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TANJONG KATONG SECONDARY SCHOOL
End of Year Examination 2017
Secondary 2

CANDIDATE
NAME

CLASS

INDEX NUMBER

MATHEMATICS

4048/01

Paper 1

Tuesday 10 October 2017

1 hour 30 minutes

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.

Write in dark blue or black pen.

You may use an HB 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.

Omission of essential working will result in loss of marks.

You are expected to use a scientific calculator to evaluate explicit numerical expressions.

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 of the marks for this paper is 60.

For Examiner's Use

*Mathematical Formulae**Mensuration*

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

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

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

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

Answer all of the questions.

For
Examiner's
Use

For
Examiner's
Use

- 1 (a) Calculate $\frac{540.5 \times 2^3}{\sqrt[3]{10.52}}$, showing first 8 digits on your calculator display.
 (b) Give your answer correct to 2 significant figures.

Answer (a) [1]

(b) [1]

- 2 Consider the following numbers.

$$1.\overline{41}, \quad \sqrt{2}, \quad \frac{\sqrt[3]{8}}{5}, \quad \pi$$

- (a) Write down the rational number(s).
 (b) Arrange the numbers in ascending order.

Answer (a) [1]

(b),,, [1]

For
Examiner's
Use

For
Examiner's
Use

- 3 On a certain day in a town, the temperature was 14.6°C at noon.
At 0200 on the next day, the temperature was -3.4°C .
(a) Calculate the difference between the temperatures.

Answer (a) $^{\circ}\text{C}$ [1]

- (b) Find the average rate of change in temperature per hour during this period of time.

Answer (b) $^{\circ}\text{C/h}$ [2]

- 4 The pressure P , Pa, of an object is inversely proportional to the volume of a cube.
The pressure is 1000 Pa when the length of the cube is l cm.
Find the new pressure when the length of the cube increases by 400%.

Answer Pa [3]

For
Examiner's
Use

5 Written as the product of its prime factors,

$$90 = 2 \times 3^2 \times 5,$$

$$300 = 2^2 \times 3 \times 5^2.$$

For
Examiner's
Use(a) Find the smallest positive integer of p such that $90p$ is a cube number.Answer (a) $p = \dots\dots\dots$ [1]

(b) The highest common factor and lowest common multiple of 90, 300 and a third number are 6 and 6300 respectively. Find the third number.

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

For
Examiner's
Use

- 6 (a) Solve the inequalities $3x < 5 + 4x \leq \frac{27}{2}$.

For
Examiner's
Use

Answer (a) [3]

- (b) Show your solution on the number line below.

Answer (b) [1]



For
Examiner's
Use

For
Examiner's
Use

7 (a) Factorise fully $6ab - 2a - 3b^2 + b$.

Answer (a)[2]

(b) If $(x - y)^2 = 40$ and $\frac{1}{2}xy = 5$, find the value of $x^2 + y^2$.

Answer (b)[2]

8 The cost of electricity is \$ x . When the cost of electricity is reduced by 10%, Mrs Tan increased her usage of electricity in her home by 10%. Mrs Tan claimed there was no change in her expenditure on electricity. Explain if Mrs Tan is correct or wrong.

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

For
Examiner's
Use

For
Examiner's
Use

- 9 12 students from Class 3A and Class 3B had their 2.4 km run.
The timings, in minutes, are shown in the stem-and-leaf diagram.

Class 3A		Class 3B
9 8	0	7 8 9
3 3 2 0 1	1	1 1 1 2 2
4 3 3 2 2	2	0 2 4
	3	0

Key (Class 3A)
3|2 means 23 minutes

Key (Class 3B)
2|4 means 24 minutes

- (a) Write down the modal timing of students from Class 3B.

Answer (a)minutes [1]

- (b) Write down the median timing of students from Class 3B.

Answer (b)minutes [1]

- (c) Write down the median timing of students from Class 3A.

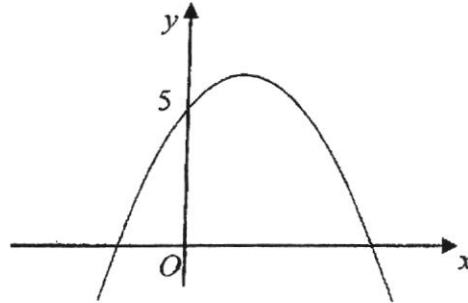
Answer (c)minutes [1]

- (d) Explain briefly whether students from Class 3A or Class 3B performed better.

Answer (d) Classperformed better because
.....[1]

For
Examiner's
Use

10 (a) The diagram shows the graph of $y = -x^2 + 4x + 5$.



For
Examiner's
Use

(i) Find the x -intercepts.

Answer (a)(i) $x = \dots\dots\dots$

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

(ii) Write down the equation of a straight line that needs to be inserted onto the same diagram in order to solve the equation $-x^2 + 6x + 3 = x$.

