Format of question paper

Sections in question paper

This paper consists of 25 questions and candidates are required to answer all questions. Each question is presented in a bilingual format on the same page, beginning with English in one paragraph followed by the bahasa Melayu version in the next. Candidates are allowed to answer either in English or in BM.

Type of items

This question paper consists of 25 graded objective items. The construct weightage is 10% on knowledge and 90% on application skills. The levels of difficulty of the items i.e. low, moderate and high in this paper are in the ratio

6 : 3 :1.

Duration of paper

Two hours.

Award of marks

Total marks for the paper is 80.

Overall performance

Only a small number of candidates have displayed high performance. Almost half of the candidates have achieved average performance. Candidates in this achievement group are still weak in topics like logarithm, trigonometry, probability distributions, permutations and combinations. A large number of candidates fall in the category of low achievers. Some of the candidates in this group do not have the basic knowledge and skills in algebraic manipulation.

Performance according to achievement group

The high achiever group

Candidates have a good command of mathematical concepts and high manipulative skills. They are able to identify the requirement of questions and apply mathematical concepts to obtain complete and accurate answers.

The presentation of working is well organized, clear and systematic with correct methods and formulae used. Answers and working presented using diagrams and graphics as in questions 6 and 17(b) are simple, clear and precise.

Varied strategies are displayed to solve certain problems such as those in Quadratic Equations(question 4), Indices(question 7), Logarithm(question 8), Circular Measure(question 18) and Permutations and Combinations(question 23).

The average achiever group

Candidates in this group have the knowledge and understanding of some simple basic concepts such as identifying the first term and common difference in Arithmetic Progression. They understand the requirement of simple questions and are able to apply mathematical concepts and skills. However, they are careless in their calculations, algebraic manipulations and approximations.

Candidates are able to give accurate answers to easy questions. Their answers to moderate and difficult items are incomplete or inaccurate because the values used in the working are carelessly obtained (either by miscalculation or inaccurate approximation). Candidates' working is less organized and less systematic.

Candidates are able to define questions 6 (quadratic inequality) and 17 (trigonometric functions) using diagrams but wrong labelling results in inaccurate answers obtained.

The low achiever group

Candidates in this group do not have the knowledge and basic mathematical skills to answer most of the questions. They do not understand the tasks involved because their command of simple basic concepts is weak.

Candidates are also weak in applying formulae. They are unable to substitute correct values in the formula because they do not understand the notations or symbols involved.

Detail Performance Based on Questions

Question 1(a)

Candidates' Strength:

They are able to Identify the value of t which corresponds to the value of y = 0. They are also able to solve the equation which involves modulus.

Example:

a) $f(x) = |2x-1|$

$y = |2x-1|$

when $y=0$

$0 = |2x-1|$

$0 = 2x-1$

$2x = 1$

$x = \frac{1}{2}$

$x = t$

$\therefore t = \frac{1}{2}$

Question 1(b)

Candidates' Strength

They are able to substitute the value of x = 5 into the given function i.e. f(5) = 9

Example

b) Range = $\{1, 9\}$

At the point $(5, y)$

$y = |2(5)-1|$

$y = |10-1|$

$y = 9$

Answer / *Jawapan*: (*a*) $t = \frac{1}{2}$

(*b*) $\{1, 9\}$

Candidates' Weakness

Candidates are unable to identify the lower limit f(x).
Some candidates state the range by giving integer images only.

Candidates' common Mistakes

Example 1

(b) $f(x) = |2x-1|$

when $x = 5$,

$y = |2(5) - 1|$

$y = 10 - 1$

$y = 9$

$1 < f(x) < 9$

Candidate mistook the lower limit of the range to be f(0)=1

Example 2

b) $f(0) = |2(0) - 1|$
$= 1$

$f(1) = |2(1) - 1|$
$= 1$

$f(2) = |2(2) - 1|$
$= 3$

$f(3) = |2(3) - 1|$
$= 5$

$f(4) = |2(4) - 1|$
$= 7$

$f(5) = |2(5) - 1|$
$= 9$

Range $= \{1, 3, 5, 7, 9\}$

Answer / *Jawapan*: (*a*) $t =$ 1

(*b*) range $= \{1, 3, 5, 7, 9\}$

Candidates find the corresponding images of 0, 1, 2, 3, 4, 5,

Question 2(a)

Candidates' Strength:

Some candidates are able to determine the inverse function i.e. $g^{-1}(6) = \dfrac{x-2}{5}$ and then substitute with $x = 6$.

