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Name	Class	Index no.	Calculator Model

DEYI SECONDARY SCHOOL



Preliminary Examination 2015 Secondary Four Express / Five Normal Academic

MATHEMATICS

4016/01

Paper 1

28 Aug 2015
1040 – 1240h
2 hours

Candidates answer on the Question Paper.
No additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number in the spaces at the top of this page.
Write in dark blue or black pen in the spaces provided on the Question Paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid / 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, the answer should be given to three significant figures.

Answers in degrees should be given to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

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

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) Calculate $\frac{6.7^2 - \sqrt[3]{4.8}}{20.15 - 19.99}$.

Write down the first six digits of your answer.

Answer (a) [1]

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

Answer (b) [1]

2 Write the following in descending order.

$$\frac{54}{67} \quad \sqrt[3]{0.512} \quad 0.77^{\frac{5}{6}} \quad 0.802$$

Answer [2]

3 Given that $9 \times 27^{-n} = 1$, find the value of n .

Answer $n =$ [2]

4 The sine of an obtuse angle is 0.6.

Without using a calculator, find the cosine of this angle.

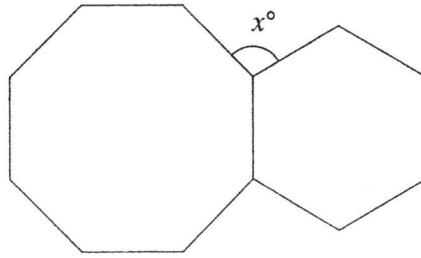
Answer [2]

[Turn over

z

4

5



The diagram shows a sketch of a regular hexagon and a regular octagon.
Calculate x .

Answer $x = \dots\dots\dots$ [2]

- 6 Brian is leaving Singapore to further his studies in the United Kingdom.
In Singapore, the exchange rate is 1 Singapore Dollar = 0.478 British Pounds.
In the United Kingdom, the exchange rate is 1 British Pound = 2.113 Singapore Dollars.

Brian would like to change 2500 Singapore Dollars into British Pounds.

How many fewer British Pounds will he get by changing his money in the United Kingdom?

Answer $\dots\dots$ British Pounds [2]

- 7 Matthew bought a new car. At the end of each year, the car's value depreciates by 10%.
The value, \$ C , of the car t years after being bought is given by

$$C = 85000 \times 0.9^t.$$

- (a) How much did Matthew pay for his new car?

Answer (a) \$ [1]

- (b) Find the percentage decrease in the value of his car at the end of three years.

Answer (b) % [1]

- 8 Two geometrically similar solids made from the same material have masses 3.60 kg and 12.15 kg respectively.

Calculate the ratio of the area of the smaller solid to the area of the larger solid.

Answer [2]

[Turn over]

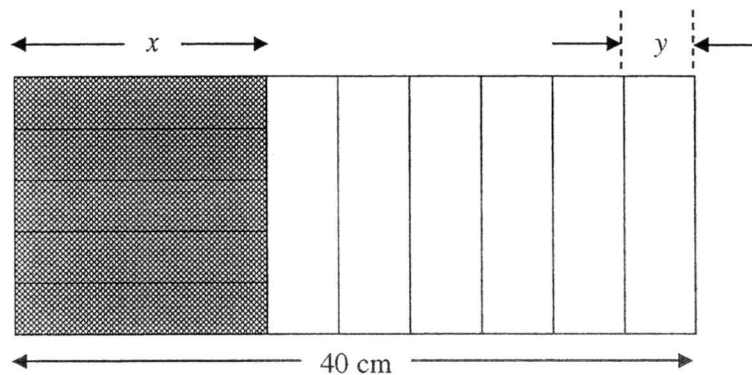
- 9 Dawn invested some money in a savings account that was compounded every six months. The rate of compound interest was 5% per annum. At the end of the 4 years there was \$14620.83 in her account.

How much did Dawn invest in the account at first?

Give your answer correct to the nearest dollar.

Answer \$ [3]

- 10 A rectangle with length 40 cm is divided into five identical shaded rectangles and another six identical unshaded rectangles.



The shaded area makes up two-thirds of the unshaded area.

Find the lengths labelled x and y .

Answer $x = \dots\dots\dots$.. cm
 $y = \dots\dots\dots$.. cm [3]

- 11 Mr Tan decided to buy a laptop under a hire-purchase scheme.

He would have paid \$3906 in total under the scheme, which consists of a deposit of 15% of the selling price of the laptop plus 24 equal monthly payments of \$140.25.

What is the selling price of the laptop?

Answer \$ [3]

- 12 Two points P and Q have position vectors $\mathbf{p}$ and $\mathbf{q}$ respectively, relative to an origin O .

It is given that $\mathbf{p} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} k \\ 0 \end{pmatrix}$.

Find

- (a) $\overrightarrow{PQ}$ in terms of k ,

Answer (a) $\overrightarrow{PQ} = \dots\dots\dots$ [1]

- (b) the possible values of k if OP and OQ are two sides of a rhombus.

Answer (b) $k = \dots\dots\dots$ or $\dots\dots\dots$ [2]

[Turn over]

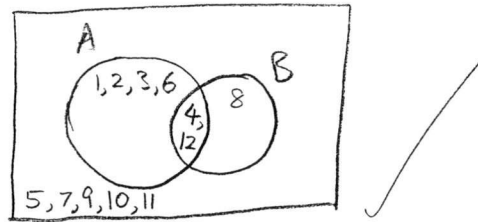
13 $\varepsilon = \{ \text{integers } x : 1 \leq x \leq 12 \}$

$A = \{ \text{factors of } 12 \}$

$B = \{ \text{multiples of } 4 \}$

(a) Draw a Venn diagram to illustrate this information.