Answer (a)(ii) $\dots\dots\dots$ [1]

(b) There are 15 girls in a group and 7 of them wear spectacles.
A girl is selected at random from the group.

(i) Find the probability that the girl selected does not wear spectacles.

(ii) When k number of boys join the group, the probability of selecting a boy from the group is $\frac{2}{7}$. Find the value of k .

Answer (b)(i) $\dots\dots\dots$ [1]

(b)(ii) $k = \dots\dots\dots$ [2]

11 (a) Construct and label quadrilateral $PQRS$ where $RS = 5.2$ cm and $SP = 10.5$ cm.

For
Examiner's
Use

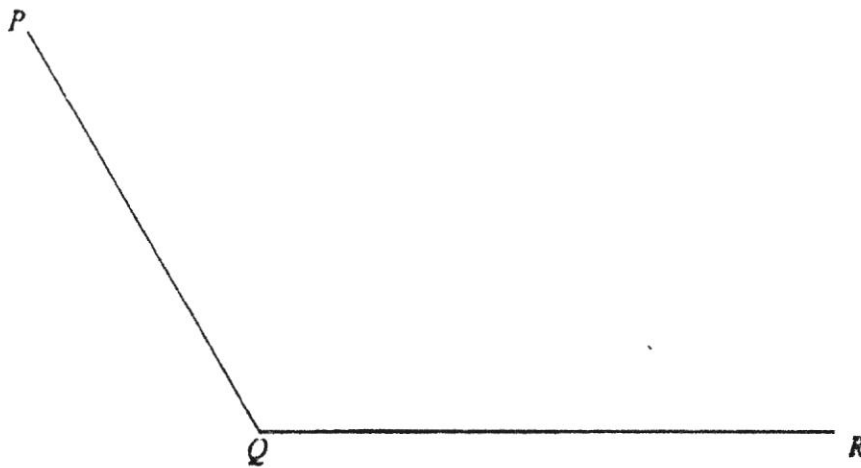
For
Examiner's
Use

[Turn over

PQ and QR have already been drawn.

[2]

Answers (a), b(i), b(ii) and (c)



(b) Construct

(i) the angle bisector of angle PQR .

[1]

(ii) the perpendicular bisector of QR .

[1]

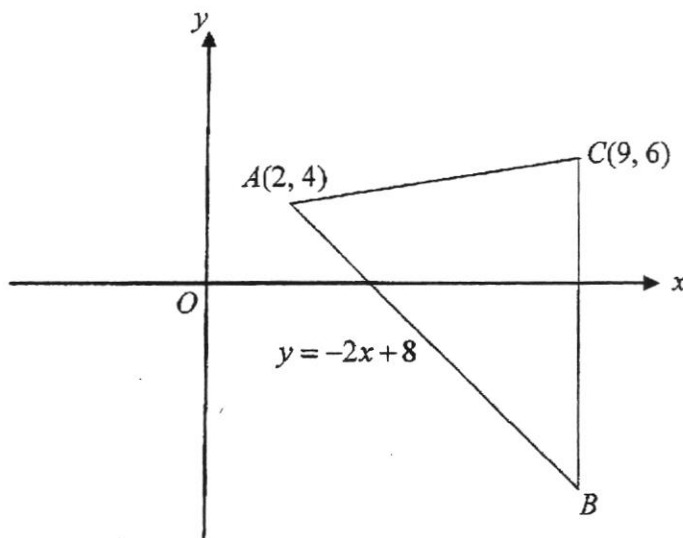
(c) Mark and label the point A on QR such that it is equidistant from Q and R .

[1]

For
Examiner's
Use

- 12 In the diagram, A is point $(2, 4)$ and C is the point $(9, 6)$.
It is given that BC is a vertical line and the equation of line AB is $y = -2x + 8$.

For
Examiner's
Use



- (a) Show that the y -coordinate of point B is -10 .

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

- (b) Hence, find the area of triangle ABC .

Answer (b)units² [2]

- (c) Explain why the line with an equation $2y + 4x = 10$ will never intersect line AB .

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

For
Examiner's
Use

13 (a) Simplify $4(a^3b)^0$.

For
Examiner's
Use

Answer (a) [1]

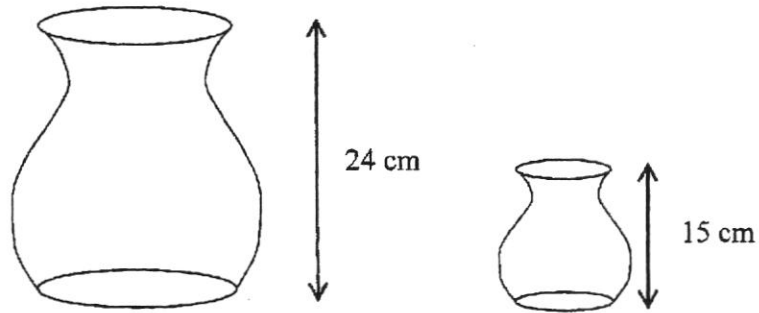
(b) If $3^m = 5$, find the value of 81^m .

