DEPARTMENT OF EDUCATION

UPPER SECONDARY SCHOOL CERTIFICATE EXAMINATIONS

ADVANCE MATHEMATICS

Paper 1

Monday

13th October 2014

Time allowed:

2 hours and 30 minutes

(8:00am – 10:30 am)

NO EXTRA TIME

(NO OTHER TIME)

Candidates are advised to fully utilise the allocated time.

MA1

INSTRUCTIONS TO CANDIDATES

To be read by the external invigilator to all candidates.

1. The subject code for Advance Mathematics is **3.**
2. There are **8** printed pages in the question booklet.
3. An Electronic Answer Sheet for Part A, 2 pages Part B Answer Booklet and a 1 page formula sheet are inserted in the question booklet.
4. There are two parts in this paper. Answer **ALL** questions.

   Part A: Multiple Choice (Questions 1-30) 30 Marks

   This part will be electronically marked.

   All answers to the Multiple Choice Part MUST be answered on the ELECTRONIC ANSWER SHEET provided.

   Carefully following the instructions, fill in your Candidate Information and Subject Information.

   Choose A or B or C or D from the alternatives given and use a HB pencil to shade in the correct letter to each question on the Electronic Answer Sheet.

   If you make a mistake, rub the shading out completely using an eraser and shade in your correct alternative clearly.

   Part B: Short Answers (Questions 31- 50) 20 Marks

   Write your name, your school name and your 10-digit candidate number on the Part B Answer Booklet provided.

5. You are required to write only the correct answer in the space provided on the Answer Sheet.
6. Calculators may be used.
7. Answer all questions on the answer sheet. Answers on any other paper including rough work paper and the question paper will not be marked.
8. Correction fluid is not allowed. Where you have made an error, cross out all the working and start on a new line.
9. Graphical Calculators are not permitted.

Penalty For Cheating Or Assisting To Cheat In National Examinations Is Non-Certification.

DO NOT TURN OVER THE PAGE AND DO NOT WRITE UNTIL YOU ARE TOLD TO START.

PARTA: MULTIPLE CHOICE (QUESTIONS 1 to 30) 30 MARKS

Answer each question by shading in with HB pencil the circle directly under the correct alternative A, B, C or D. If you make a mistake, rub it out completely using an eraser rubber and shade the correct answer on the Electronic Answer Sheet.

QUESTION 1

$2.3\times10^{-6}\ km$ is equivalent to

A. 0.00023 m B. 0.23 m

C. 0.0023 m D. 2.3 m

QUESTION 2

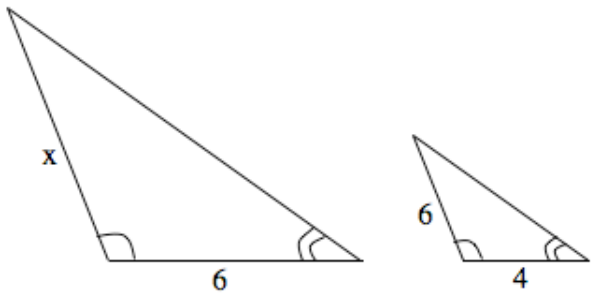
We have three numbers 1, 2 and 3. How many possible combinations of two-digit numbers can we make from these three numbers?

A. 3 B. 6

C. 4 D. 5

QUESTION 3

Two triangles below are similar and all lengths are in centimetres.



The side marked x is

A. 6 cm B. 4 cm

C. 9 cm D. 5 cm

QUESTION 4

$(x+y)^5$ is equal to

A. $x^5+10x^4y+5x^3y^2+5x^2y^3+10xy^4+y^5$

B. $x^5+5x^4y+10x^3y^2+5x^2y^3+10xy^4+y^5$

C. $x^5+5x^4y+10x^3y^2+10x^2y^3+5xy^4+y^5$

D. $x^5+5x^4y+5x^3y^2+10x^2y^3+10xy^4+y^5$

QUESTION 5

The value of the determinant $\begin{vmatrix} -1 & -2 \\ 2 & 4 \end{vmatrix}$ is

A. -8 B. -7

C. -6 D. 0

QUESTION 6

Which of the following statement is **not** true about $\sin\theta$, where θ is $\frac{2\pi}{3}$ radians.

