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YISHUN SECONDARY SCHOOL
We Seek, We Strive, We Soar
MID-YEAR EXAMINATION

Name : _____ Reg. No : _____ Class: _____

Calculator Model: _____

Sec 3 Express

Date: 8 May 2014

ELEMENTARY MATHEMATICS (4016/1)

PAPER 1

Duration: 2 hours

MAX MARKS: 80

READ THESE INSTRUCTIONS FIRST

Write your name and index number 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.

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 the 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.

1. Given that $-5 \leq x < 3$ and $-3 \leq y \leq 8$ where x and y are integers, find the smallest possible value of $\frac{y}{x}$.

Answer: [1]

2. Given that $-\frac{1}{2}$ and 3 are the roots of a quadratic equation, form the quadratic equation.

Answer: [2]

3. Solve the quadratic equation $(x+5)(x-2) = -10$.

Answer: [2]

4. Given that $m^2 - 2m = n^2 + 2n$, find the value of $m - n$.

Answer: [2]

5. Simplify $\frac{25z^0}{2x^{-4}} \times \left(\frac{5}{x^2}\right)^{-3}$, leaving your answer in positive index form.

Answer: [3]

6. Simplify $3p^2 \div \sqrt{\left(\frac{36q^4}{25p^2}\right)}$.

Answer: [3]

7. Solve the equation $49^x \times \frac{1}{7} = 343$.

Answer: [3]

8. Given the equation of a straight line $2x + 4y = 24$, find

(a) the gradient of the line,

Answer: (a) [2]

(b) the y-intercept of the line.

Answer: (b) [1]

9. If a point $R(m, -2m)$ lies on the line $3x - y = 5$, find the coordinates of R .

Answer: R (..... ,) [3]

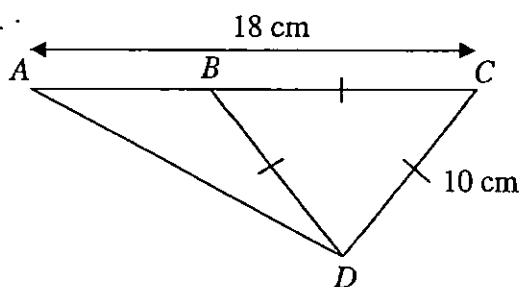
10. Given the points $P(2, 3)$, $Q(-1, -1)$ and $R(-6, -1)$,
(a) write down the coordinates of S such that $PQRS$ forms a parallelogram,

Answer: (a) S (..... ,) [1]

- (b) find the distance between points P and Q .

Answer: (b) units [2]

-
11. In the diagram below, ABC is a straight line. Given that $\triangle BDC$ is an equilateral triangle with sides 10 cm, calculate the area of triangle ABD .



Answer: cm^2 [3]

12. Solve $\frac{6x}{1-x} - \frac{2x-5}{x-1} = x$, giving your answers correct to 2 decimal places.

Answer: [4]

13. (a) Express $x^2 - 2x - 5$ in the form of $(x - a)^2 - b$.

Answer: (a) [2]

- (b) **Hence**, solve the equation $x^2 - 2x - 7 = 1$

Answer: (b) [2]

14. When written as the product of their prime factors,

$$p \text{ is } 2^4 \times 3^6,$$

$$q \text{ is } 2^3 \times 3 \times 5^2,$$

$$r \text{ is } 2 \times 3^2 \times 7.$$

Find

(a) the value of the square root of p ,

Answer: (a) [1]

(b) the Lowest Common Multiple of p , q and r , giving your answer as the product of its prime factors,

Answer: (b) [1]

(c) the greatest number that will divide p , q and r exactly,

Answer: (c) [1]

(d) the smallest positive integer k , such that qk is a perfect cube.

Answer: (d) $k =$ [1]

15. The transfer rate of a file from a computer to a storage device is 20Mbyte/s (megabyte per second).

- (a) Express this transfer rate in byte/s.
Give your answer in standard form.

Answer: (a) byte/s [1]

- (b) How long does it take to transfer a 55kB (kilobyte) file.
Express this answer in *ms* (milliseconds).

Answer: (b) ms [3]

16. The following table shows the results of a survey on the average number of hours spent by students on their phone on a weekday.

Time (x hours)	Frequency
$0 < x \leq 2$	2
$2 < x \leq 4$	7
$4 < x \leq 6$	5
$6 < x \leq 8$	15
$8 < x \leq 10$	13

The results are tabulated into a cumulative frequency table as shown.

Time (x hours)	Frequency
$x \leq 0$	a
$x \leq 2$	2
$x \leq 4$	9
$x \leq 6$	14
$x \leq 8$	b
$x \leq 10$	42

- (a) Find the values of a and b .

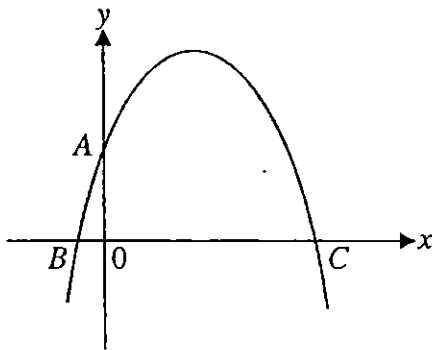
Answer: (a) $a = \dots\dots\dots$ [1]

$b = \dots\dots\dots$ [1]

- (b) Calculate the percentage of students who spent at most 4 hours using their phone.

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

17. The diagram below shows the graph of $y = -x^2 + 3x + 4$. The graph cuts the y -axis at point A and cuts the x -axis at points B and C . Find the coordinates of points A , B and C .



Answer: A (..... ,)

B (..... ,)

C (..... ,) [4]

18. A map is drawn to a scale of 2 cm : 1 km.

(a) Express the scale of the map in the form of $1 : n$.

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

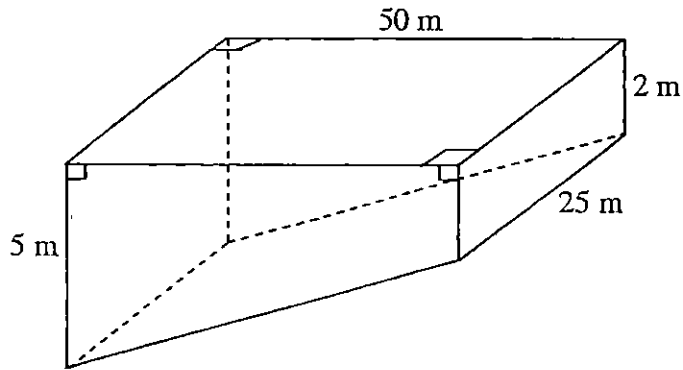
(b) The length of a bridge is 1.2 km. Calculate the length of the bridge on the map in centimetres.

Answer: (b) cm [1]

(c) The diameter of a pond measures 4 cm on the map. Find the actual area of the pond in km^2 .

Answer: (c) km^2 [3]

19. A swimming pool measures 25 m wide by 50 m long, is 2 m deep at the shallow end and 5 m deep at the other end.



- (a) Find the capacity of the pool in cubic meters.

Answer: (a) m^3 [2]

- (b) The bottom of the pool has an area of 1252.2 m^2 and is to be tiled with 0.2 m by 0.2 m tiles.