Answer (b) [2]

13

For
Examiner's
Use

14

For
Examiner's
Use

Two jars, with circular bases, shown in the diagram are geometrically similar. Their heights are 24 cm and 15 cm as shown.

- (a) Find the ratio of the circumference of the bases of bigger jar to that of smaller jar.

Answer (a) : [1]

- (b) Given that the smaller jar can hold 500 cm^3 of water when filled to the brim, calculate the volume of water the bigger jar can hold.

Answer (b) cm^3 [3]

For
Examiner's
Use

For
Examiner's
Use

- 15 (a) $\mathcal{U} = \{x : x \text{ is an integer, } 1 \leq 2x \leq 72\}$,
 $A = \{x : x \text{ is a multiple of } 4\}$,
 $B = \{x : x \text{ is a perfect square}\}$.

(i) Write down $A \cap B$.

Answer (i) [1]

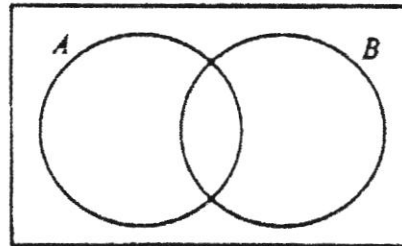
(ii) Set C has 4 elements. C is a proper subset of B .
Write down a possible set for C .

Answer (ii) [1]

(iii) On the Venn Diagram, shade the region which represents $A' \cap B$.

Answer (a)(iii)

⌘



[1]

- (b) A survey was conducted among 36 students. Results from the survey showed that 16 students enjoy sports and 27 students enjoy reading. n of them enjoy neither sports nor reading. By drawing a Venn diagram or otherwise, find the
- (i) largest possible value of n ,
 - (ii) smallest possible value of n .

Answer (b)(i) [1]

(b)(ii) [1]

For
Examiner's
UseFor
Examiner's
Use

16 (a) Given that $\begin{pmatrix} 5 & 2q \\ 4 & 2p \end{pmatrix} + \begin{pmatrix} 3 & -3p \\ 7 & 4q \end{pmatrix} = \begin{pmatrix} 8 & 9 \\ 11 & 10 \end{pmatrix}$, find the values of p and q .

Answer (a) $p = \dots\dots\dots$

$q = \dots\dots\dots$ [4]

(b) A shopkeeper sells donuts at 90 cents each and cupcakes at \$2.40 each. The selling price of the donuts and cupcakes can be represented by matrix

$S = \begin{pmatrix} 0.90 \\ 2.40 \end{pmatrix}$ and the cost price of the 2 items can be represented by

matrix $C = \begin{pmatrix} 0.50 \\ 1.00 \end{pmatrix}$.

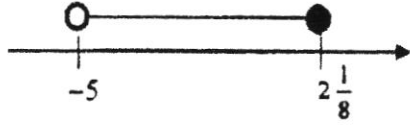
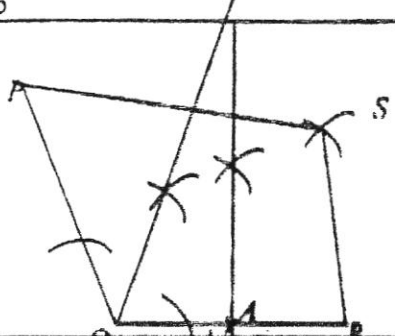
Describe in words what the elements in the matrix $S - C$ represents.

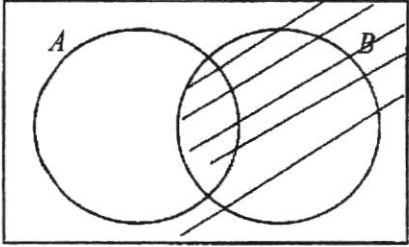
Answer (b) $\dots\dots\dots$

$\dots\dots\dots$
 $\dots\dots\dots$ [1]

End of Paper

Answers:

1a	1973.3938
1b	2000
2a	$1.41, \frac{\sqrt[3]{8}}{5}$
2b	$\frac{\sqrt[3]{8}}{5}, 1.41, \sqrt{2}, \pi$
3a	18
3b	$-1\frac{2}{7}$ or -1.29
4	8
5a	$p = 2 \times 3^2 \times 5 = 300$
5b	Third number = 42 Accept 84, 126, 252
6a	$-5 < x \leq 2\frac{1}{8}$
6b	
7a	$(3b-1)(2a-b)$
7b	$x^2 - 2(10) + y^2 = 40$ $x^2 + y^2 = 60$
8	$1.1 \times 0.9x = 0.99x$ Her new expenditure on electricity is 99% of her original expenditure. Wrong
9a	11 minutes
9b	11.5 minutes
9c	13 minutes
9d	3B they have a lower median timing
10ai	$x = -1$ or $x = 5$
10aai	$y = -x + 2$
10bi	$\frac{8}{15}$
10bii	$k = 6$
11	