A. It has the same value as $\sin\left(\frac{8\pi}{3}\right)$

B. It has the same value as $\sin 30°$

C. It has a positive value

D. It has a negative value

QUESTION 7

Express $\sqrt{32a}-\sqrt{50a}+\sqrt{18a}$ into its simplest surd form.

A. $2\sqrt{a}$ B. $4\sqrt{2a}$

C. $2\sqrt{2a}$ D. $\sqrt{2a}$

QUESTION 8

Tom takes 30 minutes to drink his six packs of ice beer. How long will Tom take to drink a carton of ice beer (24 packs), given that he drinks at the same rate?

A. 15 minutes B. 60 minutes

C. 240 minutes D. 120 minutes

QUESTION 9

Express $2\log_2 x-\frac{1}{3}\log_2 8$ as a single logarithm.

A. $\log_2 x^2$ B. $\log_2(2x)$

C. $\log_2\left(\frac{x^2}{2}\right)$ D. $\log_2(2x^2)$

QUESTION 10

Express $\frac{5}{(x+2)(x+4)}-\frac{4}{(x+2)}$ as a single fraction.

A. $\frac{11-4x}{(x+2)(x+4)}$ B. $\frac{-(11+4x)}{(x+2)(x+4)}$

C. $\frac{4x-11}{(x+2)(x+4)}$ D. $\frac{4x+11}{(x+2)(x+4)}$

QUESTION 11

Suppose we toss a coin twice. What is the probability of landing two tails?

A. $\frac{1}{2}$ B. $\frac{1}{4}$

C. $\frac{1}{6}$ D. $\frac{1}{8}$

QUESTION 12

The centre and the radius of the circle $(x+1)^2+(y-2)^2=9$ respectively are

A. $(1,2)$ *and* 9 B. $(-1,2)$ *and* 9

C. $(-1,2)$ *and* 3 D. $(1,2)$ *and* 3

QUESTION 13

Let $U=\{n|n\in Z,1\le n\le 10\}$, be the universal set and let $A=\{3,4,5,7,8\}$, $B=\{2,4,6,8,10\}$. Then the set $A'\cup B$ in roster (list) form is given by

A. $\{3,4,5,6,7,8,10\}$

B. $\{2,3,4,5,6,7,8,10\}$

C. $\{1,2,4,6,8,9,10\}$

D. $\{2,6,10\}$

QUESTION 14

The value of $\sum_{n=1}^{100}(3n-4)$ is

A. $14,850$ B. $14,851$

C. $14,750$ D. $14,950$

QUESTION 15

Given the system of linear equations

$a_{11}x_1 + a_{12}x_2 = c_1$

$a_{21}x_1 + a_{22}x_2 = c_2$

Using Cramer's Rule, the value of x_1 is given by

A. $x_1 = \dfrac{\begin{vmatrix} a_{11} & c_1 \\ a_{21} & c_2 \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}}$ B. $x_1 = \dfrac{\begin{vmatrix} c_1 & a_{12} \\ c_2 & a_{22} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}}$

C. $x_1 = \dfrac{\begin{vmatrix} a_{11} & c_1 \\ c_2 & a_{22} \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}}$ D. $x_1 = \dfrac{\begin{vmatrix} c_1 & a_{12} \\ a_{21} & c_2 \end{vmatrix}}{\begin{vmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{vmatrix}}$

QUESTION 16

Without using your calculators, given that $\sin\theta = \dfrac{4}{5}$ when $0 \le \theta \le \dfrac{\pi}{2}$, the exact value for $\cot\theta$ is

A. $\dfrac{4}{3}$ B. $\dfrac{5}{3}$

C. $\dfrac{3}{4}$ D. $\dfrac{3}{5}$

QUESTION 17

The unit vector in the same direction as vector $\underset{\sim}{v} = 2\underset{\sim}{i} - 5\underset{\sim}{j} + 2\underset{\sim}{k}$ is

A. $\dfrac{-2}{\sqrt{33}}\underset{\sim}{i} + \dfrac{5}{\sqrt{33}}\underset{\sim}{j} - \dfrac{2}{\sqrt{33}}\underset{\sim}{k}$

B. $\dfrac{-\sqrt{33}}{2}\underset{\sim}{i} + \dfrac{\sqrt{33}}{5}\underset{\sim}{j} - \dfrac{\sqrt{33}}{2}\underset{\sim}{k}$