Find the minimum number of tiles required to tile the bottom of the pool.

Answer: (b) [3]

20. It is given that y is directly proportional to $(x-1)^2$ and x is a positive number.
The table below shows some corresponding values of x and y .

x	1.5	2	b
y	a	3	48

Find

- (a) the equation connecting x and y .

Answer: (a) [2]

- (b) the value of a .

Answer: (b) [1]

- (c) the value of b .

Answer: (c) [2]

21. The data below shows the marks obtained by 14 students in a Science test.

45, 60, 58, 71, 92, 83, 74, 52, 66, 62, 76, 55, 50, 79

Find

(a) the mean marks,

Answer: (a) [2]

(b) the median marks,

Answer: (b) [2]

(c) the interquartile range.

Answer: (c) [2]

22. (a) Solve the linear inequality $\frac{x+5}{6} < \frac{4x-1}{3} \leq \frac{2x+7}{4}$.

Answer: (a) [5]

- (b) **Hence**, illustrate the solution on a number line and find the smallest integer value of x satisfying the above inequality.

Answer: (b) [2]

- End of Paper -

Answer Key

1) -8	12) $x = 0.65$ or -7.65
2) $2x^2 - 5x - 3 = 0$	13) a) $(x-1)^2 - 6$ b) $x = 4$ or -2
3) $x = 0$ or -3	14) a) 108 b) $2^4 \times 3^6 \times 5^2 \times 7$ c) 6 d) $k = 45$
4) 2	15) a) 2×10^7 byte/s b) 2.75 ms
5) $\frac{x^{10}}{10}$	16) a) $a = 0$, $b = 29$ b) 21.4 %
6) $\frac{5p^3}{2q^2}$	17) A(0,4), B(-1,0), C(4,0)
7) $x = 2$	18) a) 1:50 000 b) 2.4 cm c) 3.14 km^2
8) a) $-\frac{1}{2}$ b) 6	19) a) 4375 m^3 b) 31375
9) R(1,-2)	20) a) $y = 3(x-1)^2$ b) $a = \frac{3}{4}$ c) $b = 5$
10) a) S(7,3) or S(-3,3) b) 5 units	21) a) 65.9 b) 64 c) 21
11) 34.6 cm^2	22) a) $1 \parallel x \leq 2.5$ b) $x = 2$



YISHUN SECONDARY SCHOOL

We Seek, We Strive, We Soar

MID-YEAR EXAMINATION

Name : _____ Reg. No : _____ Class: _____

Calculator Model: _____

SEC 3 EXPRESS

Date: 14 MAY 2014

ELEMENTARY MATHEMATICS (4016/2)

PAPER 2

Duration: 2 Hours

MAX MARKS: 80

READ THESE INSTRUCTIONS FIRST

Write your name and index number 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 fluid.

Answer **all** questions.

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Omission of essential working will result in loss of marks.

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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**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

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

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

- 1 (a) (i) Factorise $4x^2 - 16$ completely. [1]

(ii) Hence, express $\frac{4}{x-2} - \frac{8x}{4x^2-16}$ as a fraction in its simplest form. [3]

(b) Given that $a = \sqrt{\frac{2b-6}{5b-c^2}}$,

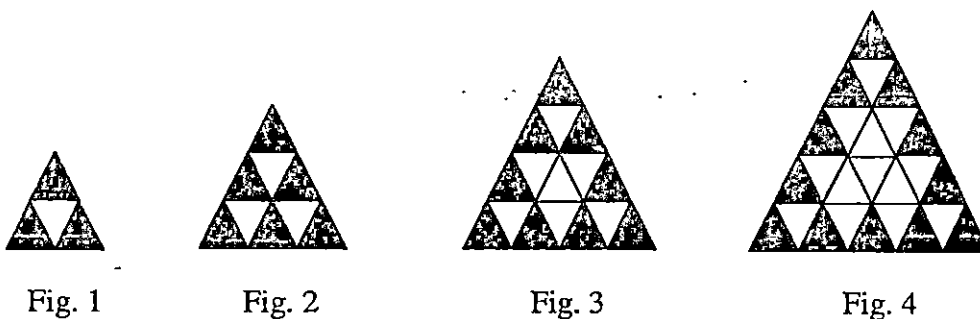
- (i) express b in terms of a and c , [3]

- (ii) find the values of c when $a = \frac{1}{2}$ and $b = 5$. [3]

- 2 A series of diagrams consisting of black and white triangles is shown below.

The black triangles line the outer perimeter of each figure.

All the other small triangles are white.



The table below shows the number of small triangles.

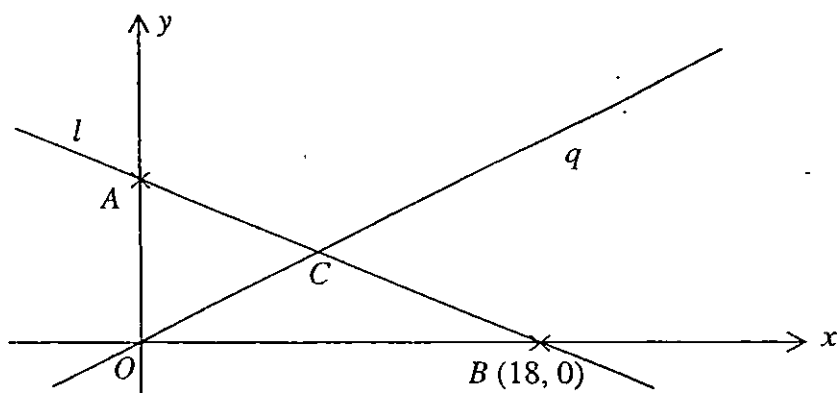
Figure	1	2	3	4	5	...	n
No. of black triangles	3	6	9	12	c	...	x
No. of white triangles	1	3	7	13	d	...	y
Total number of triangles	4	9	16	25	e	...	z

- (a) (i) State the value of c . [1]
- (ii) Write down an expression, in terms of n , for x . [1]
- (b) (i) State the value of e . [1]
- (ii) Write down an expression, in terms of n , for z . [1]
- (c) Write down the relationship between x , y and z in the form of an equation. [1]
- (d) How many white triangles are there in figure 73? [1]
- (e) Is it possible for any figure to have a total number of 1849 triangles?
Explain your answer. [1]

- 3 The line l intersects the y -axis and the x -axis at points A and B respectively.

The coordinates of B are $(18,0)$ and the gradient of line l is $-\frac{1}{3}$.

(The diagram is not drawn to scale)



- (a) Show that the coordinates of A are $(0, 6)$. [2]
- (b) Find the length of AB . [2]
- (c) Line q , with equation $3y = 5x$, intersects line l at point C .
Find the coordinates of C . [3]
- (d) Find the area of the triangle AOC . [2]
-

- 4 (a) A Mathematics test consists of 30 questions.

4 marks are awarded for a correct answer while 1 mark is deducted for a wrong answer.

No marks will be awarded or deducted for questions that are not attempted.

The passing mark for this test is 44.

If a student skipped 3 questions, by **forming an inequality**, find the minimum number of correct answers he must obtain so as to pass the test. [3]

- (b) The table below shows the population of three countries in 2012.

