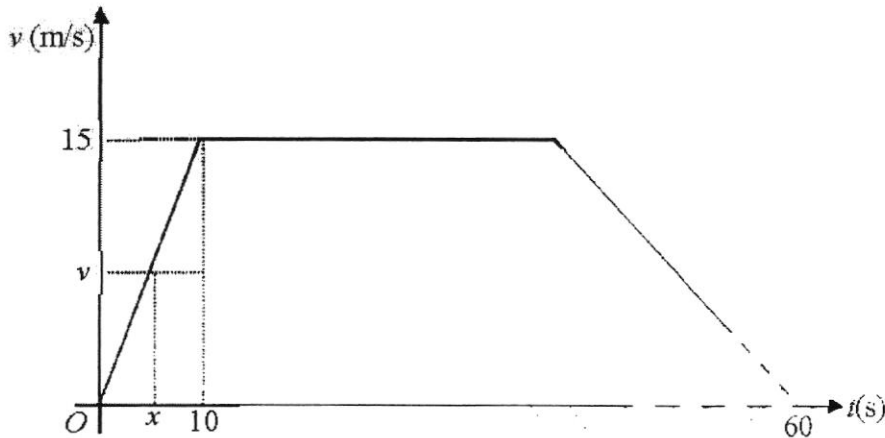
(a) Given that the speed after x seconds is v m/s, express v in terms of x.

$$\frac{v}{x} = \frac{15}{10}$$

$$v = 1.5x$$

Answer $v =$ _____ 1.5x _____ [1]

(b) For how long does the lorry travel at the maximum speed ?

$$\frac{15-0}{x-60} = -\frac{3}{4}$$

$$60 = 3x + 180$$

$$3x = 120$$

$$x = 40$$

It travels for $40 - 10 = 30$ s

Answer _____ 30 _____ s [2]

(c) Calculate the total distance travelled by the lorry during this 1 minute journey.

Total distance $= \dfrac{1}{2}(30 + 60)15$ M1

$= 675$ m   A1

Answer _____ 675 _____ m [2]

End of Paper

Cedar Girls' Secondary School

Mathematics Department

2018 Sec 4 Prelim
Mathematics 4048 P2
Solutions

Qn	Working
1a	$\dfrac{24c^3d^2}{(3de^2)^3} \div \dfrac{5c^{-2}}{10df}$ $= \dfrac{24c^3d^2}{27d^3e^6} \times \dfrac{10df}{5c^{-2}}$ $= \dfrac{16c^5f}{9e^6}$
1b	$\dfrac{7}{(6-5p)^2} - \dfrac{2p-1}{10p-12}$ $= \dfrac{7}{(6-5p)^2} + \dfrac{2p-1}{2(6-5p)}$ $= \dfrac{14+(2p-1)(6-5p)}{2(6-5p)^2}$ $= \dfrac{14+(2p-1)(6-5p)}{2(6-5p)^2}$ $= \dfrac{14+12p-10p^2-6+5p}{2(6-5p)^2}$ $= \dfrac{-10p^2+17p+8}{2(6-5p)^2}$
1c	$\dfrac{6x^2-17x+15}{18x^2-2} \times \dfrac{15x+5}{10-4x}$ $= \dfrac{(3x-1)(2x-5)}{2(3x-1)(3x+1)} \times \dfrac{5(3x+1)}{-2(2x-5)}$ $= -\dfrac{5}{4}$
1d	$1 - \dfrac{a-b}{b+2c} = \dfrac{2a-1}{2}$ $\dfrac{b+2c-a+b}{b+2c} = \dfrac{2a-1}{2}$ $\dfrac{2b+2c-a}{b+2c} = \dfrac{2a-1}{2}$ $4b+4c-2a = 2ab+4ac-b-2c$ $5b-2ab = 4ac-6c+2a$ $b(5-2a) = 4ac-6c+2a$ $b = \dfrac{4ac-6c+2a}{5-2a}$