Example

$$
\begin{aligned}
a) \quad 5x + 2 &= 6 \\
5x &= 6 - 2 \\
5x &= 4 \\
x &= \frac{4}{5} \\
g^{-1}(6) &= \frac{4}{5}
\end{aligned}
$$

There are others who are able to write the simple equation $5x + 2 = 6$, then solve for x.

Example

$$
\begin{aligned}
a) \quad g(x) &= 5x + 2 \\
5x + 2 &= a \\
5x &= a - 2 \\
x &= \frac{a-2}{5} \\
g^{-1}(x) &= \frac{x-2}{5} \\
g^{-1}(6) &= \frac{(6)-2}{5} \\
&= \frac{4}{5}
\end{aligned}
$$

Candidates' Weakness:

Some candidates do not evaluate $g^{-1}(6)$, while others do not understand the concept of inverse function.

Candidates' common Mistakes:

Example 1

a) $g(x) = 5x + 2$

$$5g^{-1}(x) + 2 = x$$

$$5g^{-1}(x) = x - 2$$

$$g^{-1}(x) = \frac{x-2}{5}$$

The candidates do not evaluate $g^{-1}(6)$ but not write $\frac{x-2}{5}$ as the final answer.

Example 2

$$g^{-1}(6) = \frac{1}{g(6)}$$

$$= \frac{1}{5(6)+2}$$

$$= \frac{1}{32}$$

The candidates find $g(6)$ then write $g^{-1}(6) = \frac{1}{g(6)}$

Question 2(b)

Candidates' Strength:

Some candidates are able to substitute $(5x+2)$ into the function $f(x)$ to obtain the composite function $hg(x)$ as shown in the example below.

Example

$$
\begin{aligned}
\text{b) } hg(x) &= h(5x+2) \\
&= (5x+2)^2 - 4(5x+2)+3 \\
&= 25x^2 + \cancel{20x} + 4 - \cancel{20x} - 8 + 3 \\
&= 25x^2 - 1
\end{aligned}
$$

Candidates' Weakness:

Some candidates are careless in expanding $-4(5x+2)$.
There are others who have not mastered he concept of composite function.

Candidates' common Mistakes:

Example 1

$$
\begin{aligned}
hg(x) &= h[g(x)] \\
&= h[5x+2] \\
&= (5x+2)^2 - 4(5x+2) + 3 \\
&= 25x^2 + 20x + 4 - 20x + 8 + 3 \\
&= 25x^2 - 15
\end{aligned}
$$

Expand $-4(5x+2)$ incorrectly

Example 2

$$
\begin{aligned}
hg(x) &= h(5x+2) \\
&= 5hx + 2h.
\end{aligned}
$$

The candidates mistook the composite function $hg(x)$ as a product of h and $g(x)$

Example 3

$$hg(x) = (x^2 - 4x + 3)(5x + 2)$$

The candidate multiplies the functions $h(x)$ and $g(x)$.

Question 3(b)

Candidates' Strength:

Some excellent candidates are able to understand the meaning of $gf(5)$, hence substitute x with the answer obtained in 3(a) into $kx + 2 = 14$ determine the inverse function i.e. $g^{-1}(x) = \frac{x-2}{5}$ and then substitute with $x = 6$ to obtain the value of k, as shown in the example below.

Example

$$3(b)\quad gf(5) = g(4)$$
$$g(4) = 14$$
$$4k + 2 = 14$$
$$4k = 12$$
$$k = 3$$

Example

There are candidates who find the composite function gf(x) and substitute x = 5 , then equate to 14.

$$b)\quad k(x-1)+2$$
$$k(5-1)+2 = 14$$
$$5k - k = 12$$
$$4k = 12$$
$$k = 3$$

Candidates’ Weakness:

Candidates are confused with the concept of composite function.

Candidates’ common mistakes:

Example 1

b) $gf(5) = 14$

$k(x-1) + 2 - 1 = 14$

$k(5-1) + 2 - 1 = 14$

$k(4) + 2 - 1 = 14$

$4k + 1 = 14$

$4k = 13$

$k = 13/4$ #

The candidate substitutes f(x) into g(x) and retain -1 from f(x)

Example 2

$g[4] = k[x-1] + 2$

$= k(4-1] + 2$

$14 = 3k + 2$

$\frac{12 \cancel{+6}}{3} = k$

$k = 4$ #

The candidate substitutes the value of f(5) from (a) into $gf(x)$ instead of $g(x)$.

Question 4

Candidates' Strength:

Candidates are able to substitute $x = -1$ into the equation and then solve for p as shown in the example below.

Example

$$x^2 - 4x - p = 0$$
$$(-1)^2 - 4(-1) - p = 0$$
$$1 + 4 - p = 6$$
$$5 - p = 0$$
$$-p = -5$$
$$p = 5$$

Candidates' Weakness:

Some candidates have applied the concept of sum of roots and product of roots incorrectly. There are others who are able to find the other root and form the correct equation. However, they are careless in equating.

