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**CRESCENT GIRLS' SCHOOL
SECONDARY THREE
MID-YEAR EXAMINATION 2016**

MATHEMATICS

4048

6 May 2016

2 hours 30 minutes

For Section A, candidates answer on the Question Paper.

For Section B, candidates answer on the writing paper and graph paper given.

READ THESE INSTRUCTIONS FIRST

Write your name, register number and class 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.

Calculators should be used where appropriate.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

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

At the end of the examination, submit section A and B separately.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for Section A is 40.

The total of the marks for Section B is 60.

For Examiner's Use	
Section A	40
Section B	60
Total	100

This paper (Section A + Section B) consists of 15 printed pages (inclusive of cover page) and 1 blank page.

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

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

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

SECTION A

Answer all the questions.

1. (a) Sixty four small cubes have edges 4 cm each measured correct to the nearest 0.1 cm. These cubes fit exactly in a bigger cube. Find the
- (i) greatest length of the bigger cube

Answer (i) [1]

- (ii) least possible base area of the bigger cube

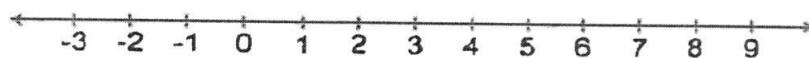
Answer (ii) [2]

- (b) The mass of a DNA molecule is 2.01×10^{-19} kg. What is the mass of 15 DNA molecules in picograms? Give your answer in standard form.

Answer (b) picograms [1]

2. Solve the inequality $\frac{1}{3}(x+7) < \frac{1}{6}(x+22) \leq x+6$ and represent the answer on the number line below.

Answer



[3]

3. (a) Express the expression $x^2 - 12x + 5$ in the form $(x - a)^2 + b$.

Answer (a) [2]

- (b) Using your answer from part (a), solve the equation $3x^2 - 36x + 12 = 0$.

Answer (b) [3]

4. David has \$ P in a bank that pays compound interest at the rate of 2.4 % per annum compounded quarterly. If he receives a total of \$ 2500 from the bank after 3 years, find the value of P , giving your answer to the nearest whole number.

Answer $P = \$$ [2]

5. (a) A cartridge in a printer will last 30 days when an average of 70 sheets of paper are printed each day. How long will a cartridge last when the average number of sheets printed per day is increased by 30?

Answer (a)days [2]

- (b) y is inversely proportional to d^2 . Given that $y = 2$ for a certain value of d , find the value of y when this value of d is increased by 200%?

Answer (b) [2]

6. (a) (i) Sketch the graph $y = x^2 + 2x$ on Figure 1. [2]

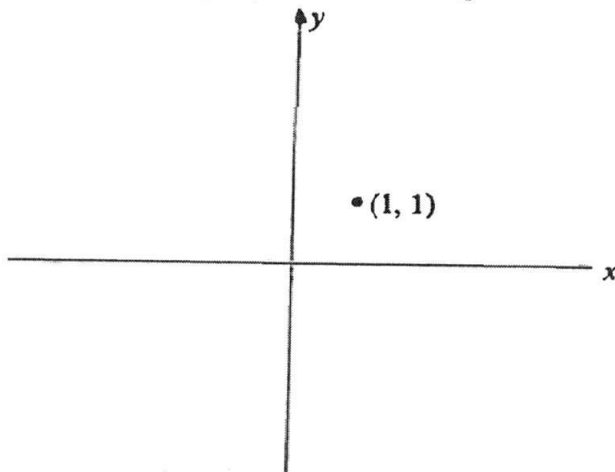


Figure 1

(ii) Sketch the graph $y = -3^x + 3$ on Figure 2.

[2]