12a	$y = -2(9) + 8$
12b	56 units ²
12c	$y = -2x + 5$ Since both lines have the same gradient, and different y-intercept , they will be parallel lines and will not intersect.
13a	4
13b	$81^n = 3^{4n}$ $= 5^4$ $= 625$
14a	8 : 5
14b	Vol ratio 512:125 Vol = 500 x (their ratio) $= 2048 \text{ cm}^3$
15ai	{ 4, 16, 36 }
15aii	C = { 4, 9, 16, 25 } or other combination that has 4, 9, 16, 25, 36
15aiii	
15bi	9
15bii	0
16a	$P = -1$ $Q = 3$
16b	Elements represent profit/earnings of selling one donut and cupcake respectively.



TANJONG KATONG SECONDARY SCHOOL
End of Year Examination 2017
Secondary 2

CANDIDATE
NAME

CLASS

INDEX NUMBER

MATHEMATICS

4048/02

Paper 2

Thursday 5 October 2017

2 hours

Additional Materials: Writing Paper
Graph Paper

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
 Write in dark blue or black pen.
 You may use an HB 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.

Omission of essential working will result in loss of marks.

You are expected to use a scientific calculator to evaluate explicit numerical expressions.

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 of the marks for this paper is 80.

*Mathematical Formulae**Mensuration*

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

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

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

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

- 1 (a) Express as a single fraction in its simplest form.

(i) $\frac{(-4x)^3}{15y} \div \frac{8x}{5y^2}$ [2]

(ii) $\frac{9m^2 - 25}{9m^2 - 30m + 25}$ [3]

(iii) $\frac{5}{(2k-3)^2} + \frac{2}{3-2k}$ [3]

- (b) It is given that $\sqrt{a-3} + 2b = c$.

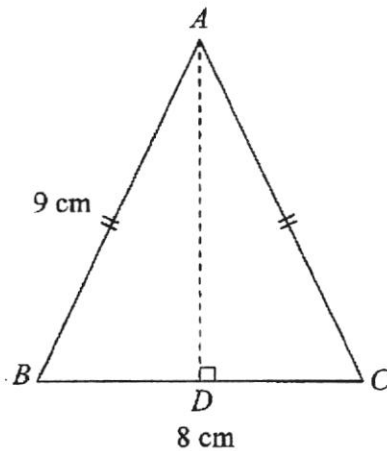
Express a in terms of b and c .

[2]

- 2 (a) A 7-sided polygon has 6 interior angles of 135° . Find the remaining interior angle.

[2]

- (b) In triangle ABC , $AB = AC = 9$ cm and $BC = 8$ cm.
 D is the foot of the perpendicular from A to BC .



- (i) Find BD .

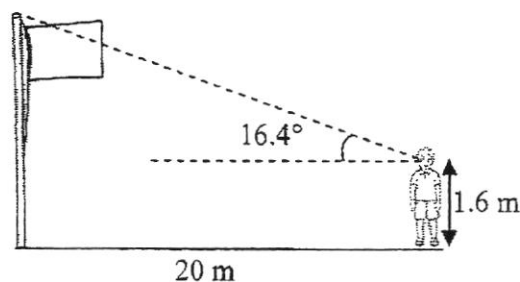
[1]

- (ii) Find angle ABC .

[2]

- (c) The eye level of a boy is 1.6 m from the horizontal ground. He stands 20 m in front of the vertical flag pole. His angle of elevation of the top of the flag pole from his eyes is 16.4° . Find the height of the flag pole.

[3]



- 3 (a) The first five terms in a sequence of numbers are given below.

1, 4, 9, 16, 25, ...

- (i) Write down the next term. [1]
- (ii) Write down an expression, in terms of n , for the n th term. [1]
- (iii) Using your answer from part (ii), write down the n th term for the following sequence. [1]

3, 6, 11, 18, 27, ...