Candidates' common mistakes:

Example 1

$$-1 + \beta = -4$$
$$\beta = -3$$

The candidates equate the sum of roots to $\frac{b}{a}$ instead of $-\frac{b}{a}$

$$-1 \times -3 = -p$$
$$p = 3$$

The candidates equate the product of roots to $-\frac{c}{a}$ instead of $\frac{c}{a}$.

Example 2

Roots = −1 and 5

$(x+1)(x-5)=0$

$x^2-5x+x-5=0$

$x^2-4x-5=0$

$x^2-4x-5=0$

$x^2-4x-p=0$

$p = -5$

The candidate equates $p = -5$ instead of –p = -5 when comparing the equations.

Question 5

Candidates' Strength

Majority of the candidates are able to identify x = -q as the axis of symmetry and r as the minimum value.

Candidates' Weakness

Many candidates could not relate the key word 'minimum' with the range of p.

Candidates' common mistake

Example

a) $p > 0$

$p < 0$

Candidates know p≠0, but fails to write the correct range

Question 6

Candidates’ Strength

Some candidates are able to convert $x-3\ ^{2} < 5-x$ to the general form $x^2 - 5x + 4 < 0$ and factorise it completely. They are also able to use the number line or graphical method to determine the range of values of x which satisfy the inequality $x^2 - 5x + 4 < 0$.

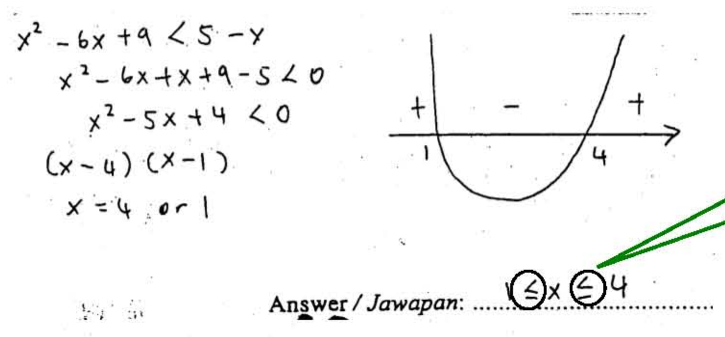
Example

Candidates’ Weakness

Candidates cannot understand the concept of inequality and fail to give the final answer using the correct notation for inequality.

Candidates’ common mistakes

Example 1



Includes the equal sign in the final answer

Example 2

Candidates solve the inequality as an equation keeping the inequality sign.

$$(x-3)^2 < 5 - x$$
$$x^2 - 6x + 9 < 5 - x$$
$$x^2 - 6x + 9 - 5 + x < 0$$
$$x^2 - 5x + 4 < 0$$
$$(x-4) < 0 \quad (x-1) < 0$$
$$x < 4 \quad x < 1$$

Answer / ***Jawapan***: $x < 4$, $x < 1$

Question 7

Candidates' Strength

Many candidates are able to change accurately the numbers 16 and 8 to index form with base 2.

Example

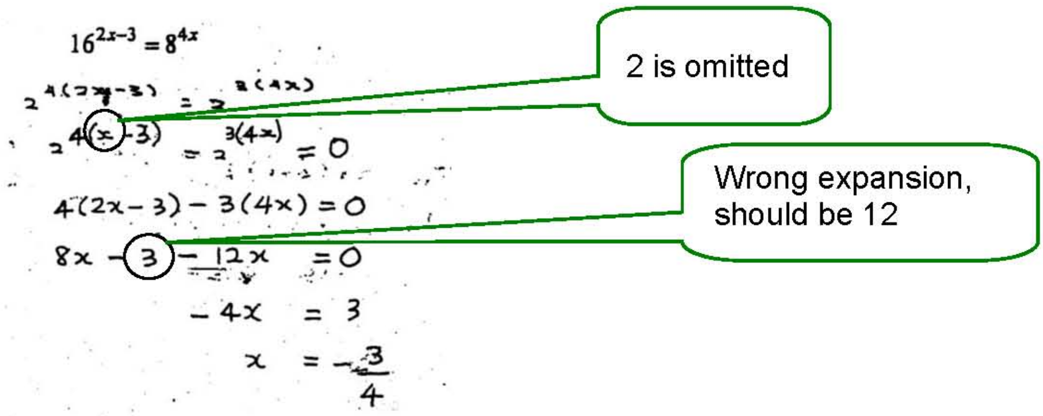
$$(2^4)^{2x-3} = (2^3)^{4x}$$
$$2^{8x-12} = 2^{12x}$$
$$8x - 12 = 12x$$
$$8x - 12x = 12$$
$$-4x = 12$$
$$x = -\frac{12}{4}$$
$$x = -3$$

Candidates' Weakness

Candidates fail to expand correctly the indices obtained.