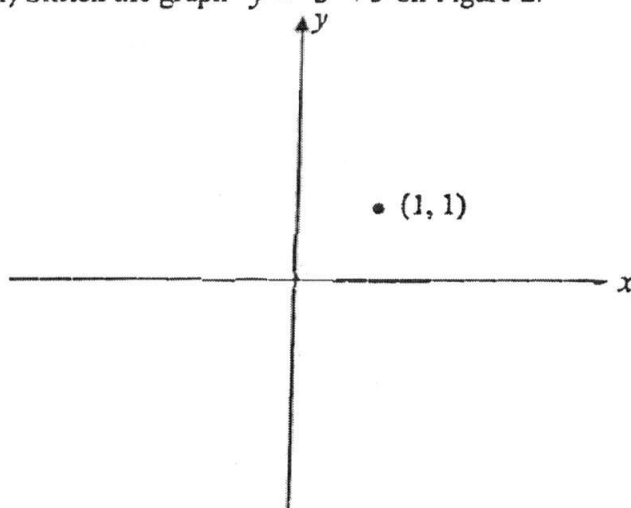
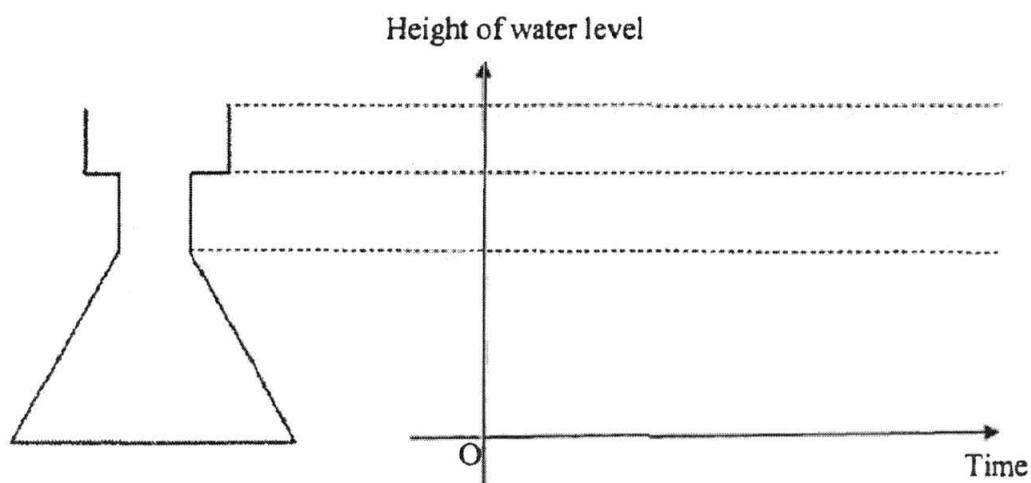


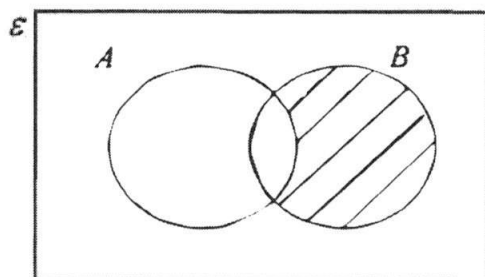
Figure 2

7. Water is poured at a constant rate into the container as shown below. Draw on the axes provided, the change in the water level of the container over time.

[2]

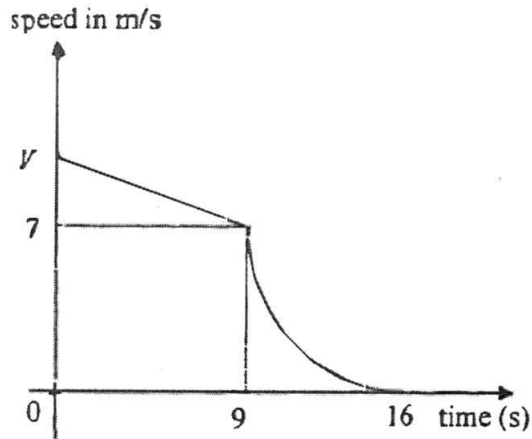


8. Express in set notation, the region shaded in the Venn diagram below.



Answer [1]

9.



The diagram above shows the speed-time graph of a car travelling in a straight line.

It decelerates uniformly from an initial speed V for the first nine seconds at $\frac{1}{3} \text{ m/s}^2$.

Given that its deceleration in the last seven seconds is such that the curve on the graph is a quarter of a circle, calculate

- (a) the value of V ,
- (b) the distance travelled in the last 7 seconds,
- (c) the average speed of the car for the first nine seconds.

[Take π to be $\frac{22}{7}$.]

Answer (a) [2]

(b) m [2]

(c) m/s [2]

10. James plans to buy either pens or bags as gifts for his friends. He has exact amount of money to buy either 15 wallets or 60 pens. If he buys an equal number of pens and wallets, how many of each can he buy with the money?