Singapore	5.312×10^6
China	1.351×10^9
Philippines	9.671×10^7

- (i) The population of Philippines can be expressed as k billion.

Find the value of k . [1]

- (ii) Calculate the difference in the population of China and Singapore.

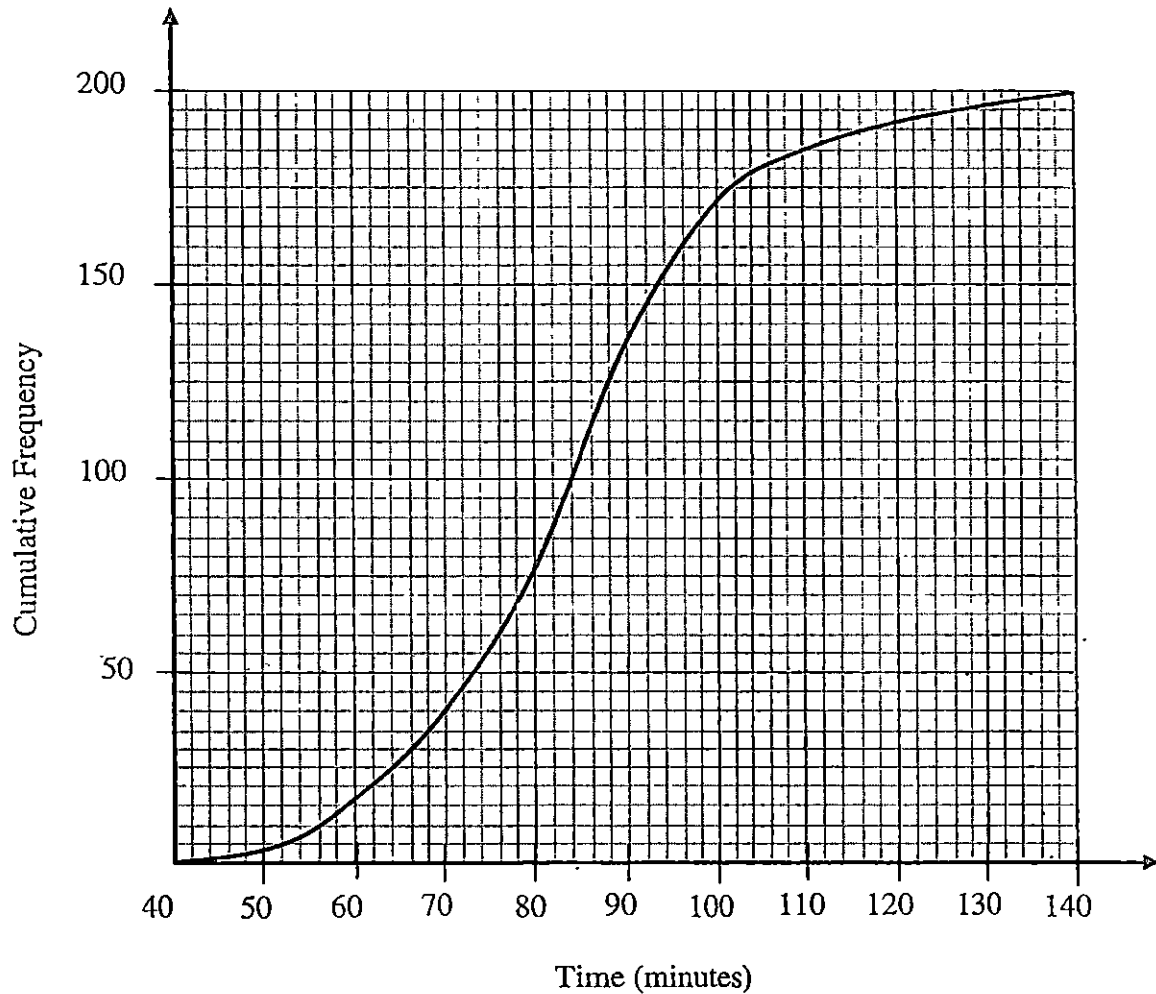
Give your answer in standard form. [2]

- (iii) Find the ratio of the population of Philippines to the population of China, expressing your answer in the form $1 : n$, where n is an integer. [2]

- (iv) Given that 43.9% of the Singapore population is males, find the number of males in Singapore.

Give your answer in standard form. [2]

- 5 200 students from Chong Pang Secondary School took part in an Amazing Race competition. The diagram below shows the cumulative frequency curve of the time taken by the students to complete the race.



- (a) Use your graph to estimate
- (i) the median time taken to complete the competition, [1]
 - (ii) the 60th percentile, [1]
 - (iii) the inter-quartile range, [2]
 - (iv) the value of T if 20% of the students took more than T minutes to complete the competition. [2]
- (b) Students who complete the competition in 70 minutes or less, will be awarded a distinction.
- Calculate the percentage of students who qualified for a distinction. [2]

- (c) 200 students from Khatib Secondary School also participated in the same competition and the results of the time taken were recorded as follows

25th percentile: 85 min

50th percentile: 90 min

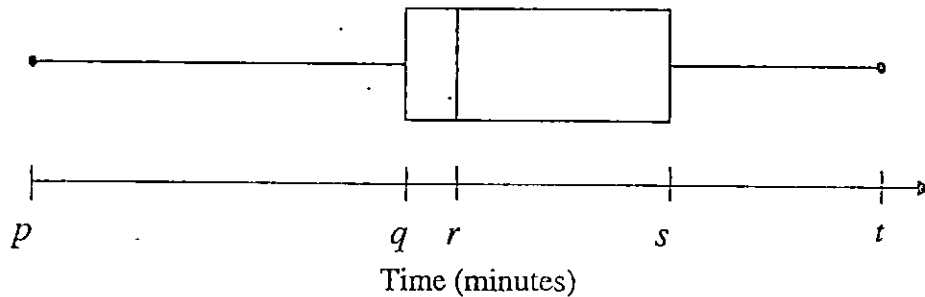
65th percentile: 100 min

Interquartile range: 25min

Fastest time: 50 min

Range: 80 min

The time taken by Khatib Secondary School students were also represented in a box-and-whisker diagram as shown below.



- (i) Using the given information, write down the values of p , q , r , s and t . [2]
- (ii) The students from Khatib Secondary School claimed that they were generally faster in completing the competition than Chong Pang Secondary School. Do you agree? Give a reason for your answer. [1]
-

6 A bus commutes passengers to and from Singapore and Kuala Lumpur.

- (a) On a certain trip, the bus leaves Singapore at 2000 and arrives at Kuala Lumpur at 0420 the next morning.

Find the time taken, in hours and minutes, for the journey. [1]

- (b) The fare of an adult ticket from Kuala Lumpur to Singapore is RM23.50 and the child's fare is RM15.90.

Mr Ku boarded this bus with his wife and three children.

Given that the exchange rate is S\$100 = RM 259, calculate the total amount in S\$ that Mr Ku has to pay for the family.

Give your answer correct to 2 decimal places. [2]

- (c) The distance between Kuala Lumpur and Singapore is 650 km.