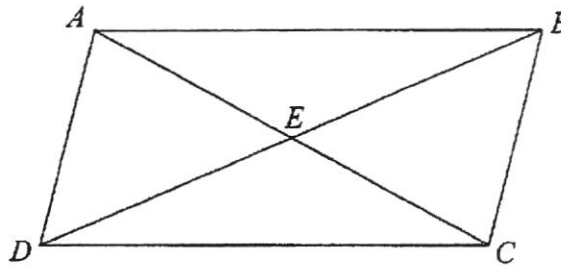
- (b) The numbers 1 to 49 are arranged in a grid as shown.
A square is placed in various positions on the grid to enclose five of the numbers.
One possible position of the square is as shown where the number at the top and bottom of this square is 2 and 16 respectively.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

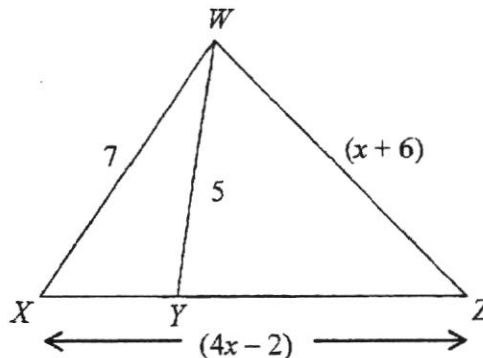
- (i) A square is placed so that the number at the top is 18.
Find the sum of the five numbers in this square. [1]
- (ii) Given that the number at the top of a square is x ,
- (a) write down an expression, in terms of x , for the number at the bottom of the square. [1]
- (b) write down and simplify an expression, in terms of x , for the sum of the five numbers. [2]
- (iii) Hence or otherwise, find the number at the top of the square given that the square is placed in a position such that the sum of the five numbers is 150. [1]
- (iv) Explain why it is not possible to place a square if the sum of the five numbers is 161. [1]

- 4 (a) (i) The scale of a map is $1 : n$.
An actual area of 72 m^2 is represented by an area of 32 cm^2 in the map. [2]
Find the value of n .
- (ii) The length of a walking path is 10 m . [2]
Calculate the length, in centimetres, of the walking path on the map.

- (b) $ABCD$ is a parallelogram and the diagonals AC and BD intersect at E .

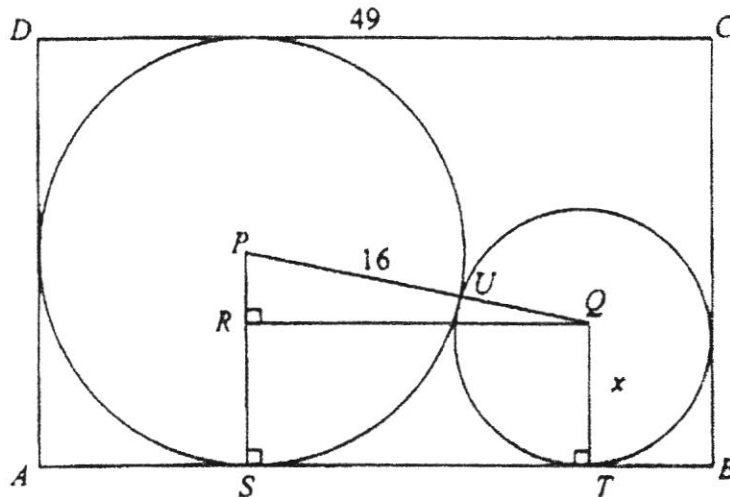


- (i) Name the triangle congruent to $\triangle BEC$. [1]
- (ii) State the total number of pair(s) of congruent triangles. [1]
- (c) In the diagram, triangle WXZ is similar to triangle YWZ .
All measurements are in centimetres.



- (i) Given that $WZ = (x + 6) \text{ cm}$ and $XZ = (4x - 2) \text{ cm}$. [3]
Find the value of x .
- (ii) Find $\frac{\text{area of } \triangle YWZ}{\text{area of } \triangle WXY}$. [2]

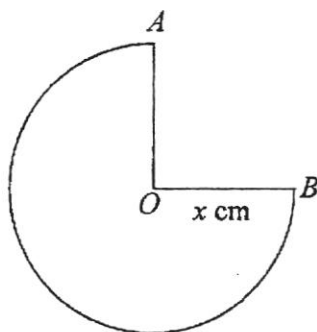
- 5 The diagram shows the cross-section of an open rectangular box $ABCD$. Two cylinders touch each other at U and fit exactly into the box. The larger cylinder touches AB at S and the sides AD and CD . The smaller cylinder touches AB at T and the side BC . P and Q are centre of the circles. R lies on PS and angle $PRQ = \text{angle } PST = \text{angle } QTS = 90^\circ$.



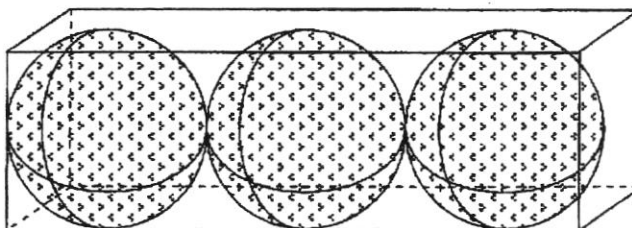
It is given that $CD = 49$ cm, $PU = 16$ cm and the radius of the smaller cylinder is x centimetres.