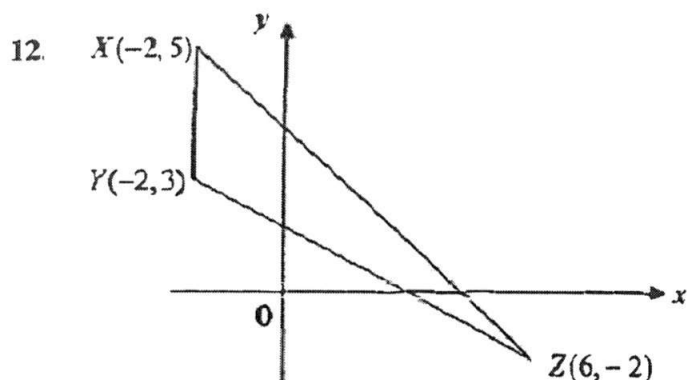
Answer (a) [2]

11. (a) A metal cylinder has a radius $8x^{\frac{3}{4}}$ cm and height $\frac{9}{4}x^{\frac{5}{6}}$ cm . Express the volume of the cylinder in terms of x and π .

- (b) The cylinder is melted to form a hemisphere. Find the radius of the hemisphere in terms of x .

Answer (a).....cm³ [2]

(b).....cm [2]



The points X , Y and Z are $(-2, 5)$, $(-2, 3)$ and $(6, -2)$ respectively. Find the

(a) gradient of the line XZ ,

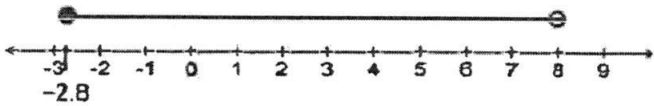
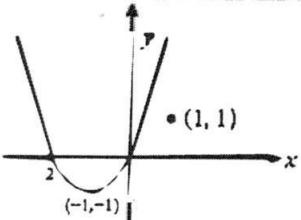
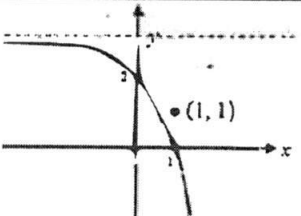
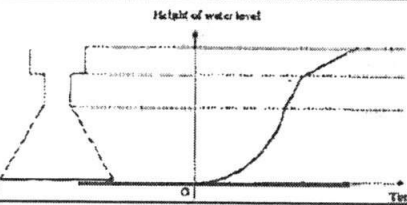
(b) $XYZA$ is a trapezium such that $XY \parallel AZ$ and the area of trapezium is 3 times the area of $\triangle XYZ$ find the coordinates of A .

Answer (a) [1]

(b) units² [2]

END OF SECTION A

Section A – Anskey

1	a i)	16.2 cm
	a ii)	249.64 cm^2
	b)	3.015×10^{-3}
2		$-2.8 \leq x < 8$ 
3	a)	$(x-6)^2 - 31$
	b)	$x = 11.7(3\text{sf})$ or $0.343(3\text{sf})$
4		\$2327
5	a)	21 days
	b)	$\frac{2}{9}$
6	a)	
	b)	
7		
8		$B \cap A'$ or $(A \cap B)' \cap B$
9	a)	10 m/s
	b)	$10\frac{1}{2} \text{ m}$
	c)	8.5 m/s
10		12
11	a)	$144\pi x^{\frac{7}{3}} \text{ cm}^3$
	b)	$6x^{\frac{7}{9}} \text{ cm}$
12	a)	$-\frac{7}{8}$
	b)	(6, 2)

2016 CGS SEC 3 EM MYE

SECTION B

Answer all the questions.

-
- 1 (a) Factorise $4x^2 - 20xy + 25y^2 - 12x + 30y$. [3]
- (b) Given that $x = 3$, find the values of y when $4x^2 - 20xy + 25y^2 - 12x + 30y = 0$. [2]
- 2 (a) Simplify $\left(\frac{2a^3b}{3c^{-4}}\right)^{-2} \div \frac{4a^{-4}}{9bc}$, leaving your answer in positive indices. [3]
- (b) Solve $25^{3x-1} = 125^{1-x}$. [3]
- 3 A boat travelled from Sunshine Town to Moonlight City and back to Sunshine Town. It is given that the distance between Sunshine Town and Moonlight City is 80 km and the speed of the boat in still water is 25 km/h. On that day, there is a constant current of x km/h from Sunshine Town to Moonlight City which resulted in a difference of 40 minutes of travelling time in the two journeys.
- (a) Write down an expression, in terms of x , for the time taken, in hours, by the boat to travel from Sunshine Town to Moonlight City. [1]
- (b) Write down an expression, in terms of x , for the time taken, in hours, by the boat to travel from Moonlight City to Sunshine Town. [1]
- (c) Form an equation in x and show that it simplifies to $x^2 + 240x - 625 = 0$. [3]
- (d) Solve the equation $x^2 + 240x - 625 = 0$. [2]
- (e) Hence, find the time taken by the boat to travel from Moonlight City to Sunshine Town, leaving your answer in hours and minutes, correct to the nearest minute. [2]
- (f) State the assumption that you made to solve this problem. [1]