Cedar Girls' Secondary School   Mathematics Department

Qn	Working
2a	$FH^2 = 36^2 + 40^2$ $FH = \sqrt{2896}$ or 53.814 cm $BH = \sqrt{12^2 + 2896}$ $BH = 55.1$ cm (3 s.f)
2b	$CG = \sqrt{12^2 + 16^2} = 20$ cm Perimeter of the cross-sectional area $= 20 + 12 + 36 + 20 = 88$ cm Lateral surface area $= 88 \times 40 = 3520$ cm^2 Total Surface area $= 3520 + 2\left(\dfrac{1}{2} \times (20 + 36) \times 12\right)$ $= 4192$ cm^2
2c	Volume of prism $= 336 \times 40$ m^3 $= 13440$ m^3 Let the side of the square base be x. $\dfrac{1}{3} \times x^2 \times 24 = 13440$ $x = 41.0$ cm (3 s.f)

Qn	Working
3(a)	Correct plotting of points Correct scale and axes Smoothness of curve
(b)(i)	$4250 (accept $4200 to $4300)
(b)(ii)	425 tarts (accept 400 to 450)
(b)(iii)	$1.275 < x < 3.675$ (accept lower limit: 1.25 to 1.35 (accept upper limit: 3.65 to 3.75)
(c)(i)	Draw line $\dfrac{y}{x} = \dfrac{1}{4}$
(c)(ii)	0.45 (accept 0.4 to 0.5)
(c)(iii)	The number of pieces of the blueberry tarts to be sold such that the profit made per piece is $0.25.
(c)(iv)	$5x - x^2 - 2 = \dfrac{1}{4}x$ $x^2 - 4\dfrac{3}{4}x + 2 = 0$ $4x^2 - 19x + 8 = 0$ $4x - 19 + \dfrac{8}{x} = 0$ $A = 8, \quad B = -19$

Qn	Working
4a	Area of triangle ABC $= \dfrac{1}{2}(95)(82)\sin 75°$ $= 3760 \text{ cm}^2 (3 \text{ s.f})$
4b	$AC^2 = 95^2 + 82^2 - 2(95)(82)\cos 75°$ $AC = 108.24$ $\quad = 108 \text{ m } (3 \text{ s.f})$
4c	$\dfrac{\sin \angle ACB}{95} = \dfrac{\sin 75°}{108.24}$ $\angle ACB = 57.970°$ $\quad\quad = 58.0°$
4d	$\angle DAC = 57.970° - 25°$ $\quad\quad\quad = 32.97°$ (alt $\angle$s, parallel lines) $\sin 32.97° = \dfrac{DE}{71}$ $DE - 38.638 \text{ m}$ Let the greatest angle of elevation be θ. $\tan\theta = \dfrac{67}{38.638}$ $\theta = 60.0°$ (1 dp)

Qn	Working
5a	$\left(\dfrac{25}{x}\right)$ h
5b	$\left(\dfrac{30}{x+3}\right)$ h
5c	$\dfrac{25}{x}-\dfrac{30}{x+3}=\dfrac{5}{4}$ $\dfrac{25(x+3)-30x}{x(x+3)}-\dfrac{5}{4}$ $\dfrac{75-5x}{x(x+3)}=\dfrac{5}{4}$ $300-20x=5x^2+15x$ $5x^2+35x-300=0$ $x^2+7x-60=0$ (shown)
5d	$x^2+7x-60=0$ $(x+12)(x-5)=0$ $x=-12$ or $x=5$
5e	$\dfrac{30}{5+3}=3.75$ h

Cedar Girls' Secondary School

Mathematics Department

Qn	Working
6a	Interquartile range $= 29 - 20 = 9$ marks
6bi	$p = 20$, $q = 130$, $r = 280$, s $= 70$
6bii	Mean $= \dfrac{15350}{500}$ $= 30.7$ marks
6biii	$\text{SD} = \sqrt{\dfrac{492305}{500} - \left(\dfrac{15350}{500}\right)^2}$ $= 6.49$ marks (3 s.f)
6c	34 marks
6d	Median mark for Paper 1 $= 25$ Median mark for Paper 2 $= 31.5$ (between 31 and 32) Since the median mark for Paper 1 is lower than the median mark for Paper 2, Paper 1 is the more difficult paper.