- (i) If the bus travels from Singapore to Kuala Lumpur at an average speed of x km/h, write down an expression for the time taken, in hours, for the journey. [1]

- (ii) On the return trip from Kuala Lumpur, the bus increases its speed by 5 km/h. Write down an expression for the time taken, in hours, for the return journey.

[1]

- (iii) If the difference in time between the two journeys is 2 hours 45 minutes, form an equation in x and show that it can be reduced to $11x^2 + 55x - 13000 = 0$. [3]

- (iv) Solve the equation $11x^2 + 55x - 13000 = 0$, giving your answers correct to 2 decimal places. [3]

- (v) Hence, find the time taken, in hours and minutes, for the return journey. [2]
-

- 7 Fig 7.1 (not drawn to scale) shows 4 identical spherical iron balls packed into a transparent box.

Fig 7.2 shows the top view of the box.

Each ball is in contact with the interior surfaces of the box and the balls beside it.

It is given that the radius of each ball is 3 cm.

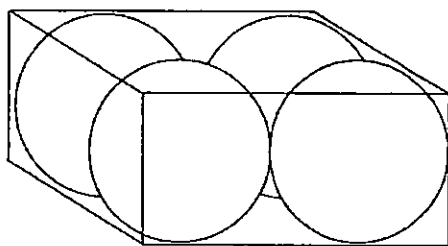


Fig 7.1

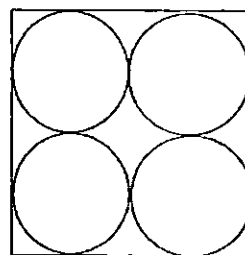


Fig 7.2
Top View

- (a) Calculate
- the total volume of the four iron balls, in terms of π , [1]
 - the volume of the box, [2]
 - the percentage of the space in the box that is not occupied by the balls. [2]
- (b) The 4 iron balls are melted and moulded into a **solid** cone as shown in Fig 7.3.
The cone has a height of 12 cm and its base radius is x cm.

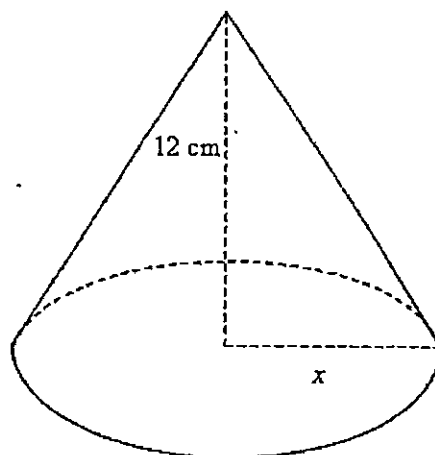


Fig 7.3

- Using your answer from (a)(i), show that the radius, x , is 6 cm. [2]
 - Calculate the total surface area of the cone. [3]
-

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

The following table gives the corresponding values of x and y which are connected by the equation $y = 19 - 4x - 3x^2$.

x	-4	-3	-2	-1	0	1	2	3	4
y	-13	4	15	p	19	12	-1	q	-45

- (a) Calculate the value of p and of q . [2]
- (b) Using a scale of 2 cm to represent 1 unit on the x -axis for $-4 \leq x \leq 4$ and 2 cm to represent 10 units on the y -axis for $-45 \leq y \leq 25$, draw the graph of $y = 19 - 4x - 3x^2$. [3]
- (c) From the graph, find the maximum value of $y = 19 - 4x - 3x^2$. [1]
- (d) Use your graph to
- (i) find y when $x = -2.5$ [1]
- (ii) find x for which $19 - 4x - 3x^2 = 0$ [1]
- (e) (i) On the same axis, draw the line $y = -3x + 1$ for $-4 \leq x \leq 4$. [1]
- (ii) Hence write down the points of intersection of the curve $y = 19 - 4x - 3x^2$ and the line $y = -3x + 1$. [1]

- End of paper -



YISHUN SECONDARY SCHOOL

We Seek, We Strive, We Soar

MID-YEAR EXAMINATION

Name : _____ Reg. No : _____ Class: _____

Calculator Model: _____

SEC 3 EXPRESS *Mark Scheme*

Date: 14 MAY 2014

ELEMENTARY MATHEMATICS (4016/2)

PAPER 2

Duration: 2 Hours

MAX MARKS: 80

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*Mathematical Formulae**Compound Interest*

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Mensuration

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

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

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

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

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Trigonometry

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

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

Statistics

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

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

- 1 (a) (i) Factorise $4x^2 - 16$ completely.

[1]

$$= 4(x^2 - 4)$$

$$= 4(x+2)(x-2) \quad B1$$

- (ii) Hence, express $\frac{4}{x-2} - \frac{8x}{4x^2-16}$ as a fraction in its simplest form.

[3]

$$= \frac{4}{x-2} - \frac{8x}{4(x+2)(x-2)}$$

$$= \frac{4(4(x+2)) - 8x}{4(x+2)(x-2)} \quad M1: \text{Make same denominator}$$

$$= \frac{16x + 32 - 8x}{4(x+2)(x-2)}$$

$$= \frac{8x + 32}{4(x+2)(x-2)} \quad M1: \text{Correct expansion \& simplify into a fraction}$$

$$= \frac{2(x+4)}{(x+2)(x-2)} \quad A1 (OE)$$

(b) Given that $a = \sqrt{\frac{2b-6}{5b-c^2}}$

- (i) express b in terms of a and c ,

[3]

$$a^2 = \frac{2b-6}{5b-c^2} \quad M1: \text{Square both sides}$$

$$a^2(5b-c^2) = 2b-6$$

$$5a^2b - a^2c^2 = 2b-6$$

$$5a^2b - 2b = a^2c^2 - 6$$

$$b(5a^2 - 2) = a^2c^2 - 6$$

$$b = \frac{a^2c^2 - 6}{5a^2 - 2} \quad \begin{array}{l} \text{Arrange terms with } b \\ M1: \text{on one side of equation} \\ \text{and factor out } b \end{array}$$

A1

- (ii) find the values of c when $a = \frac{1}{2}$ and $b = 5$.

[3]

$$\frac{1}{2} = \sqrt{\frac{2(5) - 6}{5(5) - c^2}}$$

M1: Sub values into original equation or equation in b(i) - 5

$$\frac{1}{4} = \frac{4}{25 - c^2}$$

$$16 = 25 - c^2$$

$$c^2 = 9$$

$$c = \pm \sqrt{9}$$

M1: Accurate algebra manipulation to c^2

$$\therefore c = 3 \text{ or } -3 \quad \#$$

A1

- 2 A series of diagrams consisting of black and white triangles is shown below. The black triangles line the outer perimeter of each figure. All the other small triangles are white.



Fig. 1



Fig. 2

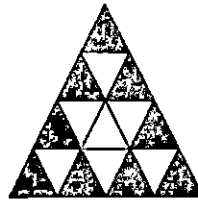


Fig. 3

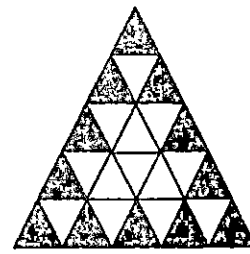


Fig. 4

The table below shows the number of small triangles.