Answer (a)



[2]

(b) Describe in words what the set $(A \cup B)^c$ represents.

Answer (b) ...

[1]

14 A train 45 m long passes through a tunnel 6 km long.

The average speed of the train is 27 km/h.

(a) Change 27 km/h into m/s.

Answer (a) m/s [1]

(b) Calculate the time taken for the train to pass completely through the tunnel.

Give your answer in minutes and seconds, to the nearest second.

Answer (b) minutes ... ~~seconds~~ [3]

15 Simplify

(a) $28x^2y^{-3} \div 16x^3y^{-1}$,

Answer (a) [2]

(b) $\frac{2}{x-3} + \frac{3x}{x^2-9}$.

Answer (b) [2]

16 The numbers 1 to 100 are arranged in a table as shown below.

A U-shaped, shaded frame can be placed around various numbers throughout the table.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
91	92	93	94	95	96	97	98	99	100

The **U-number** is used to refer to the **shaded frame** that is drawn **around a particular number**.For example, U_2 refers to the **shaded frame** shown above since it is drawn **around the number 2**.

(a) State the largest possible U-number.

Answer (a) [1]

(b) Write and simplify an expression, in terms of n , for the sum of the numbers in U_n .

Answer (b) [2]

(c) Find the sum of numbers in U_{75} .

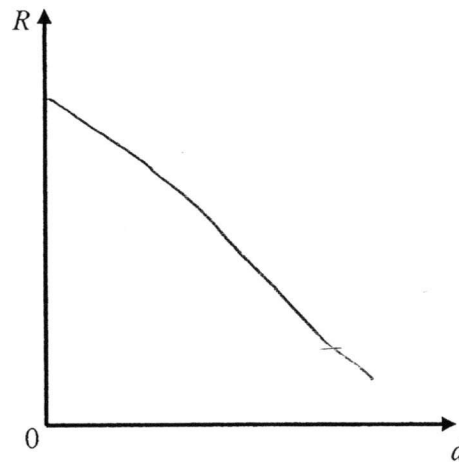
Answer (c) [1]

[Turn over

17 The resistance of a wire, R ohms, is inversely proportional to the square of its diameter, d μm .

(a) Sketch a resistance-diameter graph for the wire.

Answer (a)



[1]

For a fixed length of wire, the resistance is 25.6 ohms when the diameter is 50 μm .

(b) Find the equation for R in terms of d .

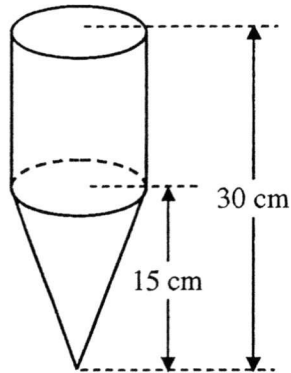
Answer (b) $R = \dots\dots\dots$ [2]

(c) Another wire of the same length has resistance 120 ohms.

Calculate its diameter.

Answer (c) $\dots\dots\dots \mu\text{m}$ [1]

- 18 A composite container made from a cylinder and a cone has a vertical height of 30 cm. Water is poured into the empty container at a constant rate. It takes 60 seconds to fill up the entire container.

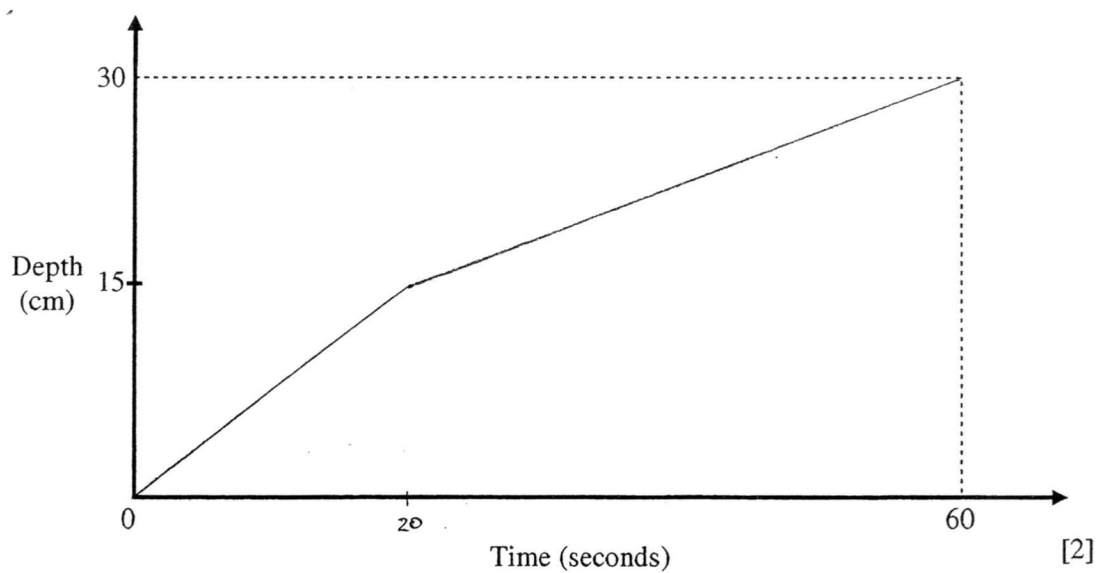


- (a) Find the time taken to fill up the cone.