23. Find the value of $\frac{4x}{y}$, $y \neq 0$, given that $\frac{2x-3y}{x+7y} = \frac{2}{3}$.

Ans: 23

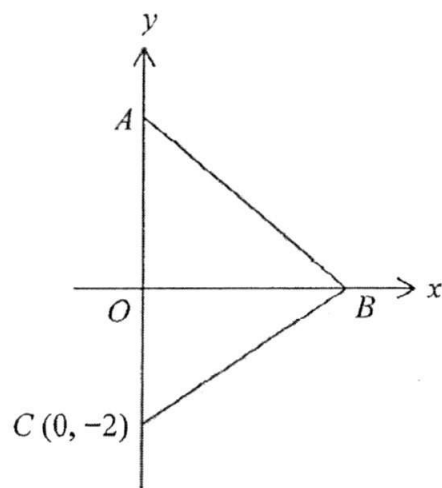
[CGS/2013/EOY/P1]

24. Given that $y = 1 + \sqrt{(3-x^2)y}$, express x in terms of y .

Ans: $x = \pm \sqrt{3 - \frac{(y-1)^2}{y}}$

[CGS/2013/EOY/P1]

- 4 In the diagram, C is the point $(0, -2)$, A is a point on the y -axis and B is a point on the x -axis. It is given that the length of AC is 4.5 units and BC is parallel to the line $3y - 2x = 5$.



Find,

- (a) the coordinates of B , [2]
- (b) the equation of AB , [2]
- (c) the area of triangle ABC , [2]
- (d) the perpendicular distance from C to AB . [3]

- 5 Jim has \$15000 to invest in either Bank *A* or Bank *B*. Here is some information about the investment plans offered by both banks.

Bank A

- 2.5% per annum compound interest, compounded yearly
- Interest will only be paid with a minimum of 5 years of investment

Bank B

- 2.2% per annum compound interest, compounded half yearly
- Interest will only be paid with a minimum of 5 years of investment

- (a) Jim wishes to invest the money for a period of 5 years.
- (i) Which bank should Jim invest in? Explain your answer. [3]
- (ii) Calculate the difference in interest earned after 5 years. [2]
- (b) After 3 years of investment, Jim decides to buy a car but was short of \$15000. He has two options to consider.

Option 1

- Withdraw his investment of \$15000 from the bank chosen in (a)(i).
- Jim will not earn any interest as he did not invest the money for a minimum of 5 years.

Option 2

- Continue his investment of \$15000 in the bank chosen in (a)(i).
- Borrow \$15000 from Bank *C* which charges 3% per annum simple interest for 2 years.

Which option should Jim choose? Explain your answer. [4]

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

In 2008, a research was carried out to determine the wild cat population on Paradise Island.

The table below shows the population of cats, y , on Paradise Island, t years after 2008.

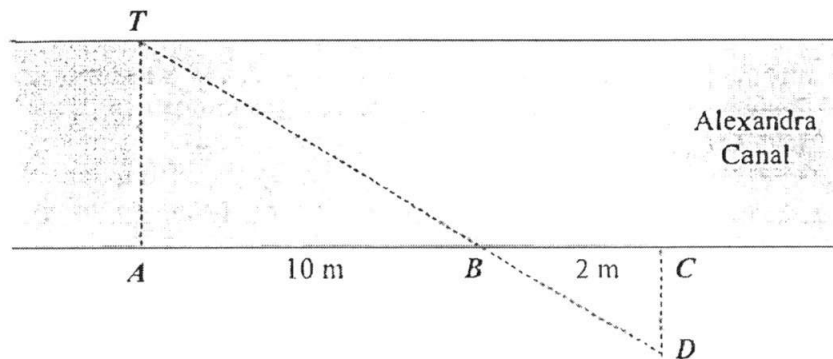
t	0	1	2	3	4	5	6	7	8
y	32	60	68	62	48	32	20	18	32