Figure	1	2	3	4	5	...	n
No. of black triangles	3	6	9	12	c	...	x
No. of white triangles	1	3	7	13	d	...	y
Total number of triangles	4	9	16	25	e	...	z

- (a) (i) State the value of c . 15 B1 [1]
 (ii) Write down an expression, in terms of n , for x . $3n$ B1 [1]
 (b) (i) State the value of e . 36 B1 [1]
 (ii) Write down an expression, in terms of n , for z . $(n+1)^2 / n^2 + 2n + 1$ [1]
 (c) Write down the relationship between x , y and z in the form of an equation. B1 (OE) [1]

$$y = z - x \quad \text{B1} \quad \text{or} \quad y = (n+1)^2 - 3n$$

- (d) How many white triangles are there in figure 73?

[1]

$$(73+1)^2 - 3(73) \\ = 5257 \quad \text{B1}$$

- (e) Is it possible for any figure to have a total number of 1849 triangles?
Explain your answer.

[1]

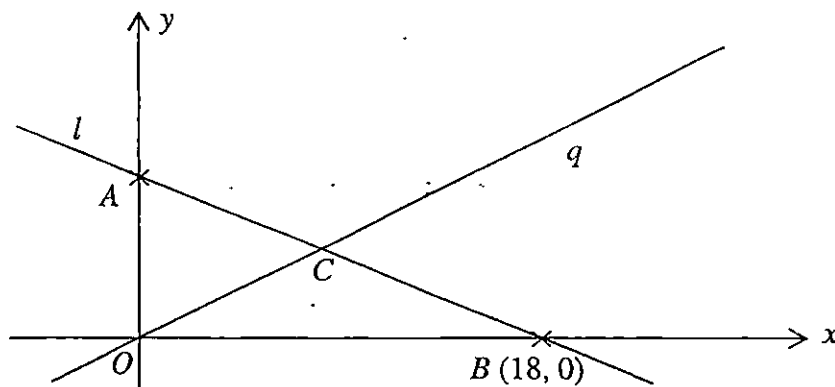
Yes. $\sqrt{1849} = 43$ 1849 is a perfect square or the 42th term has 1849 triangles B1

No marks awarded if working is showed w/o explanation

- 3 The line l intersects the y -axis and the x -axis at points A and B respectively.

The coordinates of B are $(18,0)$ and the gradient of line l is $-\frac{1}{3}$.

(The diagram is not drawn to scale)



- (a) Show that the coordinates of A are $(0, 6)$.

[2]

let $A = (0, y)$, since A is on y -axis

$$\text{grad} = \frac{0-y}{18-0} = -\frac{1}{3}$$

M1: Alternative: use of equation

$$-3y = -18$$

$$y = 6$$

$\therefore A = (0, 6)$ shown ~~✗~~ A1

- (b) Find the length of AB .

[2]

$$AB = \sqrt{(18-0)^2 + (0-6)^2}$$

M1. correct substitution into formula or use of Pyth thm.

$$= 18.9737$$

$$= 19.0 \text{ units (3sf)} \quad \text{✗} \quad \text{A1}$$

- (c) Line q , with equation $3y = 5x$, intersects line l at point C .

Find the coordinates of C .

[3]

eqn of line l : $y = -\frac{1}{3}x + 6$ B1

eqn of line q : $y = \frac{5}{3}x$

$$-\frac{1}{3}x + 6 = \frac{5}{3}x \quad \text{M1}$$

$$6 = 2x$$

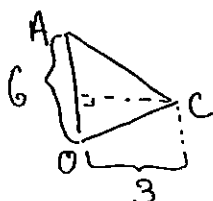
$$x = 3$$

$$y = 5$$

$\therefore$ Coordinates of $C = (3, 5)$ # A1

- (d) Find the area of the triangle AOC .

[2]



Area of $\triangle AOC$ M1: find base and height of $\triangle$.

$$= \frac{1}{2} \times 3 \times 6$$

$$= 9 \text{ units}^2 \quad \# \quad \text{A1}$$

Accept shoelace method but no method marks awarded if answer is wrong.

- 4 (a) A Mathematics test consists of 30 questions.

4 marks are awarded for a correct answer while 1 mark is deducted for a wrong answer.

No marks will be awarded or deducted for questions that are not attempted.

The passing mark for this test is 44.

If a student skipped 3 questions, by forming an inequality, find the minimum number of correct answers he must obtain so as to pass the test.

[3]

let no. of questions answered correctly be x .

$$\text{no. of questions answered} = 30 - 3 = 27$$

$$4x - (27 - x) > 44$$

$$4x - 27 + x > 44$$

$$5x > 71$$

$$x > 14.2$$

M1: form inequality (OE)

M1: Correct manipulation of inequality

$\therefore$ minimum correct answers he obtained is 15 # A1

- (b) The table below shows the population of three countries in 2012.

Singapore	5.312×10^6
China	1.351×10^9
Philippines	9.671×10^7

- (i) The population of Philippines can be expressed as k billion.
Find the value of k .

[1]

$$k = 0.09671 \quad B_1$$

- (ii) Calculate the difference in the population of China and Singapore. Give your answer in standard form.

[2]

$$\begin{aligned} &1.351 \times 10^9 - 5.312 \times 10^6 \\ &= 1345688000 \\ &= 1.345688 \times 10^9 \end{aligned} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} \begin{array}{l} M_1: \text{Use of calculator or} \\ \text{change to same power} \\ A_1 \end{array}$$

- (iii) Find the ratio of the population of Philippines to the population of China, expressing your answer in the form $1 : n$, correct your answer to the nearest integer.

[2]