Answer (a) seconds [2]

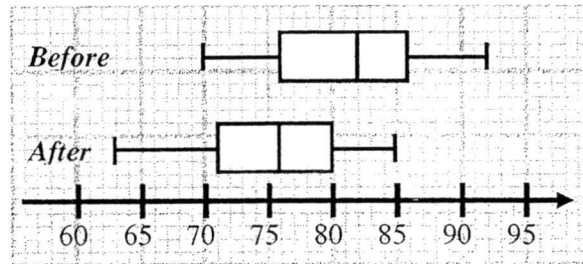
- (b) Sketch the graph of how the depth of water in the container varies during the 60 seconds.

Answer (b)



[Turn over]

- 19 The diagram shows the box-and-whisker plots for the distributions of the speeds, in km/h, of 100 vehicles before and after a speed camera was placed on an expressway.



- (a) Find the interquartile range of the distribution before the camera was placed.

Answer (a) km/h [1]

- (b) Find the interquartile range of the distribution after the camera was placed.

Answer (b) km/h [1]

- (c) After the camera was placed, 25% of the motorists were issued with traffic summons for exceeding the speed limit of the expressway.

What is the speed limit of the expressway?

Answer (c) km/h [1]

- (d) Has the speed camera been effective in regulating the speed limit of the expressway?
Explain your answer by comparing the distributions of the speeds before and after the camera was placed.

Answer (d) ...

..... [1]

- 20 Abraham and Lincoln sent out some letters, postcards and greeting cards.

The number of letters, postcards and greeting cards is shown in the table below.

	Letters	Postcards	Greeting cards
Abraham	4	9	2
Lincoln	7	3	3

The postage for each letter, postcard and greeting card is \$0.30, \$0.40 and \$0.50 respectively.

- (a) Write out a 2×3 matrix $\mathbf{P}$ and a column matrix $\mathbf{Q}$ to represent the above information.

Answer (a) $\mathbf{P} =$

$\mathbf{Q} =$ [2]

- (b) Evaluate the matrix $\mathbf{S} = \mathbf{PQ}$.

Answer (b) $\mathbf{S} =$ [2]

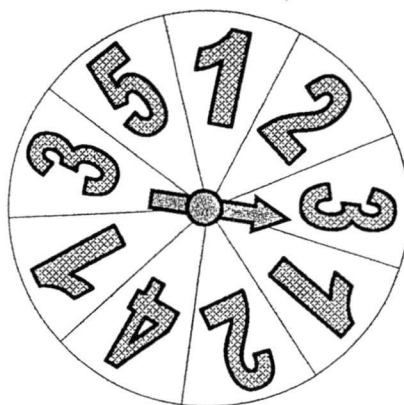
- (c) State what the elements of $\mathbf{S}$ represent.

[1]

[Turn over

7

- 21 The diagram shows a spinner with nine numbered sectors of identical sizes.



Each time the pointer is spun, it is equally likely to stop on one of the sectors.

- (a) The pointer is spun once.

Find the probability that it stops on an odd number.

Answer (a) [1]

- (b) Aysha spins the pointer twice.

Find the probability that the pointer lands on a prime number **at least once**.

Answer (b) [2]

- (c) Natasha spins the pointer twice.

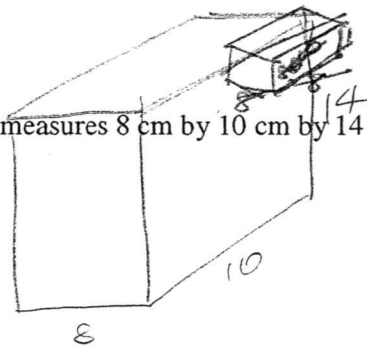
Her score is found from the difference of the numbers from her two spins.

Find the probability that her score is 0.

Answer (c) [2]

22 Benjamin has 165 identical cubes of sides 2 cm.

- (a) He uses some of the cubes to make a cuboid which measures 8 cm by 10 cm by 14 cm.
Calculate the total surface area of the cuboid.



Answer (a) cm^2 [2]

- (b) Benjamin makes the largest cube possible using some of the 165 cubes.
He then makes the largest cube possible from the unused cubes.
How many cubes will he have left over after making the second cube?

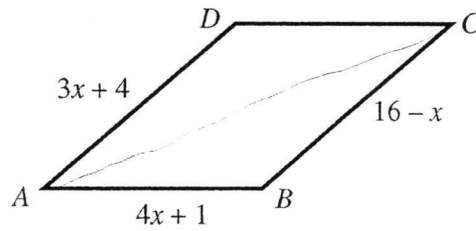
Answer (b) [2]

- (c) Benjamin uses all 165 cubes to make a cuboid.
Find the dimensions of the cuboid.

Answer (c) cm by cm by cm [2]

[Turn over]

- 23 Expressions for the lengths of three sides of a quadrilateral are shown on the diagram below.
All lengths are in centimetres.



- (a) The perimeter of this quadrilateral is given by the expression $(11x + 19)$ cm.

Find an expression, in terms of x , for the length of DC .

Give your expression in its simplest form.

Answer (a) cm [2]

- (b) Given that $ABCD$ is a parallelogram and that $AB = AD$, calculate the perimeter of $ABCD$.

Answer (b) cm [2]

- (c) Calculate the area of $ABCD$ if $AC = (10x - 6)$ cm.

Answer (c) cm^2 [5]

Name	Class	Index no.	Calculator Model

DEYI SECONDARY SCHOOL



Preliminary Examination 2015 Secondary Four Express / Five Normal Academic

MATHEMATICS

4016/01

Paper 1

28 Aug 2015
1040 – 1240h
2 hours

Candidates answer on the Question Paper.
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Answers in degrees should be given to one decimal place.
For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

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

*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) Calculate $\frac{6.7^2 - \sqrt[3]{4.8}}{20.15 - 19.99}$.