Candidates' common mistake

Example

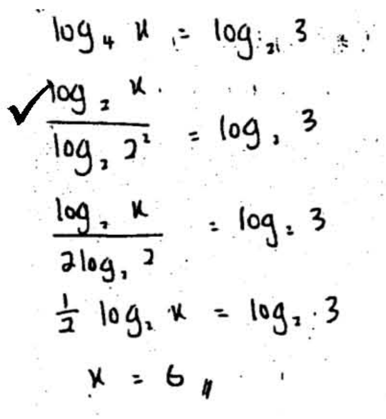


Question 8

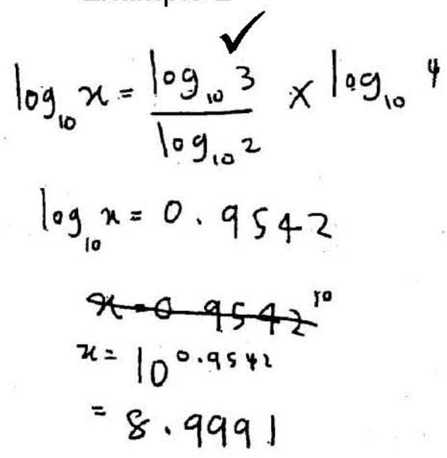
Candidates' Strength

Candidates are able to change the base of logarithms acurately '

Example 1



Example 2



Candidates' Weakness

Candidates are unable to apply the third law of logarithms, i.e. n log x =log x^n accurately.

Candidates' common mistake

Example 1

$$\log_4 x = \log_2 3$$

$$\frac{\log_2 x}{\log_2 2^2} = \log_2 3$$

$$\frac{\log_2 x}{2\log_2 2} = \log_2 3$$

$$\frac{1}{2}\log_2 x = \log_2 3$$

$$x = 6$$

Mistook as $\log_4 \left(\frac{3}{2}\right)$ and apply the quotient law incorrectly

Example 2

$$\log_4 x = \frac{\log_4 3}{\log_4 2}$$

$$\log_4 x = \log_4 3 - 2$$

$$\log_4 x = \log_4 1$$

$$x = 1$$

Wrong manipulation and poor understanding of concept of Laws of logarithms

Question 9

Candidates' Strength

Most candidates are able to find the common ratio and use the formula $T_n=ar^{n-1}$ correctly.

Example

$$T_n = ar^{n-1}$$
$$T_4 = 3(2)^{4-1}$$
$$= 3(2)^3$$
$$= 24$$

Candidates' Weakness

Some candidates carry out the wrong order of operation and fail to expand correctly the indices obtained. There are others who apply the wrong concept of arithmetic progression.

Candidates' common mistakes

Example 1

$$T_4 = ar^{n-1}$$
$$= 3(-2)^{4-1}$$
$$T_4 = -6^3$$
$$= -216$$

3 is multiplied with -2 first

Example 2

$$x - 12 = -6 - 3$$
$$x = 3$$

Find x using common difference

Question 10

Candidates' Strength

Many candidates are able to use the formula $T_n=a+(n-1)d$ of the arithmethic progression. They are able to define the requirement of the question using correct mathematical notations such as $T_n<0$.:

Example

Given : T_n is negative

$T_n = a + (n-1)d$

$T_n = 46 + (n-1)(-3)$

$46 + (n-1)(-3) < 0$

$46 + (-3n+3) < 0$

$46 - 3n + 3 < 0$

$-3n < -49$

$n > 16.33$

$\therefore n = 17$

Candidates' Weakness

Some candidates are unable to translate the information 'the n^{th} term is negative' into a correct mathematical sentence, while others failed to understand that n is an integer.

Candidates' common mistakes

Example 1

$T_n = 46 + (n-1)(-3)$

$= 49 - 3n$

$3n = 49$

$n = \dfrac{49}{3}.$

Treat the expression T_n as an equation

Example 2

$$m = a + (n-1)d$$
$$= 46 + (n-1)d$$
$$= 46 + (n-1) - 3$$
$$-1 = 49 - 3n$$
$$-50 = -3n$$
$$n = 50/3$$
$$= 16.667$$

Cannot deduce
n = 17

Question 11

Candidates' Strength

Most candidates are able to identify the value of a and use the correct formula

$$S_\infty = \frac{a}{1-r}$$

Example

Given : $S_\infty = 16$

$$S_\infty = \frac{a}{1-r}$$
$$\frac{4}{1-r} = 16$$
$$4 = 16(1-r)$$
$$4 = 16 - 16r$$
$$16r = 12$$
$$r = \frac{12}{16}$$

Candidates' Weakness

A few candidates use the wrong formula of $T_n = ar^{n-1}$ instead of $S_\infty = \frac{a}{1-r}$

Some candidates do not simplify the final answer.

