HORNSBY GIRLS HIGH SCHOOL

Mathematics Extension 1

Year 12 Higher School Certificate
Assessment Task 2 Term 1 2020

STUDENT NUMBER: ______________________

General Instructions

- Working Time – 75 minutes
- Reading Time – 5 minutes
- Write using black pen
- NESA approved calculators may be used
- The NESA Reference Sheet is provided separately
- In Questions 6 – 9, show relevant mathematical reasoning and/or calculations
- Marks may be deducted for untidy and poorly arranged work
- Do not use correction fluid or tape
- Do not remove this paper from the examination

Total marks – 42

Section I Pages 2 – 3

5 marks

Attempt Questions 1 – 5. Answer on the Objective Response Answer Sheet

Section II Pages 5 – 9

37 marks

Attempt Questions 6 – 9.

Start each question in a new writing booklet.

Write your **full** student number and fill in the required information on each booklet

Question Total	***1-5***	***6***	***7***	***8***	***9***	***Total***
	/5	*/9*	*/10*	*/9*	*/9*	*/42*

This assessment task constitutes 25% of the Higher School Certificate Course School Assessment

Section I

5 marks
Attempt Questions 1– 5

Answer on the Objective Response Answer Sheet

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1. Find $\underset{\sim}{u} = \underset{\sim}{v} + 3\underset{\sim}{w}$ if $\underset{\sim}{v} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$ and $\underset{\sim}{w} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$.

(A) $\underset{\sim}{u} = \begin{pmatrix} -3 \\ 13 \end{pmatrix}$

(B) $\underset{\sim}{u} = \begin{pmatrix} 7 \\ -1 \end{pmatrix}$

(C) $\underset{\sim}{u} = \begin{pmatrix} 13 \\ -3 \end{pmatrix}$

(D) $\underset{\sim}{u} = \begin{pmatrix} -1 \\ 7 \end{pmatrix}$

2. What is the middle term of the expansion $\left(4a + \frac{b^3}{6}\right)^8$?

(A) ${}^8C_4(4a^4)\left(\frac{b^{12}}{6}\right)$

(B) ${}^8C_4(4a)^4\left(\frac{b^3}{6}\right)^4$

(C) ${}^8C_5(4a)^3\left(\frac{b^3}{6}\right)^5$

(D) ${}^8C_3(4a)^5\left(\frac{b^3}{6}\right)^3$

3. In how many ways can 6 people from a group of 15 people be chosen and then arranged in a circle?

(A) $\dfrac{14!}{8!}$

(B) $\dfrac{14!}{8!6!}$

(C) $\dfrac{15!}{9!}$

(D) $\dfrac{15!}{9!6}$

4. The water in a river flows at a rate of $6\sqrt{3}$ km/h. Sayan can row at a speed of 12 km/h. In what direction should Sayan row in order to go straight across the river?

(A) Angle of 30^o to the riverbank downstream

(B) Angle of 30^o to the riverbank upstream

(C) Angle of 60^o to the riverbank downstream

(D) Angle of 60^o to the riverbank upstream

5. In how many ways can a number plate containing two letters followed by two numbers followed by two letters be formed if the letter M must appear at least once?

(A) $26^4 \times 10^2$

(B) $25^4 \times 10^2$

(C) $10^2(26 \times 25 \times 24 \times 23)$

(D) $10^2(26^4 - 25^4)$

End of Section 1

Section II
37 marks
Attempt Questions 6 – 9

Begin each question in a new writing booklet, indicating the question number and number of booklets used. Extra writing booklets are available

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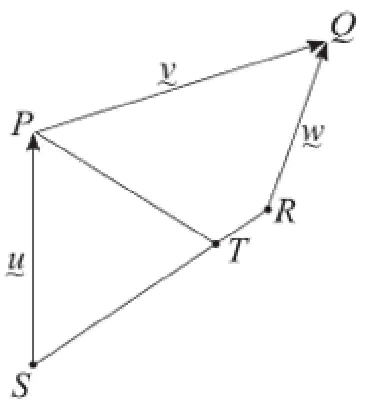
Question 6 (9 marks) Start a new writing booklet

(a) What is the constant term in the expansion of $\left(x - \dfrac{1}{2x^3}\right)^{20}$? **2**

(b) In the quadrilateral *PQRS*, *T* lies on *SR* such that *ST* : *TR* = 3 : 1. Let $\overrightarrow{SP} = \underset{\sim}{u}$, $\overrightarrow{PQ} = \underset{\sim}{v}$ and $\overrightarrow{RQ} = \underset{\sim}{w}$.