Write down the first six digits of your answer.

Answer (a) 270.019 ✓ [1]

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

Answer (b) 270 ✓ [1]

2 Write the following in descending order.

$$\frac{54}{67}, \quad \sqrt[3]{0.512}, \quad 0.77^{\frac{5}{6}}, \quad 0.802$$

$$0.86591, \quad 0.8, \quad 0.804283, \quad 0.802$$

Answer $\frac{54}{67}$ ✓, $0.77^{\frac{5}{6}}$ ✓, 0.802 ✓, $\sqrt[3]{0.512}$ ✓, 0.8 ✗ [2]

3 Given that $9 \times 27^{-n} = 1$, find the value of n .

$$9 \times 27^{-n} = 1$$

$$3^2 \times (3^3)^{-n} = 1$$

$$3^2 \times 3^{-3n} = 3^0$$

$$2 - 3n = 0$$

$$2 = 3n$$

$$n = \frac{2}{3}$$

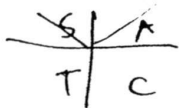
Answer $n = \dots\dots\dots \frac{2}{3}$ ✓ [2]

4 The sine of an obtuse angle is 0.6.

Without using a calculator, find the cosine of this angle.

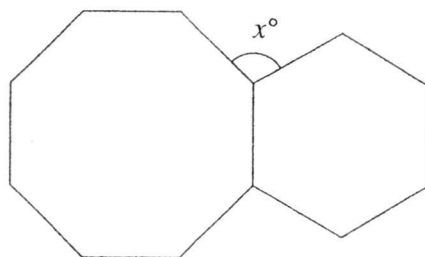
$$\sin x = 0.6$$

$$x = \sin^{-1} 0.6$$



Answer $-\frac{4}{5}$ [2]

5



The diagram shows a sketch of a regular hexagon and a regular octagon.

Calculate x .

$$\frac{(6-2) \times 180^\circ}{6} = 120^\circ$$

$$\frac{(8-2) \times 180^\circ}{8} = 135^\circ$$

$$360^\circ - 135^\circ - 120^\circ = 105^\circ$$

Answer $x = \dots\dots\dots 105^\circ \dots\dots\dots$ [2]

2

- 6 Brian is leaving Singapore to further his studies in the United Kingdom.

In Singapore, the exchange rate is 1 Singapore Dollar = 0.478 British Pounds.

In the United Kingdom, the exchange rate is 1 British Pound = 2.113 Singapore Dollars.

Brian would like to change 2500 Singapore Dollars into British Pounds.

How many fewer British Pounds will he get by changing his money in the United Kingdom?

$$S\$ 2500 \div \$1 \times 0.478 = \pounds 1195$$

$$S\$ 2500 \div 2.113 \times \pounds 1 = \pounds 1183.151917$$

$$\pounds 1195 - \pounds 1183.151917 = \pounds 11.848083$$

$$\approx \pounds 11.85$$

Answer $\dots\dots\dots 11.85 \dots\dots\dots$ British Pounds [2]

2

- 7 Matthew bought a new car. At the end of each year, the car's value depreciates by 10%.
The value, \$C\$, of the car \$t\$ years after being bought is given by

$$C = 85000 \times 0.9^t$$

- (a) How much did Matthew pay for his new car?

Answer (a) \$ 85000 ✓ [1]

- (b) Find the percentage decrease in the value of his car at the end of three years.

$$85000 \times 0.9^3 = 61965$$

$$\cancel{85000}$$

$$85000 - 61965 = 23035$$

$$\frac{23035}{85000} = 27.1\%$$

Answer (b) 27.1 ✓ % [1]

- 8 Two geometrically similar solids made from the same material have masses 3.60 kg and 12.15 kg respectively.

Calculate the ratio of the area of the smaller solid to the area of the larger solid.

$$\left(\frac{3.60}{12.15}\right)^3 = \frac{A_1}{A_2} \quad \left(\frac{l_1}{l_2}\right)^3 = \frac{3.6}{12.15}$$

$$\frac{64}{729} = \frac{A_1}{A_2}$$

$$\frac{l_1}{l_2} = \frac{2}{3}$$

$$A_1 : A_2$$

$$l_1 : l_2$$

$$64 : 729$$

$$2 : 3$$

$$\left(\frac{l_1}{l_2}\right)^2 = \frac{A_1}{A_2}$$

$$\left(\frac{2}{3}\right)^2 = \frac{4}{9}$$

$$A_1 : A_2$$

$$4 : 9$$

Answer 64 : 729 × [2]

[Turn over]

- 9 Dawn invested some money in a savings account that was compounded every six months. The rate of compound interest was 5% per annum. At the end of the 4 years there was \$14620.83 in her account.

How much did Dawn invest in the account at first?

Give your answer correct to the nearest dollar.

$$P\left(1 + \frac{5}{100}\right)^8 = \$14620.83 = P\left(1 + \frac{5}{100}\right)^8$$

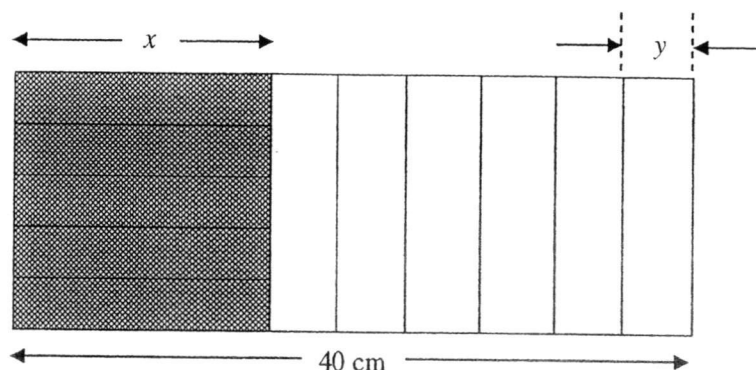
$$= \$14620.83$$

$$P = \$11999.99608$$

$$\approx \$12000$$

Answer \$ 12000 ✓ [3]

- 10 A rectangle with length 40 cm is divided into five identical shaded rectangles and another six identical unshaded rectangles.