Example 1

Given : $S_\infty = 16$

$S_\infty = \frac{a}{1-r}$

$\frac{4}{1-r} = 16$

$4 = 16(1-r)$

$4 = 16 - 16r$

$16r = 12$

$r = \frac{12}{16}$

Answer not simplified to $\frac{3}{4}$

Example 2

$T_n = ar^{n-1}$

$16 = 4r$

$\frac{16}{4} = r$

$r = 4$

Wrong formula used

Question 12(a)

Candidates' Strength

Most candidates are able to use logarithms to convert the given equation to linear form.

Example

$y = k5^{-x}$

$\log_{10} y = \log_{10} k + -x \log_{10} 5$

~~$\log_{10} y = -x \log_{10} 5$~~

$\log_{10} y = -\log_{10} 5x + \log_{10} 5$

Candidates' Common Mistakes

Example

$$y = k5^{-x}$$

$$\log_{10} y = \log_{10} k + -x \log_{10} 5$$

$$\cancel{\log_{10} y = -x \log_{10} 5}$$

$$\log_{10} y = -\log_{10} 5x + \log_{10} 5$$

Should be written as –x log 5 or (-log5) x

Question 12(b)

Candidates' Strength

Some candidates are able to relate the equation in linear form obtained with the given straight line graph.

Example

(b) $\log_{10} k = -2$

$$k = 10^{-2}$$

$$= 0.01$$

Candidates' Common Mistakes

Example

$$\lg y = -x \log 5 + \log k$$

$$y = -5^{x} + k$$

$$-2 = -5^{0} + k$$

$$k = -2 - 1$$

$$k = -3$$

Log has been cancelled throughout

Question 13 (b)

Candidates' Strength

Most students are able to use the distance formula to find the equation of the locus of P accurately.

Example

b) $PS = PT$

$$\sqrt{(x-x_1)^2+(y-y_1)^2} = \sqrt{(x-x_1)^2+(y-y_1)^2}$$

$$(x-3)^2+(y-0)^2 = (x-0)^2+(y-4)^2$$

$$x^2-6x+9+y^2 = x^2+y^2-8y+16$$

$$\cancel{x^2}-\cancel{x^2}+\cancel{y^2}-\cancel{y^2}-6x+8y+9-16=0$$

$$6x-8y+7=0$$

$$6x-8y+7=0$$

Some candidates know that the locus of P is the perpendicular bisector of the straight line ST, hence they are able to find the equation correctly.

Example

b) coordinates of point $P = \left[\frac{nx_1+mx_2}{m+n}, \frac{ny_1+my_2}{m+n}\right]$

$$= \left[\frac{1(3)+1(0)}{2}, \frac{1(0)+1(4)}{2}\right]$$

$$= \left[\frac{3+0}{2}, 2\right]$$

$$= \left[\frac{3}{2}, 2\right]$$

$$M_{ST} = \frac{y_2-y_1}{x_2-x_1}$$

gradient for the equation of locus $P = 3/4$

$$= \frac{4-0}{0-3}$$

$$= -\frac{4}{3}$$

$$M_P M_{ST} = -1$$

$$M_P\left(-\frac{4}{3}\right) = -1$$

$$M_P = 3/4$$

$\therefore$ equation $= y-2 = 3/4x - 9/8$

$y = 3/4x + 7/8$

Answer / *Jawapan*: (a) $\frac{x}{3}+\frac{y}{4}=1$

(b) $y = 3/4x + \frac{7}{8}$

Candidates' Weakness

Some candidates fail to use the condition of the perpendicular line $m_1m_2 = -1$ to find the gradient of the locus of P

Candidates' common mistake

Example 1

b) $y = mx + c$

$y = -\frac{4}{3} + c$

midpoint of $ST = \left(\frac{3+0}{2}, \frac{0+4}{2}\right)$

$= (1.5, 2)$

$P = (1.5, 2)$

$2 = -\frac{4}{3}(1.5) + c$ $\quad \therefore = y = \frac{-4}{3}x + 4$

Gradient should be $\frac{3}{4}$

$2 = -2 + c$

$4 = c$

E

b) $PS = PT$

$= \sqrt{(x-3)^2 + (y-0)^2} = \sqrt{(x-0)^2 + (y-4)^2}$

$= x^2 - 6x + 9 + y^2 = \left(\sqrt{x^2 + y^2 - 8y + 16}\right)^2$

$= x^2 - x^2 + y^2 - y^2 - 6x + 9 + 8y - 16$

$= 8y - 6x - 7$

Answer is given as an expression

Question 14

Candidates' Strength

Some candidates are able to apply the formula of area of triangle by substituting all values accurately and equating with 4. There are others who are able to understand the definition of modulus and give both the correct value of t as the answer:

Example

$$4 = \frac{1}{2}\begin{vmatrix} 0 & 2 & -2 & 0 \\ 3 & t & -1 & 3 \end{vmatrix}$$

$$4 = \frac{1}{2}\left|(0-2-6)-(6-2t-0)\right|$$

$$4 = \frac{1}{2}\left|-8-6+2t\right|$$

$$4 = \frac{1}{2}\left|-14+2t\right|$$

$$8 = -14+2t$$

$$t = 11.$$

$$-(-14+2t) = 8 \Rightarrow 14-2t = 8$$

$$-2t = -6$$

$$t = 3.$$

$$t = 3, 11.$$

Candidates' Weakness

Most candidates are not able to apply correctly the concept of modulus. They treat the modulus notation as a bracket. There are some candidates who understand modulus to be changing the negative sign to positive.

Candidates' common mistakes

Example 1

Area of triangle =

$$4 = \frac{1}{2}\begin{vmatrix} 0 & 2 & -2 & 0 \\ 3 & t & -1 & 3 \end{vmatrix}$$

$$4 = \frac{1}{2}\left|(0-2-6)-(6-2t-0)\right|$$

$$4 = \frac{1}{2}\left|-8-6+2t\right|$$

$$4 = \frac{1}{2}\left|-14+2t\right|$$

$$8 = -14+2t$$

$$t = 11$$

Only one value of t is given

Example 2

$$\text{Area of } \Delta = \frac{1}{2}\begin{vmatrix} 0 & 2 & -2 & 0 \\ 3 & t & -1 & 3 \end{vmatrix}$$

$$\cancel{4 = \frac{1}{2}\left|(-2-6)+(\right.}$$

$$4 = \frac{1}{2}\left|(-2-6)-(6-2t)\right|$$

$$4 = \frac{1}{2}\left|-8-6+2t\right|$$

$$4 = \frac{1}{2}\left|-14+2t\right|$$

$$4 = 7 + t$$

$$\therefore t = -3$$

Negative sign is change to positive when the modulus notation is removed

Question 15

Candidates' Strength

A few candidates are able to apply the concept of two vectors which are non zero and non parallel by equating the coefficients of $\underline{a}$ and $\underline{b}$

Example

$$h + 3 = 0 \qquad k - 5 = 0$$
$$h = -3 \qquad k = 5$$

A small number of candidates apply the concept of equality of vectors and compare coefficients.

Example

$$(h+3)\underline{a} = (k-5)\underline{b}$$
$$h\underline{a} + 3\underline{a} = k\underline{b} - 5\underline{b}$$
$$h\underline{a} - k\underline{b} = -3\underline{a} - 5\underline{b}$$
$$h = -3, \quad k = 5$$

Candidates’ Weakness

Most candidates do not know the concept of non zero and non parallel vectors.

Candidates’ common mistakes

Example 1

$(h+3)\underset{\sim}{a} = (k-5)\underset{\sim}{b}$

$h = k-8$

$(k-8)+3$

$k = -5$

$h = -5-8$

$= -13$

Equating the coefficients of $\underset{\sim}{a}$ and $\underset{\sim}{b}$

Example 2

(a) $h = $ ....3..........

(b) $k = $ ....5..........

Random guessing without any working

Question 16

Candidates' Strength

Most candidates are able to apply the triangle law of vectors correctly to find $\overrightarrow{QR}$.

Example

$$a)\ \overrightarrow{QR} = \overrightarrow{QP} + \overrightarrow{PR}$$
$$= -6\underset{\sim}{b} + 4\underset{\sim}{a}$$
$$= 4\underset{\sim}{a} - 6\underset{\sim}{b}$$

Question 16(b)

Candidates' Strength

Some candidates are able to state $\overrightarrow{QT}$ and $\overrightarrow{TR}$ accurately using the ratio given. They are able to add and /or substact two vectors accurately to find $\overrightarrow{PT}$.

Candidates' Weakness

Many candidates are unable to state $\overrightarrow{QT}$ and $\overrightarrow{TR}$ correctly using the given ratio.

There are others who are unable to substitude $\overrightarrow{QT}$ and $\overrightarrow{TR}$ correctly.