- (a) Show that $ST = (33 - x)$ cm. [1]
- (b) Find, in terms of x ,
- (i) PQ , [1]
- (ii) PR . [1]
- (c) Hence, form an equation in x and show that it reduces to $x^2 - 130x + 1089 = 0$. [3]
- (d) Solve the equation $x^2 - 130x + 1089 = 0$. [3]
- (e) State the special name for quadrilateral $PQTS$ and hence find its area. [3]

- 6 (a) The diagram shows a circle with centre O with one quarter of it cut off. An open cone is formed by joining the two edges OA and OB .



- (i) The surface area of the cone is $12\pi \text{ cm}^2$. Find the value of x . [2]
- (ii) Find the radius of the cone. [2]
- (b) The diagram shows 3 mouldable plastic balls each of radius 5 cm packed in a rectangular cardboard box, of negligible thickness. Each ball touches the top, bottom and sides of the box, fitting exactly into the rectangular box.



- (i) Find the minimum dimensions of the cardboard box needed. [1]
- (ii) Find the volume of the 3 balls, leaving your answer in terms of π . [2]
- (iii) The 3 balls are remoulded to form a square pyramid of base length of 12 cm. Find the height of the pyramid, leaving your answer to 1 significant figure. [3]

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

A stone was thrown from a bridge.

Its position during the flight is represented by the equation $y = -2x^2 + 3x + 20$, where y metres is the height of the stone above the water and x is the time in seconds after the stone is thrown.

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

x	0	0.5	1	2	3	4	5
y	p	21	21	18	q	0	-15

- (a) Find the values of p and q . [2]
- (b) Explain the significance of the value of p . [1]
- (c) Using a scale of 2 cm to represent 1 second, draw a horizontal x -axis for $0 \leq x \leq 5$.
Using a scale of 2 cm to represent 5 metres, draw a vertical y -axis for $-15 \leq y \leq 25$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (d) Use your graph to find the greatest height reached by the stone. [1]
- (e) Find the length of time for the stone to have a height greater than 20.5 metres. [2]
- (f) How long does it take for the stone to hit the water? [1]

- 8 Singapore has jumped on the bandwagon with a trio of privately owned bike-sharing services: Mobike, oBike, and ofo. As such, residents now do not need to go to great lengths to rent a bicycle.

Rental of bikes are done using respective smartphones applications. The details of renting a bike from each company are as follows.

	oBike	ofo	Mobike
Charges	Free first 15 minutes \$0.50 for 15 minutes block	\$1 per hour Max \$2 for whole ride	\$0.50 for 30 minutes block

James would like to cycle to Marina Barrage from East Coast Park and his cycling speed is 10 km/h. The time taken is 72 minutes.

- (a) Find the distance travelled, in kilometres. [3]
- (b) Assuming that all 3 different bikes are available at the same bike parking area, showing your working clearly, which bike is the best value for money for James? [3]
- (c) What is the range of distance that James can travel on the Mobike bike in order for it to be the cheapest among the three? [3]
- (d) State one possible reason for James to choose oBike regardless of the distance he travels. [1]

End of Paper

Qn	Solutions
1a(i)	$\frac{-8x^2 y}{3}$
(ii)	$\frac{3m+5}{3m-5}$
(iii)	$\frac{11-4k}{(2k-3)^2}$
(b)	$a = (c - 2b)^2 + 3$
2a)	90
b(i)	4 cm
(ii)	$\angle ABC = 63.6^\circ$
(c)	7.49

3a(i) 36

(ii) π^2

(iii) $\pi^2 + 2$

b(i) 125

ii(a) $x + 14$

(b) $5x + 35$

(iii) $n = 23$

(iv) 161 is not a multiple of 5.

161 - 35 = 126 is not a multiple of 5.

 n is not an integer (with working shown).

4a(i) $n = 150$

(ii) $6\frac{2}{3}$ cm

b(i) $\triangle DEA$

(ii) 4 pairs

c(i) $x = 4$

(ii) $\frac{25}{24}$

5(a) $49 - 16 - x = 33 - x$

b(i) $(16 + x)$ cm

(ii) $(16 - x)$ cm

(d) $(x - 121)(x - 9) = 0$

$x = 121$

$x = 9$

(e) Trapezium Area = 300cm^2

6a(i) $x = 4$

(ii) $r = 3$

b(i) $30\text{ cm} \times 10\text{ cm} \times 10\text{ cm}$

(ii) $500\pi\text{ cm}^3$

(iii) $h = 30\text{cm}$

7(a) $p = 20$

$q = 11$

(b) Height of the bridge/ Initial height of the stone/
Height of the stone when it was first thrown

(d) 21.25

(e) 0.15s - 0.2s and 1.2s - 1.35s

Length = $1.2 - 0.2 = 1\text{ sec}$

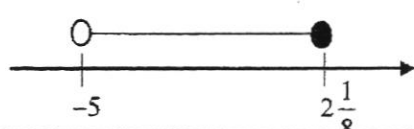
(f) 4 sec

8a 12km

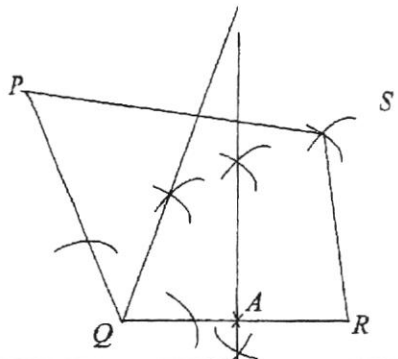
(b) Mobike is the best value for money.