The shaded area makes up two-thirds of the unshaded area.

Find the lengths labelled x and y .

$$x + 6y = 40$$

Let the ~~length~~^{breadth} of each shaded rectangle be z .

$$5(xz) + 5(6yz) =$$

$$5xz \div 2 \times 3 = 5(6yz)$$

$$1.5xz = 25yz$$

$$x = 40 - 6y$$

$$1.5(40 - 6y)z = 25yz$$

$$300z - 45yz = 25yz$$

$$300z - 45yz - 25yz = 0$$

$$300z - 70yz = 0$$

$$z(300 - 70y) = 0$$

$$300 - 70y = 0$$

$$70y = 300$$

$$y = 4\frac{2}{7}$$

$$= 4.285714286$$

$$\approx 4.29$$

$$40 - 6(4.285714286) = 14.28571429$$

$$\approx 14.3$$

$$x = 14.3$$

$$3x = 2(6y)$$

$$3x = 12y$$

$$x = 4y$$

$$10y = 40$$

$$y = 4$$

$$x = 4y$$

$$= 16$$

Answer $x = 14.3 \times 16$ cm
 $y = 4.29 \times 4$ cm [3]

3

- 11 Mr Tan decided to buy a laptop under a hire-purchase scheme.

He would have paid \$3906 in total under the scheme, which consists of a deposit of 15% of the selling price of the laptop plus 24 equal monthly payments of \$140.25.

What is the selling price of the laptop?

let selling price be x

$$15\% \times x + 24 \times \$140.25 = \$3906$$

$$15\% \times x = \$3741.75$$

$$x = \$24945$$

let selling price be x

$$15\% \times x + 24 \times \$140.25 = \$3906$$

$$15\% x = \$540$$

$$x = \$3600$$

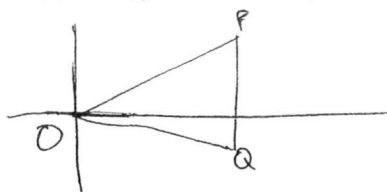
Answer \$ 24945 X 3600 [3]

- 12 Two points P and Q have position vectors $\mathbf{p}$ and $\mathbf{q}$ respectively, relative to an origin O .

It is given that $\mathbf{p} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}$ and $\mathbf{q} = \begin{pmatrix} k \\ 0 \end{pmatrix}$.

Find

- (a) $\overrightarrow{PQ}$ in terms of k ,



$$\overrightarrow{PQ} = \overrightarrow{PO} + \overrightarrow{OQ}$$

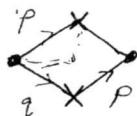
$$= -\begin{pmatrix} -3 \\ 4 \end{pmatrix} + \begin{pmatrix} k \\ 0 \end{pmatrix}$$

$$= \begin{pmatrix} 3 \\ -4 \end{pmatrix} + \begin{pmatrix} k \\ 0 \end{pmatrix}$$

$$= \begin{pmatrix} 3+k \\ -4 \end{pmatrix}$$

Answer (a) $\overrightarrow{PQ} = \begin{pmatrix} -3k \\ 4 \end{pmatrix} \times \begin{pmatrix} 3+k \\ -4 \end{pmatrix} [1]$

- (b) the possible values of k if OP and OQ are two sides of a rhombus.



$$|\overrightarrow{OP}| = \sqrt{(-3)^2 + (4)^2}$$

$$= 5 \text{ or } -5$$

Answer (b) $k = 5$ or -5 [2]

[Turn over

13 $\varepsilon = \{ \text{integers } x : 1 \leq x \leq 12 \}$

$A = \{ 1, 2, 3, 4, 6, 12 \}$

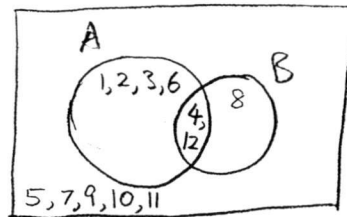
$A = \{ \text{factors of 12} \}$

$B = \{ 4, 8, 12 \}$

$B = \{ \text{multiples of 4} \}$

- (a) Draw a Venn diagram to illustrate this information.

Answer (a)



[2]

- (b) Describe in words what the set $(A \cup B)'$ represents.

Answer (b) The set $(A \cup B)'$ represents all the numbers that are not in Set A and B combined. X It represents the set of numbers that are neither factors of 12 nor multiples of 4. [1]

- 14 A train 45 m long passes through a tunnel 6 km long.

The average speed of the train is 27 km/h.

- (a) Change 27 km/h into m/s.

$$27 \text{ km} \div 1 \text{ h} = 27000 \text{ m} \div 3600 \text{ s} \\ = 7.5 \text{ m/s}$$

Answer (a) 7.5 m/s [1]

- (b) Calculate the time taken for the train to pass completely through the tunnel.