Example 1

$$b)\ \overrightarrow{PT} = \overrightarrow{PQ} + \overrightarrow{QT}$$
$$= 6\underset{\sim}{b} + \frac{1}{4}(4\underset{\sim}{a} - 6\underset{\sim}{b})$$

Should be $\frac{3}{4}(4\underline{a} - 6\underline{b})$

$$= 6\underset{\sim}{b} + (\underset{\sim}{a} - \frac{3}{2}\underset{\sim}{b})$$
$$= \underset{\sim}{a} + 6\underset{\sim}{b} - \frac{3}{2}\underset{\sim}{b}$$
$$= 2\underset{\sim}{a} + 12\underset{\sim}{b} - 3\underset{\sim}{b}$$
$$= 2\underset{\sim}{a} + 9\underset{\sim}{b}$$

Example 2

$$\vec{PT} = \vec{PR} + \vec{RT}$$
$$= 4\underset{\sim}{a} + \frac{1}{3}(4\underset{\sim}{a} - 6\underset{\sim}{b})$$
$$= \frac{16}{3}\underset{\sim}{a} - 2\underset{\sim}{b}$$

Wrong ratio used

Example 3

$$\text{(b)}\quad \vec{RT} = \frac{1}{4}\vec{QR}$$
$$= \frac{1}{4}(4\underset{\sim}{a} - 6\underset{\sim}{b})$$
$$= \underset{\sim}{a} - \frac{3}{2}\underset{\sim}{b}$$
$$\vec{PT} = \vec{PR} + \vec{RT}$$
$$= 4\underset{\sim}{a} + \underset{\sim}{a} - \frac{3}{2}\underset{\sim}{b}$$
$$= 5\underset{\sim}{a} - \frac{3}{2}\underset{\sim}{b}$$

Should be
$$-\frac{1}{4}(4\underline{a} - 6\underline{b})$$

Question 17(a)

Candidates' Strength

Most candidates give the correct answer.

Example

$$\text{cosec}\,\theta = \frac{1}{\sin\theta}$$
$$= \frac{1}{p}$$

Question 17(b)

Candidates' Strength

Many candidates are able to substitute $\sin\theta = p$ into $\sin 2\theta = 2\sin\theta\cos\theta$.

Example

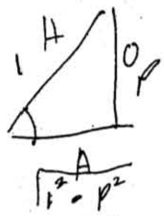
$$\sin 2\theta = 2\sin\theta\cos\theta$$
$$= 2(p)\cos\theta$$
$$= 2p\cos\theta$$

Candidates' Weakness

Some candidates do not apply Pythagoras Theorem to find $\cos\theta$ in terms of p. They are unable to sketch a right-angled triangle in the correct quadrant. A few candidates are not aware that the information given i.e. $90^\circ \leq \theta \leq 180^\circ$ refers to the angle θ in the second quadrant.

Common mistakes

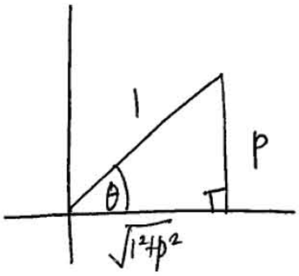
Example 1



Assumes that θ is in the first quadrant, hence the negative sign is omitted

$$\wedge 2p(\sqrt{1^2 - p^2})$$

Example 2



Assumes θ is in the first quadrant and application of Pythagoras Theorem is incorrect

$$\begin{aligned} \sin 2\theta &= 2\sin\theta\cos\theta \\ &= 2p\sqrt{1^2+p^2} \\ &= 2p\sqrt{1+p^2} \end{aligned}$$

Question 18 (a)

Candidates' Strength

Many candidates are able to find $\angle QOR$ in radians correctly.

Example

$$\begin{aligned} &\text{(a) } OQ = 10\text{cm} \\ &\therefore OP = 5\text{cm} \\ &\cos\angle QOR = \frac{5}{10} \\ &\angle QOR = 60^\circ \\ &60^\circ = 60^\circ \times \frac{\pi}{180} \\ &\quad = 1.047 \text{ rad} \end{aligned}$$

Question 18 (b)

Candidates' Strength

Candidates are able to find the area of sector QOR using $\frac{1}{2}r^2\theta$ or $\frac{\theta}{360}\pi r^2$

Triangle POR and the area of shaded region using area of sector QOR – area of triangle POR

Example

b) Area of ~~sector QOR~~ $= \frac{1}{2}r^2\theta$

$= \frac{1}{2}(10)^2(1.05)$

$= 52.5 \text{ cm}^2$

Area of $\triangle$ POR $= \frac{1}{2}(5)(\sqrt{75})$

$= 21.65 \text{ cm}^2$

Area of coloured region

$= (52.5 - 21.65) \text{ cm}^2$

$= 30.85 \text{ cm}^2$

Candidates' Weakness

Candidates do premature approximation in their working. There are others who use the wrong formula to find the area of sector QOR and triangle POR.