Qn	Working
7ai	$T_5 = 3^4 - 14 = 67$
7aii	$T_n = 3^{n-1} - (2 + 3(n-1))$
	$\quad = 3^{n-1} - (3n-1)$
	$\quad = 3^{n-1} - 3n + 1$
7aiii	$T_{15} = 3^{14} - 3(15) + 1 = 4\ 782\ 925$
7bi	$\mathbf{B} = \begin{pmatrix} p-12 \\ q-15 \end{pmatrix}$
	$\mathbf{C} = \begin{pmatrix} 6 & 8 \\ 12 & 14 \end{pmatrix}\begin{pmatrix} p-12 \\ q-15 \end{pmatrix}$
	$\quad = \begin{pmatrix} 6p - 72 + 8q - 120 \\ 12p - 144 + 14q - 210 \end{pmatrix}$
	$\quad = \begin{pmatrix} 6p + 8q - 192 \\ 12p + 14q - 354 \end{pmatrix}$
7bii	$\mathbf{D} = \begin{pmatrix} 92 \\ 170 \end{pmatrix}$
	$\begin{pmatrix} 6p + 8q - 192 \\ 12p + 14q - 354 \end{pmatrix} = \begin{pmatrix} 92 \\ 170 \end{pmatrix}$
	$6p + 8q - 192 = 92$
	$6p + 8q = 284 ----(1)$
	$12p + 14q - 354 = 170$
	$12p + 14q = 524 ----(2)$
	$(1) \times 2: 12p + 16q = 568 ----(3)$
	$(3) - (2): 2q = 44$
	$q = 22, p = 18$

Cedar Girls' Secondary School   Mathematics Department

Qn	Working
8ai	Reflex angle $COA = 360° - 116°$ $\qquad\qquad = 244°$ Angle $CBA = \dfrac{244°}{2}$ $\qquad = 122° (\angle$ at centre $= 2\angle$ at circumference)
8aii	Angle $OAC = \dfrac{180° - 116°}{2}$ (base $\angle$s of isos. Δ) $\qquad = 32°$ Angle **CAT** $= 90° - 32°$(tan $\perp$ rad) $\qquad = 58°$
8aiii	Angle **ACT** $=$ angle **CAT** $= 58°$(tangents from ext. pt) Angle **CTA** $= 180° - 2(58°)$ ($\angle$ sum of Δ) $\qquad = 64°$
8bi	Triangle **QRP** is a right angle triangle ($\angle$ in semicircle) $\cos\dfrac{\pi}{5} - \dfrac{RP}{10}$ $RP = 10\cos\left(\dfrac{\pi}{5}\right)$ $PR = 8.0902$ cm (to 5 s.f) OR Angle **ROP** $= \pi - 2\left(\dfrac{\pi}{5}\right) = \dfrac{3\pi}{5}$ (base $\angle$s of isos Δ, $\angle$sum of Δ) $PR^2 = 5^2 + 5^2 - 2(5)(5)\cos\dfrac{3\pi}{5}$ $PR - 8.0902$ cm (to 5 s.f)
8bii	Arc length **QR** $= 5\left(\dfrac{2\pi}{5}\right) = 2\pi$ Arc length **RSP** $= 5\pi - 2\pi = 3\pi$ Semicircle $PRT = \dfrac{8.0902}{2}\pi = 4.0451\pi$ Perimeter of shaded region $= 3\pi + 4.0451\pi$ $\qquad\qquad\qquad = 22.1$ cm (3 s.f)

Cedar Girls' Secondary School   Mathematics Department

8biii	Area of sector $ORSP = \dfrac{1}{2}(5)^2\left(\dfrac{3\pi}{5}\right) = 7.5\pi$ cm^2
	Area of triangle $ORP = \dfrac{1}{2}(5)(5)\sin\left(\dfrac{3\pi}{5}\right) = 11.888$ cm^2
	Area of segment $RSP = 7.5\pi - 11.888 = 11.674$ cm^2
	Area of shaded region $= \dfrac{1}{2}\pi\left(\dfrac{8.0902}{2}\right)^2 - 11.674 = 14.0$ cm^2 (to 3 sf)