(c) $10 < d \leq 15\text{km}$

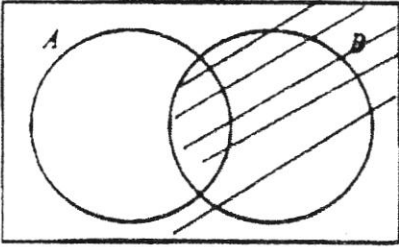
2017 Sec Two End-of-Year (Paper 1) Marking Scheme

Question no.	Answers	Marks	Remarks
1a	1 973.3938	B1	
1b	2 000	B1	
			2 marks
2a	$1.4\dot{1}, \frac{\sqrt[3]{8}}{5}$	B1	All must be seen
2b	$\frac{\sqrt[3]{8}}{5}, 1.4\dot{1}, \sqrt{2}, \pi$	B1	All must be seen
			2 marks
3a	1 8	B1	
3b	$\frac{18}{14} = -1\frac{2}{7}$ or -1.29	M1 A1	<i>their ans</i> 14 Accept both
			3 marks
4	$P = \frac{k}{l^3}$ $P_{new} = \frac{k}{(5l)^3}$ $= \frac{k}{125l^3}$ $= \frac{1000}{125}$ $= 8$	B1 B1 B1	$P = \frac{k}{l^3}$ seen 125l ³ seen or (5l ³) seen Do not accept 5l ³
			3 marks
5a	$p = 2 \times 3^2 \times 5 = 300$	B1	Reject $2 \times 3^2 \times 5$
5b	$6300 = 2^2 \times 3^2 \times 5^2 \times 7$ By observing HCF, third number contains $2 \times 3 = 6$ By observing LCM, third number must contain $2 \times 3 \times 7 = 42$ Third number = 42	B1 B1	3 rd number must be divisible by 42, cannot contain 5 Accept 84, 126, 252
			3 marks
6a	$3x < 5 + 4x$ and $5 + 4x \leq \frac{27}{2}$ $x > -5$ and $x \leq 2\frac{1}{8}$ $-5 < x \leq 2\frac{1}{8}$	B1 M1 A1	Split (if got 'or' no mark given) Simplify either expression Reject 17/8
6b		√ B1	Penalise 1 mark if 17/8 is seen in either (a) or (b)

2017 Sec Two End-of-Year (Paper 1) Marking Scheme

Question no.	Answers	Marks	Remarks
			award if factorised form seen)
10aii	$y = -x + 2$	B1	
10bi	$\frac{8}{15}$	B1	
10bii	$\frac{k}{15+k} = \frac{2}{7}$ $k = 6$	M1 A1	Form eqn (o.e.)
			6 marks
11a		B1 B1	Both arcs drawn at S correctly Correct shape & size Do not penalise if labelling not seen
11bi		B1	Construction arcs and labelling seen
11bii		B1	Construction arcs and labelling seen
11c		B1	Mark and label seen
			5 marks
12a	$y = -2(9) + 8$	B1	Substitution must be seen
12b	Area = $0.5 \times 7 \times 16$ $= 56 \text{ units}^2$	M1 A1	Any correct method
12c	$y = -2x + 5$ Since both lines have the same gradient, and different y-intercept , they will be parallel lines and will not intersect.	B1 B1	Same gradient Different y-intercept With complete sentence (w/o complete sentence, 1 mark only)
			5 marks
13a	$4(a^{-3}b)^0$ $= 4$	B1	

2017 Sec Two End-of-Year (Paper 1) Marking Scheme

Question no.	Answers	Marks	Remarks
13b	$81^m = 3^{4m}$ $= 5^4$ $= 625$	B1 B1	$(3^4)^m$ seen If 625 only that is seen, only B1 given
			3 marks
14a	8:5	B1	
14b	Vol ratio 512:125 Vol = 500 x (their ratio) $= 2048 \text{ cm}^3$	B1 M1 A1	Cube seen V
			4 marks
15ai	{4, 16, 36}	B1	
15aii	C = {4, 9, 16, 25} or other combination that has 4, 9, 16, 25, 36	B1	C must have any of the 4 elements from B
15aiii	⊆ 	B1	
15bi	9	B1	
15bii	0	B1	
			5 marks
16a	$2q - 3p = 9 - (1)$ $2p + 4q = 10 - (2)$ $p = -1$ $q = 3$	B1 M1 A1, A1	Form either equation Solve simultaneous eqn
16b	Elements represent profit/earnings of selling one donut and cupcake respectively.	B1	Need to mention those in bold
			5 marks