- (a) Using a scale of 2cm to represent 1 year, draw a horizontal t -axis for $0 \leq t \leq 8$.
Using a scale of 2cm to represent 10 cats, draw a vertical y -axis for $0 \leq y \leq 70$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (b) (i) By drawing a tangent, find the gradient of the curve when $t = 3$. [2]
(ii) Using your answer to (b)(i), explain what was happening to the wild cat population when $t = 3$. [1]
- (c) There were 10 wild cats on Beauty Island in 2008 and the population of the wild cats, y , increased at a uniform rate of 5 cats per year.
- (i) Express the population of wild cats, y , on Beauty Island in terms of t , where t is the number of years after 2008. [1]
(ii) On the same axes, draw the graph of the equation in (c)(i) for $0 \leq t \leq 8$ and estimate the year in which the population of wild cats will be the same on both islands. [3]
- (d) Jim proposes that the wild cat population on Paradise Island can be modelled by the equation $y = t^3 - 13t^2 + 40t + 32$.
Can this equation be used to predict the wild cat population on the island after 20 years? Explain your answer. [1]

- 7 (a) George is an engineer and he has been tasked to build a bridge across a part of the Alexandra canal. However, before he can build the bridge, he will need to determine the width of the canal.

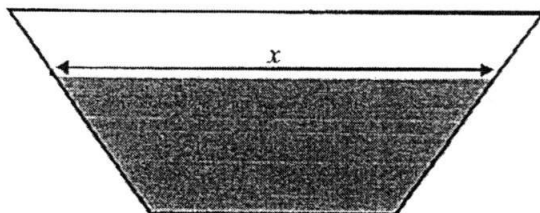


George decides to use the following method to determine the width of the canal. He notices that there is a tree T that is located at the edge of the canal and he erects a pole at a point A directly opposite the tree. He walks along the canal and erects poles at points B and C , 10 m and 12 m away from point A respectively. At point C , George walks away from the canal in a direction perpendicular to BC until he sees that the pole at point B coincides the tree T . George then erects a pole at this point D .



- (i) Prove that triangles TAB and DCB are similar. [2]
- (ii) Find the width of the canal given that the distance CD is 4.6 m. [2]
- (iii) State one assumption made by George when determining the width of the canal. [1]

- (b) The cross sectional area of the Alexandra canal can be modelled by a trapezium. On a rainy day, $\frac{2}{3}$ of the canal is filled with water and the width of the water surface is x m.



- (i) Using the value found in (a)(ii), find the value of x . [2]
- (ii) It is given that the cross sectional area of the canal is 525 m^2 and the length of the canal is 1.2 km . Find the volume of water, in m^3 , in the canal on a rainy day. [3]

END OF SECTION B

Section B – Anskey

1	a)	$(2x - 5y)(2x - 5y - 6)$
	b)	$y = 1\frac{1}{5}$ or $y = 0249.64 \text{ cm}^2$
2	a)	$\frac{81}{16a^2bc^7}$
	b)	$x = \frac{5}{9}$
3	a)	$\left(\frac{80}{25+x}\right)h$
	b)	$\left(\frac{80}{25-x}\right)h$
	d)	2.58 (3sf) or -243 (3sf)
	e)	3 hours 34 minutes (nearest minute)
	f)	The boat is travelling in the same direction as the current from Sunshine Town to Moonlight City and against the current from Sunshine Town to Moonlight City.
4	a)	(3, 0)
	b)	$y = -\frac{5}{6}x + \frac{5}{2}$
	c)	6.75 units ²
	d)	3.46 (3sf)
5	a i)	Jim should invest in Bank A as he will have more money after 5 years.
	a ii)	\$237.00
	b	Jim should choose Option 2 as he will earn \$1071.12 after 5 years as compared to Option 1.
6		See attached
7	a ii)	23 m
	a iii)	George assumed that the width of the river is the same for this stretch of the canal.
	b i)	18.8 (3sf)
	b ii)	420000 m ³

Name: _____ Index No.: _____

Subject: _____ Class: _____ Date: _____