NOT TO SCALE

(i) Find $\overrightarrow{TS}$ in terms of $\underset{\sim}{u}, \underset{\sim}{v}$ and $\underset{\sim}{w}$. **1**

(ii) Hence or otherwise, find $\overrightarrow{TP}$ in terms of $\underset{\sim}{u}, \underset{\sim}{v}$ and $\underset{\sim}{w}$. **2**

(c) (i) Express $\sqrt{3}\sin 2x - \cos 2x$ in the form $R\sin(2x - \beta)$ **2**

(ii) Hence or otherwise, solve $\sqrt{3}\sin 2x - \cos 2x = 1$ in the domain $[0, 2\pi]$ **2**

End of Question 6

Question 7 (10 marks)   Start a new writing booklet

(a) (i) The letters of the word *TARGET* are arranged in a line. How many arrangements are possible if:

(α) there are no restrictions **1**

(β) the vowels are separated **2**

(ii) How many arrangements are possible if only <u>three</u> letters are chosen at a time? **2**

(b) Solve for x: $40 - 8\cos(2x + \pi) = 36$ in the domain $0 \le x \le 2\pi$. **3**

(c) Calculate the angle between the two vectors $\underset{\sim}{u} = (5, 24)$ and $\underset{\sim}{v} = (1, 3)$, expressing your answer correct to the nearest degree. **2**

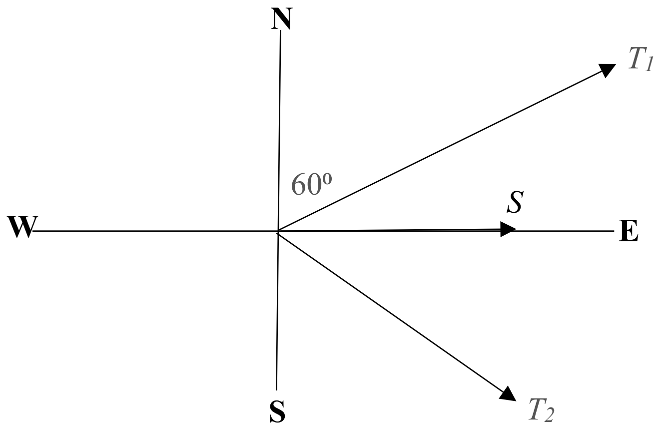
End of Question 7

Question 8 (9 marks) Start a new writing booklet

(a) Prove ${}^{n}P_{r} + r({}^{n}P_{r-1}) = {}^{n+1}P_{r}$ **2**

(b) Find the vector projection of $\underset{\sim}{a} = 6\underset{\sim}{i} + 8\underset{\sim}{j}$ onto $\underset{\sim}{b} = \underset{\sim}{i} - 6\underset{\sim}{j}$. **2**

(c) A large ship, S, is being towed by two tugs. The larger tug, T_1, exerts a force that is 25 percent greater than the smaller tug, T_2, and at an angle of N60ºE. **3**



NOT TO SCALE

Which direction must the smaller tug pull to ensure that the ship travels <u>due east</u>?

(d) A bundle of 51 letters are placed into 12 different letterboxes.

(i) Show that there is at least one letterbox with at least 5 letters. **1**

(ii) What is the minimum number of letters to ensure that there is at least one letterbox with eight letters? **1**

End of Question 8

Question 9 (9 marks) Start a new writing booklet

(a) Find the value of k in the expansion $\left(kx^3 + \frac{1}{x}\right)^4$ if the coefficients of the first term and third term are in the ratio 3:2 respectively. **3**

(b) Using t-formulae, solve for x in the domain $[0,2\pi]$ **3**

$$\sqrt{3}\sin x - \cos x = 1$$

(c) Use the products to sums identity to solve: $\sin x + 2\cos 2x \sin x = \frac{1}{2}$, $0 \le x \le 2\pi$. **3**