Give your answer in minutes and seconds, to the nearest second.

$$6000 \text{ m} + 45 \text{ m} = 6045 \text{ m} \\ 6045 \text{ m} \div 7.5 \text{ m/s} = 806 \text{ s} \\ = 13 \text{ minutes } 26 \text{ seconds}$$

Answer (b) 13 minutes 26 seconds [3]

15 Simplify

(a) $28x^2y^{-3} \div 16x^3y^{-1}$,

$$28x^2y^{-3} \div 16x^3y^{-1} = \frac{28x^2y^{-3}}{16x^3y^{-1}}$$

$$= \frac{28x^2y^1}{16x^3y^3}$$

Answer (a) $\frac{7}{4xy^2}$ ✓ [2]

(b) $\frac{2}{x-3} + \frac{3x}{x^2-9}$.

$$= \frac{7}{4xy^2}$$

$$\frac{2(x+3)}{(x-3)(x+3)} + \frac{3x}{x^2-9}$$

$$= \frac{2x+6+3x}{(x-3)(x+3)}$$

$$= \frac{5x+6}{x^2-9}$$

Answer (b) $\frac{5x+6}{x^2-9}$ ✓ [2]

16 The numbers 1 to 100 are arranged in a table as shown below.

A U-shaped, shaded frame can be placed around various numbers throughout the table.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
91	92	93	94	95	96	97	98	99	100

The **U-number** is used to refer to the **shaded frame** that is drawn **around a particular number**.For example, U_2 refers to the **shaded frame** shown above since it is drawn **around the number 2**.

(a) State the largest possible U-number.

Answer (a) $89 \times U_{89}$ [1]

(b) Write and simplify an expression, in terms of n , for the sum of the numbers in U_n .

$$n-1 + n + 1 + n+9 + n+10 + n+11 = 5n+30$$

Answer (b) $5n+30$ [2]

(c) Find the sum of numbers in U_{75} .

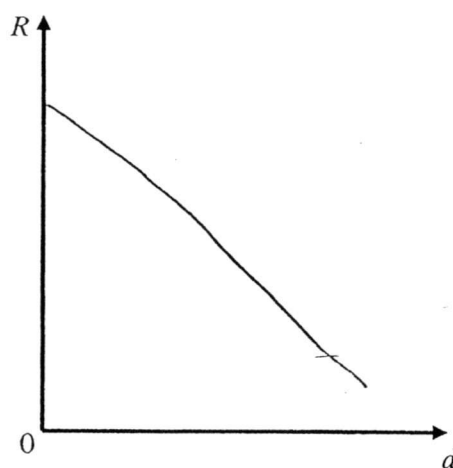
Answer (c) 405 ✓ [1]

[Turn over]

- 17 The resistance of a wire, R ohms, is inversely proportional to the square of its diameter, d μm .

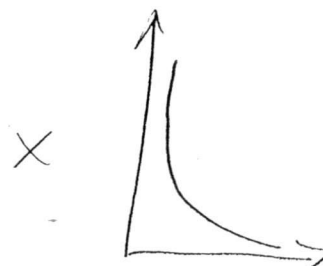
(a) Sketch a resistance-diameter graph for the wire.

Answer (a)



$$R = \frac{1}{d^2}$$

$\frac{1}{4}$	$\frac{1}{9}$	$\frac{1}{16}$	$\frac{1}{25}$	$\frac{1}{36}$
2	3	4	5	6



[1]

For a fixed length of wire, the resistance is 25.6 ohms when the diameter is 50 μm .

(b) Find the equation for R in terms of d .

$$R = \frac{k}{d^2}$$

$$25.6 = \frac{k}{2500}$$

$$k = 64000$$

$$R = \frac{64000}{d^2}$$

Answer (b) $R = \frac{64000}{d^2}$ [2]

(c) Another wire of the same length has resistance 120 ohms.

Calculate its diameter.

$$120 = \frac{64000}{d^2}$$

$$d = 23.09401077$$

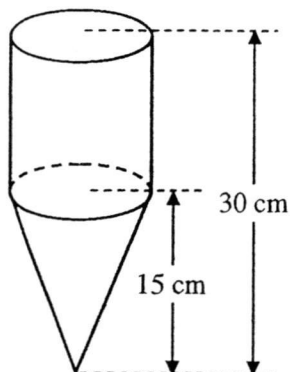
$$\approx 23.1$$

Answer (c) 23.1 μm [1]

- 18 A composite container made from a cylinder and a cone has a vertical height of 30 cm.

Water is poured into the empty container at a constant rate.

It takes 60 seconds to fill up the entire container.



$$V_{\text{cone}} = \frac{1}{3} V_{\text{cylinder}}$$

$$\text{Total } V = 4 \text{ units}$$

$$V_{\text{cone}} = 1 \text{ unit}$$

$$\frac{1}{4} \text{ of time} = 15 \text{ s}$$

- (a) Find the time taken to fill up the cone.