Philippines : China

$$9.671 \times 10^7 : 1.351 \times 10^9$$

$$1 : \frac{1.351 \times 10^9}{9.671 \times 10^7} \quad M_1$$

$$1 : 13.97$$

$$1 : 14 \quad \# \quad A_1$$

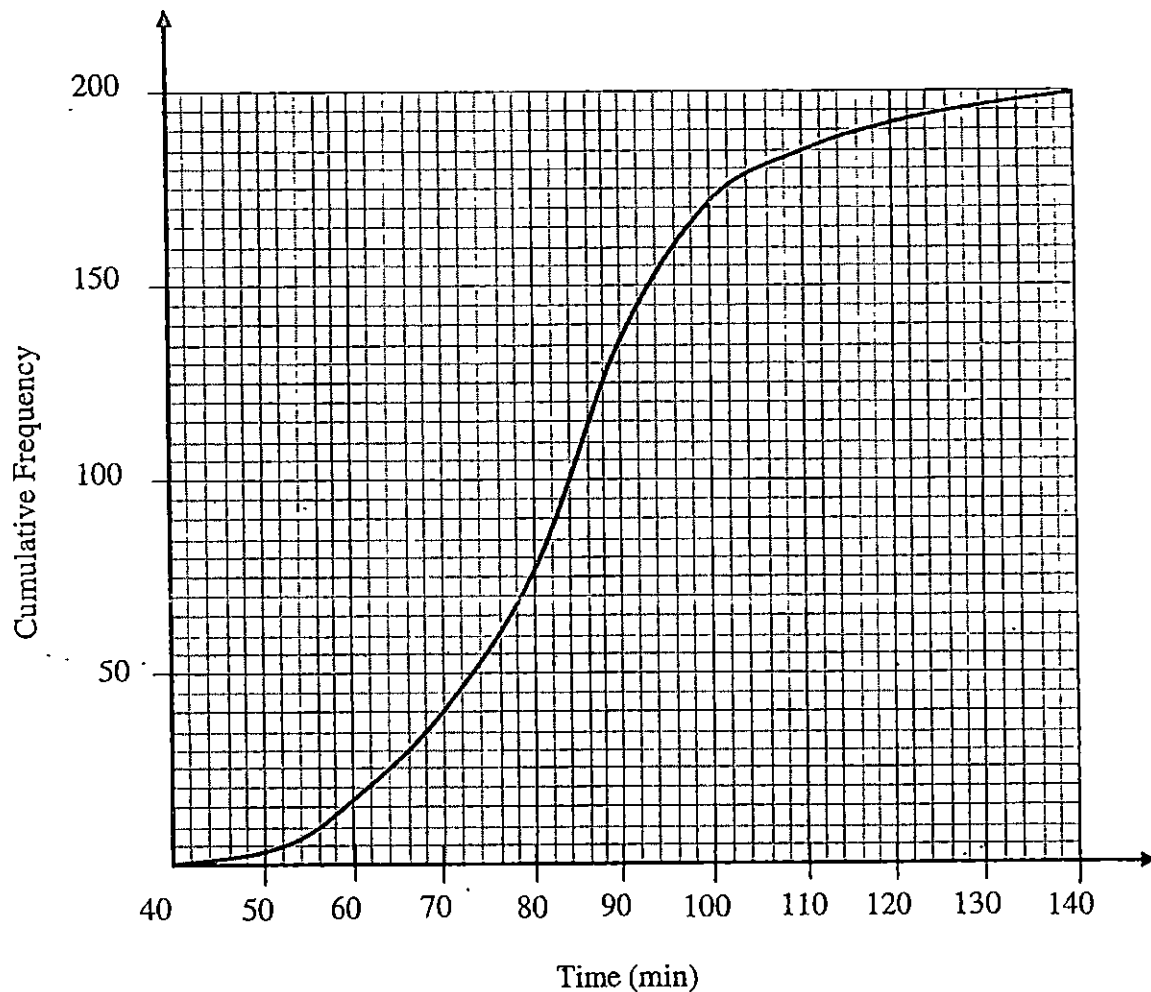
- (iv) Given that 43.9% of the Singapore population is males, find the number of males in Singapore. Give your answer in standard form.

[2]

$$5.312 \times 10^6 \times 43.9\% = 2331968 \quad M_1$$

$$= 2.331968 \times 10^6 \quad A_1$$

5. 200 students from Chong Pang Secondary School took part in an Amazing Race competition. The diagram below shows the cumulative frequency curve of the time taken by the students to complete the race.



- (a) Use your graph to estimate
- the median time taken to complete the competition, [1]
 $\text{median} = 84$ B_1
 - the 60th percentile, [1]
 $\text{60th percentile} = 87 (\pm 1)$ B_1
 - the inter-quartile range, [2]
 $Q_1 = 73$
 $Q_3 = 93$
 $\text{Interquartile range} = 93 - 73$
 $= 20$ B_1 $\rightarrow B_1 - \text{Working shown}$

- (iv) the value of T if 20% of the students took more than T minutes to complete the competition. [2]

highest 20% $\rightarrow$ 160th term M_1 :

$$\therefore T = 96 \text{ min } (\pm 1) \quad A_1$$

- (a) Students who complete the competition in 70 minutes or less, will be awarded a distinction. Calculate the percentage of students who qualified for a distinction. [2]

no. of students who took less than 70 min = 40

$$\text{Dist \%} = \frac{40}{200} \times 100$$

$$= 20\% \quad B_1$$

- (b) 200 students from Khatib Secondary School also participated in the same competition and the results of the time taken were recorded as follows

25th percentile: 85 min

50th percentile: 90 min

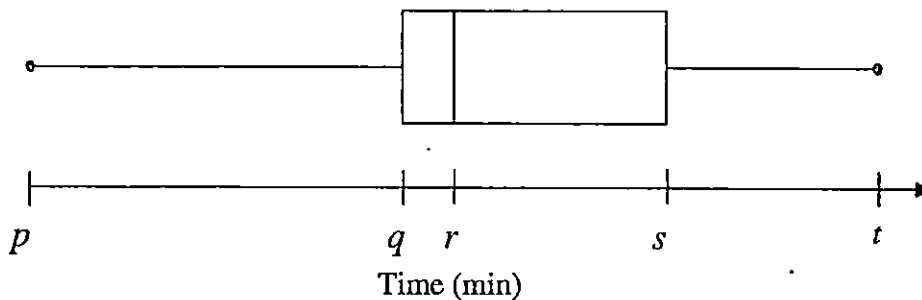
65th percentile: 100 min

Interquartile range: 25 min

Fastest time: 50 min

Range: 80 min

The time taken by Khatib Secondary School students were also represented in a box-and-whisker diagram as shown below.



- (i) Using the given information, write down the values of p , q , r , s and t . [2]

$$p = 50$$

$$q = 85$$

$$r = 90$$

$$s = 110$$

$$t = 130$$

$B_2 \rightarrow$ all correct

$B_1 \rightarrow$ 1 mistake

$B_0 \rightarrow$ 2 or more mistakes

- (ii) The students from Khatib Secondary School claimed that they were generally faster in completing the competition than Chong Pang Secondary School.

Do you agree? Give a reason for your answer.

[1]

NO. Since median of chong pang secondary is lower than that of khatib secondary, chong pang secondary students were generally faster. B1

6. A bus commutes passengers to and fro Singapore and Kuala Lumpur.

- (a) On a certain trip, the bus leaves Singapore at 2000 h and arrives at Kuala Lumpur at 0420 h the next morning.

Find the time taken, in hours and minutes, for the journey.

[1]

8 hours 20 min B1

- (b) The fare of an adult ticket from Kuala Lumpur to Singapore is RM23.50 and the child's fare is RM15.90. Mr Ku boarded this bus with his wife and three children. Given that the exchange rate is S\$100 = RM 259, calculate the total amount in S\$ that Mr Ku has to pay for the family. Give your answer correct to 2 decimal places.

[2]

$$2(23.50) + 3(15.90) = \text{RM } 94.7 \quad \text{B1}$$

$$\begin{aligned} \text{RM } 94.7 &= \text{S\$ } \frac{94.7}{259} \times 100 = \text{S\$ } 36.5637 \\ &= \text{S\$ } 36.56 \text{ (2 dp)} \quad \# \quad \text{B1} \end{aligned}$$

- (c) The distance between Kuala Lumpur and Singapore is 650 km.

- (i) If the bus travels from Singapore to Kuala Lumpur at an average speed of x km/h, write down an expression for the time taken, in hours, for the journey.

[1]

$$\frac{650}{x} \text{ h} \quad \text{B1}$$

- (ii) On the return trip from Kuala Lumpur, the bus increases its speed by 5 km/h. Write down an expression for the time taken, in hours, for the return journey.