End of paper

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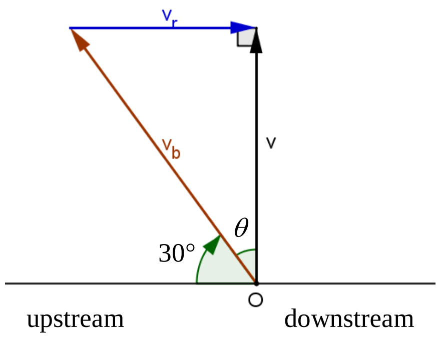
Solutions of Mathematics Extension 1 Assessment Task 2, Term 1 2020

Section I

SOLUTION	COMMENT
Question 1 $\underset{\sim}{u} = \underset{\sim}{v} + 3\underset{\sim}{w}$ $= \begin{pmatrix} 3 \\ -2 \end{pmatrix} + 3\begin{pmatrix} -2 \\ 5 \end{pmatrix}$ $= \begin{pmatrix} 3 \\ -2 \end{pmatrix} + \begin{pmatrix} -6 \\ 15 \end{pmatrix}$ $= \begin{pmatrix} -3 \\ 13 \end{pmatrix}$ **(A)**	1% chose **(C)**
Question 2 $\left(4a + \frac{b^3}{6}\right)^8$ has 9 terms, $\therefore$ middle term is the 5th term $T_5 = \binom{8}{4}(4a)^4\left(\frac{b^3}{6}\right)^4$ **(B)**	4% chose **(A)** 15% chose **(C)** 3% chose **(D)**
Question 3 Choosing 6 people from 15 i.e. $\binom{15}{6} = \frac{15!}{9!6!}$ Then arranging 6 people in a circle = 5! The no. of ways $= \frac{15!}{9!6!} \times 5!$ $= \frac{15!}{9! \times 6 \times 5!} \times 5!$ $= \frac{15!}{9! \times 6}$ **(D)**	5% chose **(A)** 24% chose **(B)** 8% chose **(C)**
Question 4 $\theta = \sin^{-1}\left\lvert\frac{\underset{\sim}{v}_r}{\underset{\sim}{v}_b}\right\rvert$ $= \sin^{-1}\left\lvert\frac{6\sqrt{3}}{12}\right\rvert$ $= \sin^{-1}\frac{\sqrt{3}}{2}$ $= 60^\circ$  $\therefore 30°$ upstream **(B)**	12% chose **(A)** 6% chose **(C)** 31% chose **(D)**
Question 5 26 alphabets and 10 numbers. Without letter M: then 25 alphabes letter letter number number letter letter **25** | **25** | **10** | **10** | **25** | **25** With at least 1 M: no of ways $= 26^4 \times 10^2 - 25^4 \times 10^2$ $= 10^2\left(26^4 - 25^4\right)$ **(D)**	6% chose **(A)** 10% chose **(B)** 10% chose **(C)**

Section II

<table>
<tr><th>SOLUTION</th><th>COMMENT</th></tr>
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Question 6(a)

$\left(x-\frac{1}{2x^3}\right)^{20} \qquad T_{r+1}=\binom{20}{r}x^{20-r}\left(-\frac{1}{2x^3}\right)^r$

$=\binom{20}{r}x^{20-r}\left(-\frac{1}{2}\right)^r x^{-3r}$

$=\binom{20}{r}\left(-\frac{1}{2}\right)^r x^{20-4r}$

For constant, $x^{20-4r}=x^0$

$20-4r=0$

$4r=20$

$\therefore r=5$

Hence the constant term is $T_6=\binom{20}{5}\left(-\frac{1}{2}\right)^5 x^{20-4(5)}$

$=\binom{20}{5}\left(-\frac{1}{2}\right)^5$

$=-\binom{20}{5}\left(-\frac{1}{32}\right)$

$=-484\frac{1}{2}$

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1 for identifying that the constant occurs when r=5

1 for the constant term.
A large number of students missed the negative sign. This was not penalized this time but students should take care with this in future.