C. $\dfrac{\sqrt{33}}{2}\underset{\sim}{i} - \dfrac{\sqrt{33}}{5}\underset{\sim}{j} + \dfrac{\sqrt{33}}{2}\underset{\sim}{k}$

D. $\dfrac{2}{\sqrt{33}}\underset{\sim}{i} - \dfrac{5}{\sqrt{33}}\underset{\sim}{j} + \dfrac{2}{\sqrt{33}}\underset{\sim}{k}$

QUESTION 18

If $y = 3x^2 + 3\sin x$, $\dfrac{dy}{dx}$ is equal to

A. $6x + 3\cos x$ B. $6x - 3\cos x$

C. $\dfrac{3}{2}x + 3x\cos x$ D. $\dfrac{3}{2}x - 3x\cos x$

QUESTION 19

Given that $y = 2x^2 + x$, the value of $\dfrac{dy}{dx}$ at the point $x = 2$ is equal to

A. 5 B. 17

C. 12 D. 9

QUESTION 20

The value of $\displaystyle\int_0^1 2x\,dx$ is equal to

A. 0 B. -1

C. 1 D. $\dfrac{1}{2}$

QUESTION 21

The solution of the linear inequality $2x-1 \leq 3x+3$ on a real number line is

A. 

B. 

C. 

D. 

QUESTION 22

Fully factorise $(y+4)^2-(y-2)^2$.

A. $(y+4)(y-2)$ B. $(y+2)(y+1)$

C. $12(y+1)$ D. $6(y+1)$

QUESTION 23

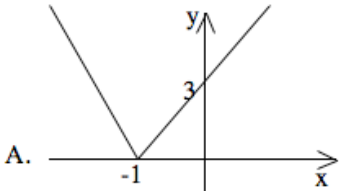
Find the value of a if the polynomial $f(x)=ax^3-12x^2+11x-3$ is divisible by $(2x-3)$.

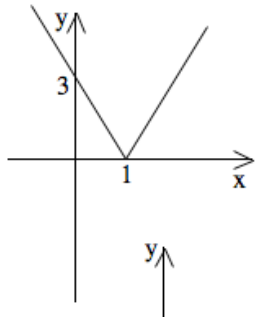
A. $a=\frac{3}{2}$ B. $a=2$

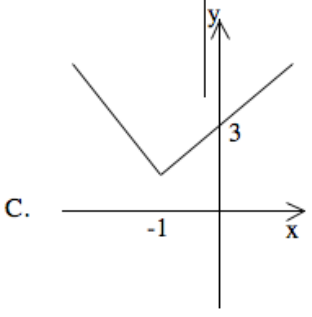
C. $a=3$ D. $a=4$

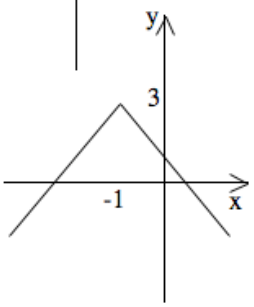
QUESTION 24

The graph of $y=|x+1|+2$ is best represented by

A. 

B. 

C. 

D. 

QUESTION 25

Given the frequency table below

Score (x)	Frequency (f)
1	5
2	8
3	5

What is the mean score?

A. 3.09 B. 2.56

C. 2 D. 8

QUESTION 26

We have three people James, Mary and Jones. There are two positions vacant to be filled by them, "president" and "vice president".

How many possible ways can the positions be filled by these three people?

A. 3 B. 6

C. 4 D. 5

QUESTION 27

A pole 10 metres high casts a shadow 4 metres long. At the same time, another pole casts a shadow 14 metres long.

What is the height of the other pole?

A. 36 metres B. 37 metres

C. 38 metres D. 35 metres

QUESTION 28

A vector of magnitude 10 that is oppositely directed to the vector $\underset{\sim}{w}=-3\underset{\sim}{i}+4\underset{\sim}{j}$ is given by

A. $-6\underset{\sim}{i}-8\underset{\sim}{j}$ B. $6\underset{\sim}{i}-8\underset{\sim}{j}$

C. $6\underset{\sim}{i}+8\underset{\sim}{j}$ D. $-6\underset{\sim}{i}+8\underset{\sim}{j}$

QUESTION 29

The gradient of the parabola $y = x^2$ at the point $x = 3$ is

A. 6 B. 4

C. 2 D. $\frac{1}{2}$

QUESTION 30

The value of $\int 2\sin x\,dx$ is

A. $2x\sin x + c$ B. $2x\cos x + c$

C. $-2\cos x + c$ D. $2\cos x + c$

PART B: SHORT ANSWERS 20 MARKS

Write your answers on the Answer Sheet provided.