Qn	Solutions	Marks	Remarks
1a(i)	$\frac{(-4x)^3}{15y} \div \frac{8x}{5y^2}$ $= \frac{-64x^3}{15y} \times \frac{5y^2}{8x}$ $= \frac{-8x^2y}{3}$	B1 B1	-64x ³ seen
(ii)	$\frac{9m^2 - 25}{9m^2 - 30m + 25}$ $= \frac{(3m+5)(3m-5)}{(3m-5)^2}$ $= \frac{3m+5}{3m-5}$	B1 B1 B1	Factorising numerator and denominator each
(iii)	$\frac{5}{(2k-3)^2} + \frac{2}{3-2k}$ $= \frac{5+2(3-2k)}{(2k-3)^2}$ $= \frac{11-4k}{(2k-3)^2}$	M1 M1 A1	Combine to single fraction correctly Expansion of numerator correctly
(b)	$\sqrt{a-3} + 2b = c$ $a-3 = (c-2b)^2$ $a = (c-2b)^2 + 3$	B1 B1	Square correctly seen isw [10]
2a)	$(7-2)180 - 135 \times 6$ $= 90$	M1 A1	(7-2)180 / 900 seen Exterior angle 45°
b(i)	4 cm	B1	
(ii)	$\cos \angle ABC = \frac{4}{9}$ $\angle ABC = 63.6^\circ$	M1 A1	
(c)	$\tan 16.4 = \frac{x}{20}$ $x = 20 \tan 16.4$ $\text{Height} = 5.8863 + 1.6 = 7.486 = 7.49$	B1 B1 B1√	5.8863 (their x) + 1.6 [8]

5(a)	$49 - 16 - x = 33 - x$	B1	Working must be seen
b(i)	$(16 + x)$ cm	B1	
(ii)	$(16 - x)$ cm	B1	$\sqrt{(16+x)^2 - (33-x)^2}$
(c)	$(16 - x)^2 + (33 - x)^2 = (16 + x)^2$ $256 - 32x + x^2 + 1089 - 66x + x^2 = 256 + 32x + x^2$ $x^2 - 130x + 1089 = 0$	M1 M1 AG1	Form equation Attempt to expand Simplify to given answer
(d)	$(x - 12)(x - 9) = 0$ $x = 12$ $x = 9$	M1 A2	Attempt to factorise No working seen 0 mark
e	Trapezium $\text{Area} = \frac{1}{2}(16 + 9)(24) = 300\text{cm}^2$	B1 M1 A1	Correct formula with subs [12]
6a(i)	$\frac{3}{4}\pi x^2 = 12\pi$ $x^2 = 16$ $x = 4$	M1 A1	
(ii)	$\pi r l = 12\pi$ $4r = 12$ $r = 3$	M1 A1	
b(i)	$30\text{ cm} \times 10\text{ cm} \times 10\text{ cm}$	B1	
(ii)	$\frac{4}{3}\pi(5)^3(3) = 500\pi\text{ cm}^3$	M1 A1	Correct substitution
(iii)	$\frac{1}{3}(14 - 4)(h) = 500\pi$ $h = \frac{125\pi}{12}$ $h = 32.7$ $h = 33\text{ cm}$	M1 A1 B1✓	to 1sf [10]

7(a)	$p = 20$ $q = 11$	B1 B1	
(b)	Height of the bridge/ Initial height of the stone/ Height of the stone when it was first thrown	B1	
(c)		P1 C1 S1	Points plotted correctly Smooth curve passing all the points Correct scale
(d)	21.25	B1	Accept 21.5
(e)	0.15s - 0.2s and 1.2s - 1.35s Length = 1.2 - 0.2 = 1 sec	B1 B1√	Both accurate
(f)	4 sec	B1	[10]
8a	$10 \times 72 + 60$ $= 12km$	M1 B1 A1	Time x speed Correct conversion (+60 seen)
(b)	Charges by OBike = $0.5 \times 4 = \$2$ Charges by ofo = \$2 Charges by MoBike = $0.5 \times 3 = \$1.50$ Mobike is the best value for money.	M2 A1	Finding charges for all 3 -1m if any is missing
(c)	Time range for Mobike to be the cheapest $60 < t \leq 90 \text{ min}$ Distance = 10 km Distance = $1.5 \times 10 = 15 \text{ km}$ $10 < d \leq 15km$	M1 A1 B1	60 and 90 mins seen regardless of signs 10 and 15 km seen Correct inequality
(d)	Any valid/sensible reason	B1	[10]