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Question 6(b)

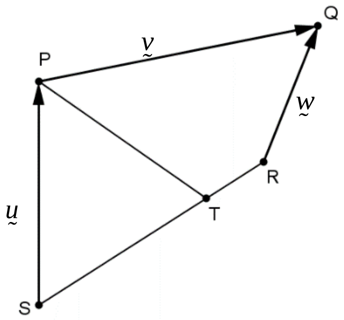
(i) $ST:TR=3:1$

$\frac{ST}{TR}=\frac{3}{1}$

$ST=3TR$

$\therefore \overrightarrow{TR}=\frac{1}{4}\overrightarrow{SR}$

$\therefore \overrightarrow{ST}=\frac{3}{4}\overrightarrow{SR}$



$\therefore \overrightarrow{SR}=\overrightarrow{SP}+\overrightarrow{PQ}+\overrightarrow{QR}$

$=\overrightarrow{SP}+\overrightarrow{PQ}-\overrightarrow{RQ}$

$=\underset{\sim}{u}+\underset{\sim}{v}-\underset{\sim}{w}$

$\therefore \overrightarrow{ST}=\frac{3}{4}\left(\underset{\sim}{u}+\underset{\sim}{v}-\underset{\sim}{w}\right)$

$=\frac{3}{4}\underset{\sim}{u}+\frac{3}{4}\underset{\sim}{v}-\frac{3}{4}\underset{\sim}{w}$

$\therefore \overrightarrow{TS}=\frac{3}{4}\underset{\sim}{w}-\frac{3}{4}\underset{\sim}{u}-\frac{3}{4}\underset{\sim}{v}$

(ii) $\therefore \overrightarrow{TP}=\overrightarrow{TS}+\overrightarrow{SP}$

$=\left(\frac{3}{4}\underset{\sim}{w}-\frac{3}{4}\underset{\sim}{u}-\frac{3}{4}\underset{\sim}{v}\right)+\underset{\sim}{u}$

$=\frac{3}{4}\underset{\sim}{w}+\frac{1}{4}\underset{\sim}{u}-\frac{3}{4}\underset{\sim}{v}$

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Other methods were more complicated and resulted in more errors

$\overrightarrow{QR}=\underset{\sim}{w} \quad \therefore \overrightarrow{RQ}=-\underset{\sim}{w}$

Done well by students

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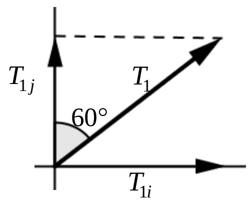
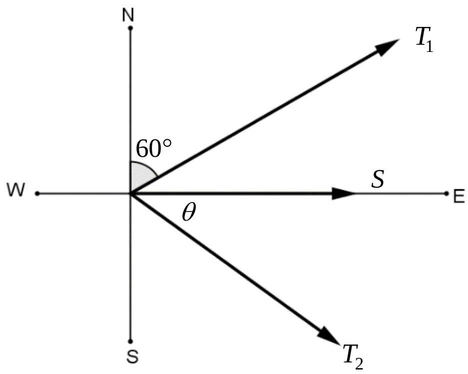
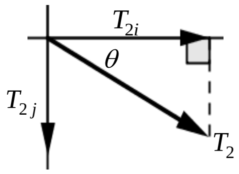
SOLUTION	COMMENT
Question 6(c) (i) Let $\sqrt{3}\sin 2x - \cos 2x \equiv R\sin(2x-\beta)$ where $R=\sqrt{a^2+b^2}$, i.e. $a=\sqrt{3}$ and $b=1$ $=\sqrt{(\sqrt{3})^2+(1)^2}$ $=\sqrt{4}$ $=2$ $\beta=\tan^{-1}\left(\frac{b}{a}\right)$ $=\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$ $=\frac{\pi}{6}$ $\therefore \sqrt{3}\sin 2x-\cos 2x \equiv 2\sin\left(2x-\frac{\pi}{6}\right)$	Done well by most students Common errors resulted in $2\sin\left(2x+\frac{\pi}{6}\right)$ or $2\sin\left(2x-\frac{\pi}{3}\right)$
(ii) $\sqrt{3}\sin 2x-\cos 2x=1,\quad 0\le x\le 2\pi$ $2\sin\left(2x-\frac{\pi}{6}\right)=1,\quad 0\le 2x\le 4\pi$ $\sin\left(2x-\frac{\pi}{6}\right)=\frac{1}{2}$ **(QI, II)** $2x-\frac{\pi}{6}=\frac{\pi}{6},\ \pi-\frac{\pi}{6},\ 2\pi+\frac{\pi}{6},\ 3\pi-\frac{\pi}{6}$ $2x-\frac{\pi}{6}=\frac{\pi}{6},\ \frac{5\pi}{6},\ \frac{13\pi}{6},\ \frac{17\pi}{6}$ $2x=\frac{\pi}{3},\ \pi,\ \frac{7\pi}{3},\ 3\pi$ $\therefore x=\frac{\pi}{6},\ \frac{\pi}{2},\ \frac{7\pi}{6},\ \frac{3\pi}{2}$	Many students did not find the last two solutions and struggled with angles of any magnitude. 1 for dealing with $\left(2x-\frac{\pi}{6}\right)$ leading to a correct solution 1 for **four** correct solutions
7(a)(i)(α) TARGET 6 letters, 2 vowels ------------ 2 Without restriction, no. of ways $=\frac{6!}{2!}$ $=360$ (β) Vowels together: no. of ways for {A, E} = 2! No. of ways arranging the 6 letters with vowels together $=\frac{5!}{2!}\times 2!$ $=5!$ $=120$ $\therefore$No. of ways arranging the 6 letters with vowels separated = 360 – 120 = 240 (ii) Three letters arranged at a time: Case 1: 3 letters containing no "T": 4 letters | 4 | 3 | 2 | $^4P_3=24$	Forgot to divide by 2! For 2 identical 'T' 24% Forgot to multiply by 2! For the arrangements between letter A and E 5% Again forgot to divide by 2! For 2 identical 'T' 29% Did not know what to do 27% Did not realized there are 3 cases to consider and many did not know what to do > 72%