QUESTION 31

Rationalize the denominator of the expression $\frac{1}{\sqrt{2}+1}$.

QUESTION 32

Convert $57m^2$ to cm^2.

QUESTION 33

A fertilizer mixture contains 2 parts nitrogen, 3 parts potash and 2 parts phosphate by mass.

How many kilograms of potash are in a bag of fertilizer that weighs 49 kilograms?

QUESTION 34

Write an algebraic equation for the following statement

"The positive difference between the squares of two pronumerals a and b is twice the sum of both."

Note: b is the larger pronumeral

QUESTION 35

What is the domain of the function $y = \sqrt{1-x}$?

QUESTION 36

How many times does the graph of the parabola $y = 4 - x - 3x^2$ cuts the x-axis?

QUESTION 37

Given the four numbers 4, 5, 6 and 7.

How many different three digit numbers can be formed from the four numbers?

QUESTION 38

Consider the contingency table below of 50 women in a group.

Marital Status	Education level		Total
	Educated	Uneducated	
Married	10	20	30
Single	15	35	50
Total	25	55	80

Based on the table, a woman is selected at random.

What is the probability that the woman selected will be an educated woman?

QUESTION 39

Consider the frequency table below of students' marks

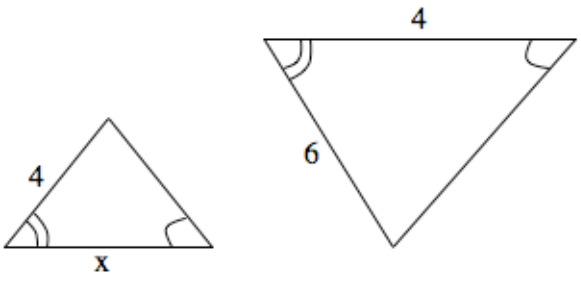
Marks	Tally	Frequency
30 – 39	|	1
40 – 49	|||	3
50 – 59	𝍸	5
60 – 69	𝍸 𝍸	10
70 – 79	|||	3
80 – 89	||	2
90 – 99	|	1

Based on the table what percentage of the students scored marks below 70?

QUESTION 40

Given that the two triangles below are similar.

Calculate the side marked x.



QUESTION 41

The sector of a circle of radius 5 cm subtends an angle of $\frac{3\pi}{10}\ rad$ at the centre.

Calculate the length of the arc.

QUESTION 42

Let the universal set U be the set of all integers Z

If $A = \{x | x \in Z,\ x\ is\ even\}$ and

$B = \{x | x \in Z,\ x\ is\ odd\}$

Determine the set $A' \cap B'$.

QUESTION 43

Express the 3rd term in the binomial expansion of $(1+4x)^7$ in its simplest form.

QUESTION 44

Evaluate the ratio of the determinant.

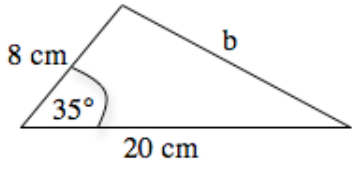
$$\frac{\begin{vmatrix} 2 & 3 \\ -1 & 4 \end{vmatrix}}{\begin{vmatrix} 5 & 1 \\ 6 & 1 \end{vmatrix}}$$

QUESTION 45

If $\cos\theta = 0.58$, find θ given that θ lies between 180° and 360°.

QUESTION 46

Calculate the value of b to the nearest centimetre.



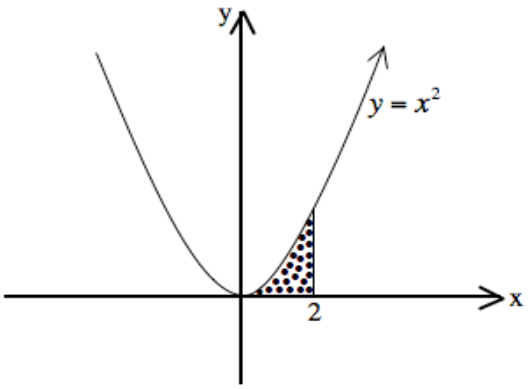
UESTION 47

Given that $\underset{\sim}{a} = 2\underset{\sim}{i} + \underset{\sim}{j}$ and $\underset{\sim}{b} = -3\underset{\sim}{i}$.