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

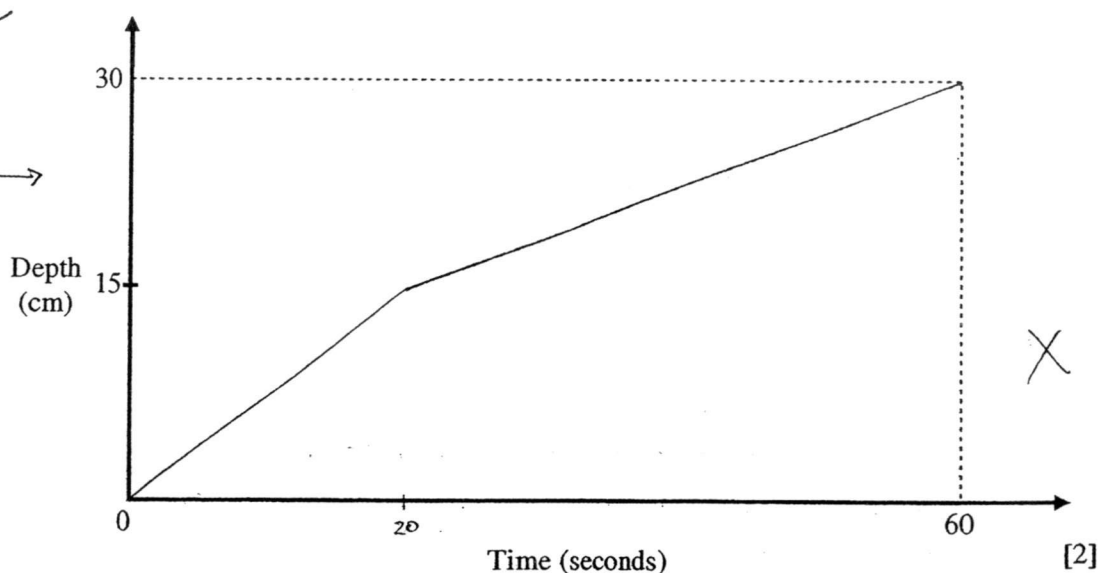
Since the volume of the cone is $\frac{1}{3}$ of the cylinder, the time taken to fill up the cone will be $\frac{1}{3}$ of the total time.

$$\frac{1}{3} \times 60 \text{ s} = 20 \text{ s}$$

Answer (a) 20×15 seconds [2]

- (b) Sketch the graph of how the depth of water in the container varies during the 60 seconds.

Answer (b)

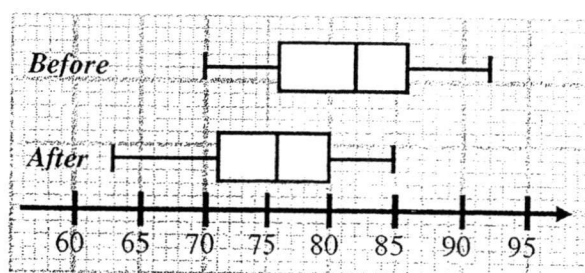


[Turn over]

14

0

- 19 The diagram shows the box-and-whisker plots for the distributions of the speeds, in km/h, of 100 vehicles before and after a speed camera was placed on an expressway.



- (a) Find the interquartile range of the distribution before the camera was placed.

Answer (a) 10 ✓ km/h [1]

- (b) Find the interquartile range of the distribution after the camera was placed.

Answer (b) 9 ✓ km/h [1]

- (c) After the camera was placed, 25% of the motorists were issued with traffic summons for exceeding the speed limit of the expressway.

What is the speed limit of the expressway?

Answer (c) 80 ✓ km/h [1]

- (d) Has the speed camera been effective in regulating the speed limit of the expressway? Explain your answer by comparing the distributions of the speeds before and after the camera was placed.

Answer (d) Yes, the speed camera has been effective. The upper limit of the motorists' speeds after the camera was placed is 85 km/h. Before the camera was placed, the upper limit was 92 km/h. ✗

Yes, it has been effective. The median and the interquartile range are lower after the camera was placed. [1]

- 20 Abraham and Lincoln sent out some letters, postcards and greeting cards.

The number of letters, postcards and greeting cards is shown in the table below.

	Letters	Postcards	Greeting cards
Abraham	4	9	2
Lincoln	7	3	3

The postage for each letter, postcard and greeting card is \$0.30, \$0.40 and \$0.50 respectively.

- (a) Write out a 2×3 matrix P and a column matrix Q to represent the above information.

Answer (a) $P = \begin{pmatrix} 4 & 9 & 2 \\ 7 & 3 & 3 \end{pmatrix}$ ✓

$Q = \begin{pmatrix} 5.2 \\ 3.9 \end{pmatrix} \begin{pmatrix} 0.30 \\ 0.40 \\ 0.50 \end{pmatrix} \quad [2]$ ✓

- (b) Evaluate the matrix $S = PQ$.

$$\begin{aligned} S &= PQ \\ &= \begin{pmatrix} 4 & 9 & 2 \\ 7 & 3 & 3 \end{pmatrix} \begin{pmatrix} 0.30 \\ 0.40 \\ 0.50 \end{pmatrix} \\ &= \begin{pmatrix} 5.8 \\ 4.8 \end{pmatrix} \end{aligned}$$

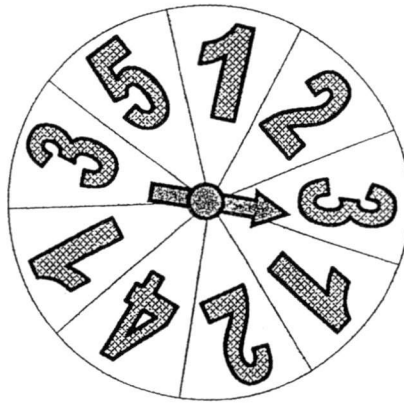
Answer (b) $S = \begin{pmatrix} 5.2 \\ 3.9 \end{pmatrix} \begin{pmatrix} 5.8 \\ 4.8 \end{pmatrix} \quad [2]$ ✓

- (c) State what the elements of S represent.

Answer (c) The elements of S represents the amount of money Abraham and Lincoln spent on postage respectively. X They represent the total postage paid by Abraham and Lincoln respectively. [1]

[Turn over

- 21 The diagram shows a spinner with nine numbered sectors of identical sizes.



Each time the pointer is spun, it is equally likely to stop on one of the sectors.