SOLUTION	COMMENT
Question 7(a)(ii) continues Case 2: 3 letters containing one "T": 3 letters [3 | 2 | 1] Choosing 2 other letters ${}^4C_2$ ${}^4C_2 \times 3! = 36$ Case 2: 3 letters containing two "T": 3 letters Choosing 1 other letter ${}^4C_1$ [3 | 2 | 1] ${}^4C_1 \times \frac{3!}{2!} = 12$ Hence no. of possible arrangements = 24 + 36 + 12 = 72	
Question 7(b) $40 - 8\cos(2x+\pi) = 36, \quad 0 \le x \le 2\pi$ Since $\cos(\pi+\theta) = -\cos\theta, \quad 0 < x < \frac{\pi}{2}$ $40 - 8(-\cos 2x) = 36$ $40 + 8\cos 2x = 36$ $8\cos 2x = -4, \quad 0 \le 2x \le 4\pi$ $\cos 2x = -\frac{1}{2}$ **(QII, III)** $2x = \pi - \frac{\pi}{3},\ \pi + \frac{\pi}{3},\ 3\pi - \frac{\pi}{3},\ 3\pi + \frac{\pi}{3}$ $2x = \frac{2\pi}{3},\ \frac{4\pi}{3},\ \frac{8\pi}{3},\ \frac{10\pi}{3}$ $\therefore x = \frac{\pi}{3},\ \frac{2\pi}{3},\ \frac{4\pi}{3},\ \frac{5\pi}{3}$	Students need to learn the technique of adjusting domain to give them the range of angles to include as well as reject. Only one student realized that $\cos(\pi+\theta) = -\cos\theta$ Using general solutions: there are more cases of error where the major problem is having the wrong formula. Students need to more practice with the techniques of solving trigonometric equations with complex angle function.
7(c) $\cos\theta = \frac{\underset{\sim}{u} \bullet \underset{\sim}{v}}{\lvert\underset{\sim}{u}\rvert \lvert\underset{\sim}{v}\rvert}$ $= \frac{(5\underset{\sim}{i} + 24\underset{\sim}{j}) \bullet (\underset{\sim}{i} + 3\underset{\sim}{j})}{\sqrt{(5)^2 + (24)^2} \times \sqrt{(1)^2 + (3)^2}}$ $= \frac{5 + 3(24)}{\sqrt{106} \times \sqrt{10}}$ $= \frac{77}{\sqrt{1060}}$ $\therefore \theta = 6.6666...^\circ$ $\therefore \theta = 7^\circ$ (to the nearest degree)	In future, students should highlight the statement "to the nearest degree" and checked their answers against the highlighted statement before they leave that question.
8(a) <u>To prove</u>: ${}^nP_r + r({}^nP_{r-1}) = {}^{n+1}P_r$ <u>Proof</u>: LHS $= {}^nP_r + r({}^nP_{r-1})$ $= \frac{n!}{(n-r)!} + r\left[\frac{n!}{(n-(r-1))!}\right]$ $= \frac{n!}{(n-r)!} + \frac{r(n!)}{(n-r+1)!}$ $= \frac{(n-r+1)n! + r(n!)}{(n-r+1)!}$ $= \frac{n!n - n!r + n! + r(n!)}{(n-r+1)!}$	Mostly well answered. Some didn't remember the formula for nPr correctly. Some fudged without showing all necessary steps to prove LHS=RHS.