[1]

$$\frac{650}{x+5} \text{ h} \quad \text{B1}$$

- (iii) If the difference in time between the two journeys is 2 hours 45 minutes, form an equation in x and show that it can be reduced to $11x^2 + 55x - 13000 = 0$. [3]

$$\frac{650}{x} - \frac{650}{x+5} = 2.75 \quad B1$$

$$650(x+5) - 650x = 2.75(x^2 + 5x) \quad M1: \text{correct expansion.}$$

$$650x + 3250 - 650x = 2.75x^2 + 13.75x$$

$$2.75x^2 + 13.75x - 3250 = 0$$

$$11x^2 + 55x - 13000 = 0 \quad A1$$

- (iv) Solve the equation $11x^2 + 55x - 13000 = 0$, giving your answers correct to 2 decimal places. [3]

$$x = \frac{-55 \pm \sqrt{(55)^2 - 4(11)(-13000)}}{2(11)} \quad M1$$

$$x = 31.968 \quad \text{or} \quad x = -36.968$$

$$= 31.97 \quad A1 \quad \quad \quad = -36.97 \quad A1$$

(reject)

- (v) Hence, find the time taken, in hours and minutes, for the return journey. [2]

$$\frac{650}{31.968 + 5}$$

$\int M1$: substitute value from (iv) into expression in (ii)

* Working must be in 5.s.f or more else -1M

$$= 17.583$$

$$= 17 \text{ hours } 35 \text{ minutes } \times \quad A1$$

- 7 Fig 7.1 (not drawn to scale) shows 4 identical iron balls packed into a transparent box. Fig 7.2 shows the top view of the box. Each ball is in contact with the interior surfaces of the box and the balls beside it. It is given that the radius of each ball is 3 cm.

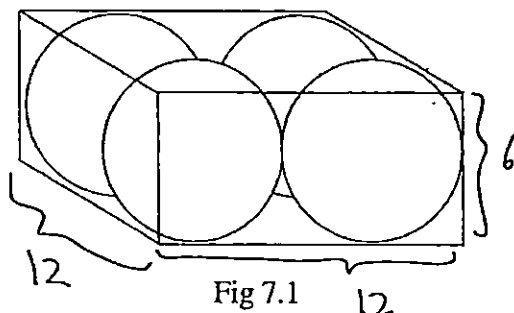
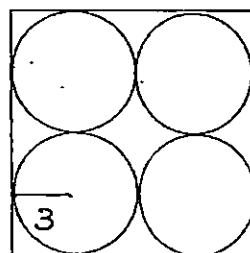


Fig 7.1

Fig 7.2
Top View

(a) Calculate

- (i) the total volume of four iron balls, in terms of π , [1]

$$\begin{aligned} \text{Vol of 1 Ball} &= \frac{4}{3}\pi(3)^3 \\ &= 36\pi \text{ cm}^3 \end{aligned}$$

$$\text{Vol of 4 balls} = 144\pi \text{ cm}^3 \quad \# \text{ B1}$$

- (ii) the volume of the box, [2]

$$\text{Width of box} = 3 \times 4 = 12$$

$$\text{height of box} = 3 \times 2 = 6$$

$$\begin{aligned} \text{Volume of box} &= 12 \times 12 \times 6 \\ &= 864 \text{ cm}^3 \end{aligned}$$

show working with
M1 - at least 2 correct
values

A1

- (i) the percentage of the space in the box that is not occupied by the balls. [2]

$$\begin{aligned} \text{Volume not occupied} &= 864 - 144\pi \\ &= 411.611 \end{aligned}$$

5M1

$$\begin{aligned} \frac{411.611}{864} \times 100 &= 47.64 \\ &= 47.6\% \quad \# \text{ A1} \end{aligned}$$

- (b) The 4 iron balls are melted, and moulded into a **solid** cone as shown in Fig 7.3. The cone has a height of 12 cm and its base radius is x cm.

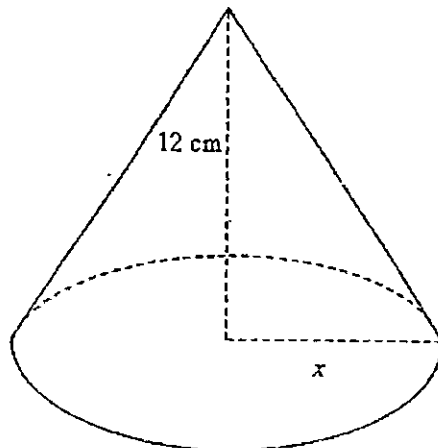


Fig 7.3

- (i) Using your answer from (a)(i), show that the radius, x , is 6 cm. [2]

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

$$144 \pi = \frac{1}{3} \pi (x)^2 \times 12 \quad \text{M1: equate correctly}$$

$$x = 6 \text{ cm (shown)} \quad \text{A1}$$

- (ii) Calculate the total surface area of the cone. [3]

$$\begin{aligned} \text{Slant height, } l &= \sqrt{12^2 + 6^2} \\ &= 13.4164 \quad \text{B1} \end{aligned}$$

$$\begin{aligned} \text{Total surface area} &= \pi r l + \pi r^2 \\ &= \pi(6)(13.4164) + \pi(6)^2 \quad \text{M1S} \\ &= 365.99 \text{ cm}^2 \quad \text{*Wording 5 sf or more} \\ &= 366 \text{ cm}^2 \text{ (3 sf)} \quad \text{A1} \end{aligned}$$

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

The following table gives the corresponding values of x and y which are connected by the equation $y = 19 - 4x - 3x^2$.

x	-4	-3	-2	-1	0	1	2	3	4
y	-13	4	15	p	19	12	-1	q	-45

- (a) Calculate the value of p and of q . [2]

$$p = 20 \quad B1 \quad q = -20 \quad B1$$

- (b) Using a scale of 2 cm to represent 1 unit on the x -axis for $-4 \leq x \leq 4$ and 2 cm to represent 10 units on the y -axis for $-45 \leq y \leq 25$, draw the graph of $y = 19 - 4x - 3x^2$. [3]

Correct scale with axis labelled

C1

Correct points plotted

C1

Smooth curve that passes through all points

C1

- (c) From the graph, find the maximum value of $y = 19 - 4x - 3x^2$. [1]

$$\text{maximum value} = 20.5 \quad (+0.5) \quad B1$$

- (d) Use your graph to

- (i) find y when $x = -2.5$ [1]

$$y = 10 \quad B1$$

Depends on student's graph

- (ii) find the value of x for which $19 - 4x - 3x^2 = 0$ [1]

$$x = 1.9 \quad \text{or} \quad x = -3.3 \quad (\pm 0.1) \quad B1$$

from graph

- (e) (i) On the same axis, draw the line $y = -3x + 1$ for $-4 \leq x \leq 4$. [1]