- (a) The pointer is spun once.

Find the probability that it stops on an odd number.

Answer (a) $\frac{2}{3}$ ✓ [1]

- (b) Aysha spins the pointer twice.

Find the probability that the pointer lands on a prime number **at least once**.

$$1 - \left(\frac{1}{9} \times \frac{1}{9} \right) = \frac{80}{81}$$

$$1 - \left(\frac{4}{9} \times \frac{4}{9} \right) = \frac{65}{81}$$

Answer (b) $\frac{80}{81} \times \frac{65}{81}$ [2]

- (c) Natasha spins the pointer twice.

Her score is found from the difference of the numbers from her two spins.

Find the probability that her score is 0.

$$\left(\frac{3}{9} \times \frac{3}{9} \right) + \left(\frac{2}{9} \times \frac{2}{9} \right) + \left(\frac{1}{9} \times \frac{1}{9} \right) + \left(\frac{1}{9} \times \frac{1}{9} \right) + \left(\frac{1}{9} \times \frac{1}{9} \right) = \frac{19}{81}$$

Answer (c) $\frac{19}{81}$ [2]

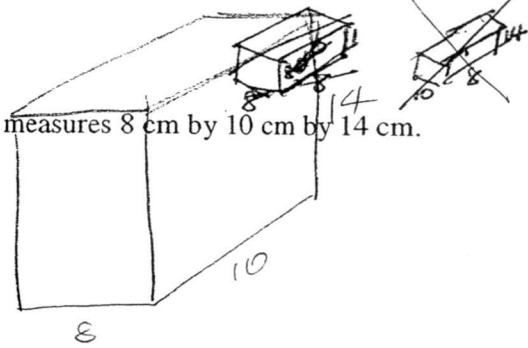
22 Benjamin has 165 identical cubes of sides 2 cm.

- (a) He uses some of the cubes to make a cuboid which measures 8 cm by 10 cm by 14 cm.
Calculate the total surface area of the cuboid.

$$(8 \times 14 \times 4) + (10 \times 14 \times 2) = 728$$

$$10 \times 14 \times 2 + 8 \times 14 \times 2 + 8 \times 10 \times 2$$

$$= 664 \text{ cm}^2 //$$



Answer (a) $\frac{664}{728 \times}$ cm^2 [2]

- (b) Benjamin makes the largest cube possible using some of the 165 cubes.
He then makes the largest cube possible from the unused cubes.

How many cubes will he have left over after making the second cube?

$$165 \times 2 \text{ cm} = 330 \text{ cm}$$

$$\sqrt{330} = 18 \dots \dots$$

$$18 \div 2 = 9$$



$$330 - 324 = 6$$

$$6 \div 2 = 3$$

$$3 \times 3 = 9$$

$$\sqrt[3]{165} = 5 \dots \dots$$

$$165 - 125 = 40$$

$$\sqrt[3]{40} = 3 \dots \dots$$

$$40 - 27 = 13 //$$

Answer (b) 9×13 [2]

- (c) Benjamin uses all 165 cubes to make a cuboid.

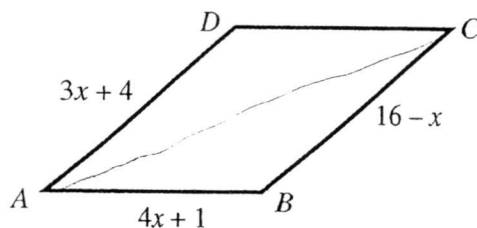
Find the dimensions of the cuboid.

$$\begin{array}{r|l} 3 & 165 \\ \hline 5 & 55 \\ 11 & 11 \\ & 1 \end{array}$$

Answer (c) $\frac{16}{2 \times}$ cm by $\frac{10}{2 \times}$ cm by $\frac{22}{330 \times}$ cm [2]

[Turn over]

- 23 Expressions for the lengths of three sides of a quadrilateral are shown on the diagram below.
All lengths are in centimetres.



- (a) The perimeter of this quadrilateral is given by the expression $(11x + 19)$ cm.

Find an expression, in terms of x , for the length of DC .

Give your expression in its simplest form.

$$11x + 19 = 3x + 4 + 16 - x + 4x + 1 + DC$$

$$11x + 19 = 6x + 21 + DC$$

$$5x - 2 = DC$$

Answer (a) $5x - 2$ ✓ cm [2]

- (b) Given that $ABCD$ is a parallelogram and that $AB = AD$, calculate the perimeter of $ABCD$.

$$AB = AD$$

$$4x + 1 = 3x + 4$$

$$x = 3$$

$$4(3) + 1 = 13$$

$$~~3(3) + 4 = 13~~$$

$$13 \times 4 = 52$$

Answer (b) 52 ✓ cm [2]

- (c) Calculate the area of $ABCD$ if $AC = (10x - 6)$ cm.

$$AC = (10x - 6) \text{ cm}$$

$$2[10(3) - 6] \text{ cm}$$

$$= 24 \text{ cm}$$

$$24 \div 2 = 12$$

$$(\frac{1}{2} \times 12 \times 24) \times 2 = 288$$

$$AC = 10(3) - 6$$

$$= 24$$

$$AB = 4(3) + 1$$

$$= 13$$

$$24^2 = 13^2 + 13^2 - 2(13)(13)\cos \angle ABC$$

$$576 = 338 - 338\cos \angle ABC$$

$$\angle ABC = 134.7602701$$

$$\frac{1}{2}(13)(13)\sin 134.7602701 = 60$$

$$60 \times 2 = 120$$

Answer (c) 288×120 cm^2 [5]

END OF PAPER