SOLUTION	COMMENT
Question 8(a) continues $= \frac{n!n+n!}{(n-r+1)!}$ $= \frac{(n+1)n!}{(n+1-r)!}$ $= \frac{(n+1)!}{[(n+1)-r]!}$ $= {}^{n+1}P_r$ $\therefore$ LHS = RHS (as required)	
Question 8(b) $\underset{\sim}{a} = 6\underset{\sim}{i} + 8\underset{\sim}{j}$ onto $\underset{\sim}{b} = \underset{\sim}{i} - 6\underset{\sim}{j}$ Scalar projection of $\underset{\sim}{a}$ onto $\underset{\sim}{b} = \underset{\sim}{a} \bullet \hat{\underset{\sim}{b}}$ $= (6\underset{\sim}{i} + 8\underset{\sim}{j}) \bullet \frac{\underset{\sim}{i} - 6\underset{\sim}{j}}{\sqrt{(1)^2 + (6)^2}}$ $= \frac{6-48}{\sqrt{37}}$ $= -\frac{42}{\sqrt{37}}$ vector projection of $\underset{\sim}{a}$ onto $\underset{\sim}{b} = (\underset{\sim}{a} \bullet \hat{\underset{\sim}{b}}) \bullet \hat{\underset{\sim}{b}}$ $= -\frac{42}{\sqrt{37}} \bullet \frac{(\underset{\sim}{i} - 6\underset{\sim}{j})}{\sqrt{37}}$ $= -\frac{42}{37}(\underset{\sim}{i} - 6\underset{\sim}{j})$	Mostly well answered. Some didn't remember how to find dot product of two vectors. Some didn't remember how to find vector projection.
Question 8(c)    Given: $T_1 = 1.25T_2$ — ① Vertically, $\sum F_j = 0$ $T_1 \cos 60^\circ = T_2 \sin\theta$ — ② Sub ① into ② $1.25T_2 \cos 60^\circ = T_2 \sin\theta$ $1.25\cos 60^\circ = \sin\theta$ $1.25\left(\frac{1}{2}\right) = \sin\theta$ $\sin\theta = 0.625$ $\therefore \theta = 38.682...^\circ$ Bearing: $90^\circ - 38.68^\circ = 51.32^\circ$ i.e. $S51.32^\circ W$	Many were able to use Trig to find the components for the forces. Some didn't use the condition that the j component of the resultant force is zero. Some mistakes shows that 0.75T1=T2 whereas it should be T1=1.25T2.