Qn	Working
9ai	$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$ $\qquad = 8\mathbf{b} - 12\mathbf{a}$ $\overrightarrow{AQ} = 4\mathbf{b} - 6\mathbf{a}$
9aii	$\overrightarrow{BP} = \overrightarrow{BO} + \overrightarrow{OP}$ $\qquad = -8\mathbf{b} + 8\mathbf{a}$
9aiii	$\overrightarrow{QP} = \overrightarrow{QA} + \overrightarrow{AP}$ $\qquad = -4\mathbf{b} + 6\mathbf{a} - 4\mathbf{a}$ $\qquad = 2\mathbf{a} - 4\mathbf{b}$
9b	$\overrightarrow{PR} = 4\overrightarrow{PQ}$ $\overrightarrow{OR} - \overrightarrow{OP} = 4(4\mathbf{b} - 2\mathbf{a})$ $\overrightarrow{OR} - 8\mathbf{a} = 16\mathbf{b} - 8\mathbf{a}$ $\overrightarrow{OR} = 16\mathbf{b}$
9c	OB is parallel to OR and since O is a common point, O, B and R are collinear.
9d	$OR = 2OB$ or B is the midpoint of OR. Since $PQBS$ is a parallelogram, $\overrightarrow{QP} = \overrightarrow{BS}$ $2\mathbf{a} - 4\mathbf{b} = \overrightarrow{OS} - 8\mathbf{b}$ $\overrightarrow{OS} = 2\mathbf{a} + 4\mathbf{b}$
9e	$\dfrac{\text{Area of } \Delta OBP}{\text{Area of } \Delta ORA} = \dfrac{\text{Area of } \Delta OBP}{\text{Area of } \Delta OBA} \times \dfrac{\text{Area of } \Delta OBA}{\text{Area of } \Delta ORA}$ $\qquad\qquad = \dfrac{2}{3} \times \dfrac{1}{2}$ $\qquad\qquad = \dfrac{1}{3}$
9f	$\overrightarrow{AB} = 8\begin{pmatrix} -1 \\ -1 \end{pmatrix} - 12\begin{pmatrix} -1 \\ 1 \end{pmatrix}$ $\qquad = \begin{pmatrix} 4 \\ -20 \end{pmatrix}$ $\left\| \overrightarrow{AB} \right\| = \sqrt{4^2 + (-20)^2}$ $\qquad = 20.4 \text{ units (3 sf)}$

Cedar Girls' Secondary School · Mathematics Department

Qn	Working
10a	Electricity tariff $= \dfrac{\dfrac{100}{107} \times 148.13}{625}$ $= \$0.2215/\text{kWh}$
10b	Average consumption per month $= 529.5 \text{ kWh}$
10c	Best Power Total cost for 12 months $= 12 \times 529.5 \times 0.1667$ $= \$1059.21$ Marco Energy Total cost for 12 months $= 12(10 + 0.1535 \times 529.5)$ $= \$1095.34$ Infinity Power Total cost for 12 months $= (6 \times 529.5 \times 0.1730) + (6 \times 0.95 \times 0.1730^* \, 529.5)$ $= \$1071.76$ Rainbow Energy Total cost for 12 months $= 3 \times 0.8 \times 529.5(0.2282 + 0.2365 + 0.2293 + 0.2386)$ $= \$1185.15$ Unicorn Supply Total cost for 12 months $= 12 \times (0.75 \times 529.5 \times 0.1685 + 0.25 \times 529.5 \times 0.1438)$ $= \$1031.41$ Mr Lim should choose Unicorn Supply as it has the lowest total costs. Assumptions: The electricity consumption in Mr Lim's household is consistent throughout the year OR The projected quarterly household electricity tariff is fairly accurate.