Find $\underset{\sim}{a} + \underset{\sim}{b}$.

QUESTION 48

Find the exact area of the shaded region below.



QUESTION 49

Given $y = \sqrt{x}$, find $\frac{dy}{dx}$.

QUESTION 50

Find $\frac{dy}{dx}$ if $y = 3x^2 - 2\sin x + \frac{1}{2}\cos x$.

END OF EXAMINATION

ADVANCE MATHEMATICS - PAPER 1

PART B ANSWER BOOKLET

Write your 10-digit candidate number, your name and your school name in the spaces provided below.

Year		Province		School			Candidate No		
1	4								

Candidate Name: _____

School Name: _____

This answer booklet is for you to write the answers to Part B only.

All Multiple Choice Answers should be on the Electronic Mark Sheet.

All answers must be written neatly in the appropriate spaces in this booklet. **Answers written elsewhere on the question paper (or any other paper) will not be marked.**

TOTAL SCORE

Recorded by: _____

Checked by: _____

ANSWERS TO PART B ONLY

Question 31	
Question 32	
Question 33	
Question 34	
Question 35	

Question 41	
Question 42	
Question 43	
Question 44	
Question 45	

Question 36	
Question 37	
Question 38	
Question 39	
Question 40	

Question 46	
Question 47	
Question 48	
Question 49	
Question 50	

HIGHER SCHOOL CERTIFICATE EXAMINATIONS 2014
FORMULAE SHEET FOR ADVANCE MATHEMATICS

MENSURATION

Arc Length	$L = \frac{\theta}{360} r = 2\pi r$
Area of Sector	$A = \frac{\theta}{360} 2\pi r^2$
Surface Area of Cylinder	$A = 2\pi r^2 + 2\pi rh$
Surface Area of Sphere	$A = 4\pi r^2$
Curved Surface Area of Cone	$A = \pi rL$
Volume of Sphere	$V = \frac{4}{3}\pi r^3$
Interior Angles of Polygon	$s_n = (n-2)\text{x } 180^o$

INTEREST

Compound Interest	$A = P\left(1 + \frac{r}{100}\right)^n$

TRIGONOMETRY

Sin Rule	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
Cosine Rule	$c^2 = a^2 + b^2 - 2ab\cos C$
Area of Triangle	$A = \frac{1}{2}ab\sin C$
Conversion	$\pi^c = 180^o$
Arc Length	$L = r\theta^c$
Area of Sector	$A = \frac{1}{2}r^2\theta^c$
Area of Minor Segment	$A = \frac{1}{2}r^2\left(\theta^c - \sin\theta^\circ\right)$

PERMUTATION AND COMBINATION

PERMUTATION	${}^nP_r = \frac{n!}{(n-r)!}$
COMBINATION	${}^nC_r = \frac{n!}{r!(n-r)!}$

SERIES

Arithmetic Progression	$T_n = a + (n-1)d$
	$S_n = \frac{n}{2}(a + l)$
	$S_n = \frac{n}{2}(2a + [n-1]d)$
Geometric progression	$T_n = ar^{n-1}$
	$S_n = \frac{a(r^n-1)}{r-1} = \frac{a(1-r^n)}{1-r}$, for $r \neq 1$
	$S_\infty = \frac{a}{1-r}$, for $-1 < r < 1$

ALGEBRA

Quadratic Formula	$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$
First Derivative	$f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h} = \lim_{\Delta x\to 0} \frac{f(x+\Delta x)-f(x)}{\Delta x}$

ANALYTIC GEOMETRY

Distance between two points	$d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$
Mid-point of Interval	$\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$
Gradient of a Line	$\frac{y_2-y_1}{x_2-x_1} = m = tan\,\theta$
ABSOLUTE VALUE	$\lvert x\rvert = \begin{cases} -x, & \text{if } x < 0 \\ x, & \text{if } x \geq 0 \end{cases}$

BINOMIAL EXPANSION

$$(x+y)^n = x^n + \binom{n}{1}x^{n-1}y + \binom{n}{2}x^{n-2}y^2 + \cdots + y^n \text{ where } \binom{n}{r} = \frac{n!}{r!(n-r)!}$$