SOLUTION	COMMENT
Question 8(c)cont. or $90^\circ + 38.68^\circ = 128.68^\circ T$ Hence the smaller tug has to move in the direction of $S51.32^\circ W$ or $128.68^\circ T$.	
Question 8(d) (i) Note: "Show" Question By Pigeonhole principle, 51 letters to be placed in 12 letterboxes, each of the 12 letterbox can hold 4 letters per letterbox with 3 letters left over, i.e. $\frac{51}{12} = 4.25$ letters per letterbox. The three extra letters can be placed into any of the 12 letterboxes in any combination such as one letter extra into any three letterboxes, or one and two letters into any two of the 12 letter boxes, or all three into any one of the 12 letterboxes. Hence at least one of the 12 letterboxes with at least 5 letters. (ii) $(8-1)\times 12 + 1 = 84 + 1$ $= 85$ Hence the minimum number of letters is 85 required.	Most of students didn't explain in more detail how pigeonhole principle is applied in this case. See the sample solution on the left. Mostly well answered. Some multiple 12 by 8.
9.(a) $\left(kx^3 + \frac{1}{x}\right)^4 = \left(kx^3\right)^4 + 4\left(kx^3\right)^3\left(\frac{1}{x}\right) + 6\left(kx^3\right)^2\left(\frac{1}{x}\right)^2 + \ldots$ $= k^4x^{12} + 4k^3x^{9-1} + 6k^2x^{6-2} + ..$ Given: $T_1 : T_3 = 3:2$ $\frac{T_1}{T_3} = \frac{3}{2}$ $2T_1 = 3T_3$ $2k^4 = 3\left(6k^2\right)$ $2k^4 = 18k^2$ $k^4 = 9k^2$ $k^4 - 9k^2 = 0$ $\left(k^2 - 9\right)k^2 = 0$ $k^2 - 9 = 0, \quad k \neq 0$ $k^2 = 9$ $\therefore k = \pm 3$	Poorly done. Many students didn't separate the coefficients from the variable thus making their working out very confusing. Some students disregarded -3
9.(b) $\sqrt{3}\sin x - \cos x = 1, \quad 0 \le x \le 2\pi$ $\sqrt{3}\left(\frac{2t}{1+t^2}\right) - \left(\frac{1-t^2}{1+t^2}\right) = 1$ where $t = \tan\frac{x}{2}$ $\frac{2\sqrt{3}t - \left(1-t^2\right)}{1+t^2} = 1, \quad 0 \le t \le \pi$ $2\sqrt{3}t - 1 + t^2 = 1 + t^2$ $2\sqrt{3}t - 1 = 1$ $2\sqrt{3}t = 2$ $t = \frac{2}{2\sqrt{3}}$ $t = \frac{1}{\sqrt{3}}$ $\tan\frac{x}{2} = \frac{1}{\sqrt{3}}$ **(QI)** (continues next page)	Many algebraic errors due to the surd.

SOLUTION	COMMENT
Question 9(b)cont. $\frac{x}{2}=\frac{\pi}{6}$ $\therefore x=\frac{\pi}{3}$ **Testing** for when $x=\pi$, LHS $=\sqrt{3}\sin\pi-\cos\pi$ $=\sqrt{3}(0)-(-1)$ $=1$ $\therefore$ LHS = RHS $\therefore x=\frac{\pi}{3},\ \pi$	Some students also found the angle in the third quadrant. However this angle ended up outside the domain. Many students did not test the solution $x=\pi$
Question 9(c) $\sin x+2\cos 2x\sin x=\frac{1}{2},\quad 0\le x\le 2\pi$ $\sin x+\left[\sin(2x+x)-\sin(2x-x)\right]=\frac{1}{2}$ $\sin x+\sin 3x-\sin x=\frac{1}{2}$ $\sin 3x=\frac{1}{2},\quad 0\le 3x\le 6\pi$ **(QI, II)** $3x=\frac{\pi}{6},\ \pi-\frac{\pi}{6},\ 2\pi+\frac{\pi}{6},\ 3\pi-\frac{\pi}{6},$ $4\pi+\frac{\pi}{6},\ 5\pi-\frac{\pi}{6}$ $3x=\frac{\pi}{6},\ \frac{5\pi}{6},\ \frac{13\pi}{6},\ \frac{17\pi}{6},\ \frac{25\pi}{6},\ \frac{29\pi}{6}$ $\therefore x=\frac{\pi}{18},\ \frac{5\pi}{18},\ \frac{13\pi}{18},\ \frac{17\pi}{18},\ \frac{25\pi}{18},\ \frac{29\pi}{18}$ ☺ **THE END** ☺	Quite a few students did not use the product to sum identity and tried solving algebraically. Otherwise, this question was answered well.