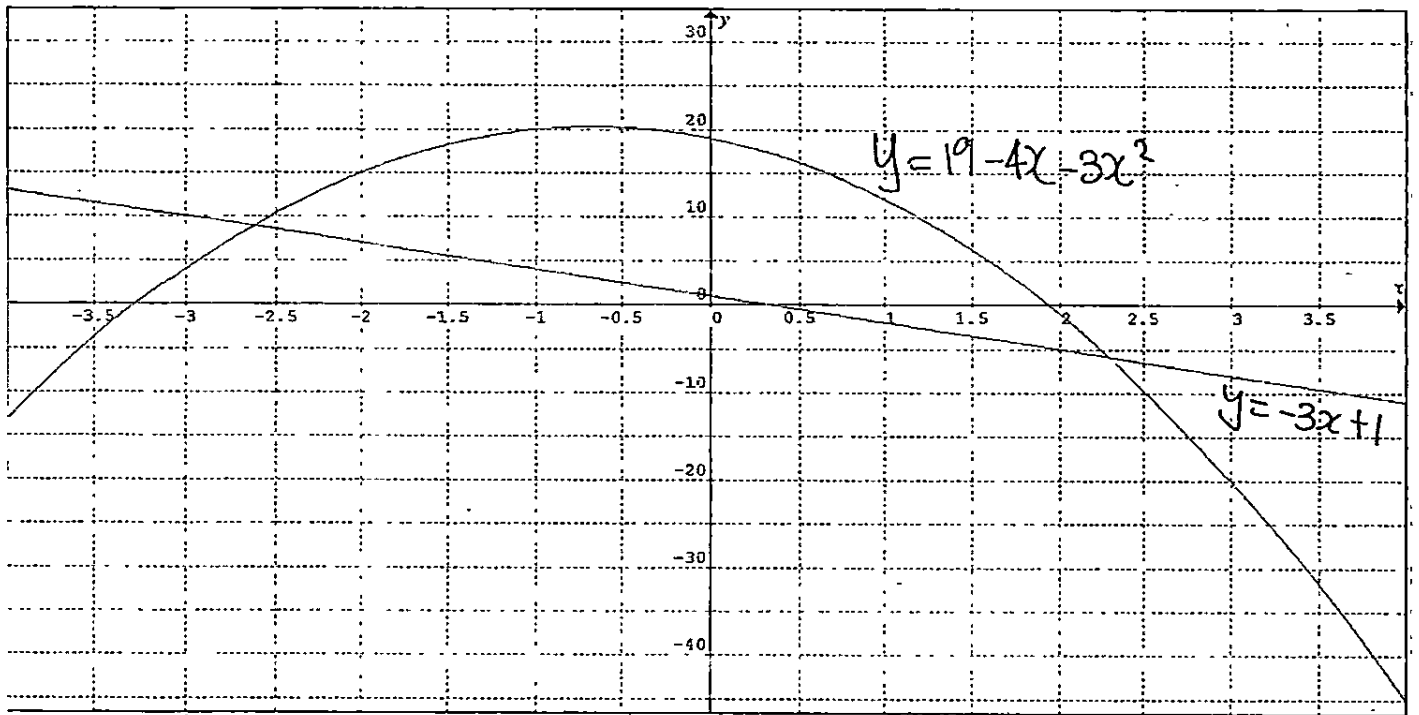
Draw line on graph with equation labelled C1

- (ii) Hence write down the points of intersection of the curve $y = 19 - 4x - 3x^2$ and the line $y = -3x - 9$. [2]

$$\therefore x = (-2.6, 9)$$

$$x = (2.3, -6) \quad (\pm)$$

reading from student's graph



Question	Answers
1(a)(i)	$4(x+2)(x-2)$
1(a)(ii)	$\frac{2x+8}{(x+2)(x-2)}$ or $\frac{2(x+4)}{(x+2)(x-2)}$
1(b)(i)	$b = \frac{a^2c^2 - 6}{5a^2 - 2}$
1(b)(ii)	$c = 3or - 3$
2(a)(i)	15
2(a)(ii)	$3n$
2(b)(i)	36
2(b)(ii)	$(n+1)^2$
2(c)	$y = z - x$
2(d)	5257
2(e)	Yes. 1849 or a perfect square (or) the 42th term has 1849 triangles
3(a)	Refer to solution
3(b)	19.0 units
3(c)	(3,5)
3(d)	9 units ²
4(a)	15
4(b)(i)	$k = 0.09671$
4(b)(ii)	1.345688×10^9
4(b)(iii)	1:14
4(b)(iv)	2.331968×10^6
5(a)(i)	84
5(a)(ii)	87
5(a)(iii)	20
5(a)(iv)	96
5(b)	20%
5(c)(i)	$p = 50, q = 85, r = 90, s = 110, t = 130$
5(c)(ii)	No. Since median of chong pang secondary is lower than that of khatib secondary, chong pang secondary students were generally faster.
6(a)	8hours 20 min
6(b)	S\$36.56
6(c)(i)	$\frac{650}{x}$
6(c)(ii)	$\frac{650}{x+5}$
6(c)(iii)	Refer to solution
6(c)(iv)	$x = 31.97$ or -36.97 (reject)
6(c)(v)	17 hours 35 minutes
7(a)(i)	$114\pi \text{ cm}^3$
7(a)(ii)	864 cm^3
7(a)(iii)	47.6%
7(b)(i)	Refer to solution
7(b)(ii)	366 cm^2
8(a)	$p = 20, q = -20$
8(c)	20.5 (+0.5)
8(d)(i)	10 (± 1)

8(d)(ii)	$x = 1.9$ or $x = -3.3 (\pm 0.1)$
8(e)(ii)	$(-2.6, 9), (2.3, -6)$ -values read from graph

Paper 2

Question	Answers
1(a)(i)	$4(x+2)(x-2)$
1(a)(ii)	$\frac{2x+8}{(x+2)(x-2)}$ or $\frac{2(x+4)}{(x+2)(x-2)}$
1(b)(i)	$b = \frac{a^2c^2 - 6}{5a^2 - 2}$
1(b)(ii)	$c = 3 \text{ or } -3$
2(a)(i)	15
2(a)(ii)	$3n$
2(b)(i)	36
2(b)(ii)	$(n+1)^2$
2(c)	$y = z - x$
2(d)	5257
2(e)	Yes. 1849 or a perfect square (or) the 42th term has 1849 triangles
3(a)	Refer to solution
3(b)	19.0 units
3(c)	(3,5)
3(d)	9 units ²
4(a)	15
4(b)(i)	$k = 0.09671$
4(b)(ii)	1.345688×10^9
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4(b)(iv)	2.331968×10^6
5(a)(i)	84
5(a)(ii)	87
5(a)(iii)	20
5(a)(iv)	96
5(b)	20%
5(c)(i)	$p = 50, q = 85, r = 90, s = 110, t = 130$
5(c)(ii)	No. Since median of chong pang secondary is lower than that of khatib secondary, chong pang secondary students were generally faster.
6(a)	8 hours 20 min
6(b)	S\$36.56
6(c)(i)	$\frac{650}{x}$
6(c)(ii)	$\frac{650}{x+5}$
6(c)(iii)	Refer to solution
6(c)(iv)	$x = 31.97$ or -36.97 (reject)
6(c)(v)	17 hours 35 minutes
7(a)(i)	$144 \pi \text{ cm}^3$
7(a)(ii)	864 cm^3
7(a)(iii)	47.6%
7(b)(i)	Refer to solution
7(b)(ii)	366 cm^2
8(a)	$p = 20, q = -20$
8(c)	20.5 (+0.5)

8(d)(i)	10 (± 1)
8(d)(ii)	$x = 1.9$ or $x = -3.3$ (± 0.1)
8(e)(ii)	$(-2.6, 9), (2.3, -6)$ -values read from graph