Candidates' common mistakes

Example 1

Area of triangle

$= \frac{1}{2} \times 5 \times 10$

$= 25$

Area of coloured region

$= 52.35 - 25$

$= 27.35 \text{ cm}^2$

Wrong height used

Example 2

b) area of sector of ~~coloured re~~ QOR

$= \frac{1}{2} r^2 \theta$

$= \frac{1}{2} (10^2)(60^\circ)$

Angle is not changed to radians

$= \frac{1}{2} (100)(60^\circ)$

$= 3000$ ~~uni~~ cm^2

Example 3

a) $\cos \theta = \frac{5}{10}$

$\theta = 60^\circ$

$= 1.05 \text{ rad}$

Premature approximation is used

of $y = \frac{10}{x}$ correctly

b) Area of sector QOR $= \frac{1}{2} r^2 \theta$

$= \frac{1}{2} \times 10^2 \times 1.05$

$= 52.5$

Area of $\triangle$ POR $= \frac{1}{2} \times 5 \times \sqrt{75}$

$= 21.7$

Area of region $= 52.5 - 21.7$

$= 30.8 \text{ cm}^2$

Candidates' Weakness

Candidates are unable to find the small change in x

Apply the formula $\partial y = \frac{dy}{dx} \times \partial x$ correctly

Example 1

$\delta y = ?$

$\delta x = h$

$\delta y = \frac{dy}{dx} \times \delta x$

$= -32x^{-3} \times h$

$\delta y = \frac{-32}{x^3}h$

x =4 is not substituted into the expression

Example 2

$\delta x = 4-(4+h)$

$= -h$

Should be
δ x=(4+h)-h
=h

Example 3

$y = \frac{16}{x^2}$

$y = 16x^{-2}$

$\frac{dy}{dx} = -2(16)x^{-1}$

$= \frac{-32}{x}$

Candidate integrates instead of differentiates

Question 20

Candidates' Strength

Few candidates understand the information given in the question and are able to differentiate with respect to x correctly the function of the curve $y = x^2 - 5x$. There are some candidates who can identify the gradient of the normal to be -1

Example

$y = x^2 - 5x$

$\frac{dy}{dx} = 2x - 5$

gradient for normal;

$y = -x + 12$

gradient for normal $= -1$

Candidates' Weakness

Many candidates assume that $\frac{dy}{dx}$ = gradient of normal, or $\frac{dy}{dx} = 0$, hence, they failed to find the coordinate of the point P correctly

Candidates' common mistakes

Example 1

$y = x^2 - 5x$

$\frac{dy}{dx} = 2x - 5$

Since normal P is parallel to $y = -x + 12$,

then $m_p = -1$.

$\frac{dy}{dx} = -1$

$2x - 5 = -1$

$2x = 4$

$x = 2$.

when $x = 2$,

$y = 2^2 - 5(2)$

$= 4 - 10$

$= -6$

$\therefore y = -x + c$

at point $(2, -6)$,

$-6 = -2 + c$

$c = -4$

$y = -x - 4$

Equating $\frac{dy}{dx} = -1$, hence obtain the wrong coordinate of P

Example 2

$y = x^2 - 5x$

$\frac{dy}{dx} = 0$

$2x - 5 = 0$

$x = \frac{5}{2}$

when $x = \frac{5}{2}$, $y = (\frac{5}{2})^2 - 5(\frac{5}{2})$

$y = (-\frac{25}{4})$

$P = (\frac{5}{2}, -\frac{25}{4})$

Equating $\frac{dy}{dx} = 0$, hence obtain the wrong coordinate of P

Question 21

Candidates' Strength

Candidates are able to apply the integration rule and make accurate comparison to find the value of P

Example 1

(a) $\int (6x^2+1)\,dx$

$= \left[\frac{6x^3}{3} + x + c\right]$

$= 2x^3 + x + c$

$\therefore 2x^3 + x + c \equiv px^3 + x + c$

$p = 2$ #

Example 2

$$\int (6x^2+1)\,dx = 13, \text{ when } x = 1$$
$$\frac{6x^3}{3} + x + c = 13$$
$$\cancel{2x^3 + x + c}$$
$$\frac{6}{3}(1)^3 + 1 + c = 13$$
$$2 + 1 + c = 13$$
$$3 + c = 13$$
$$c = 10$$

Candidates' Weakness

Some candidates are careless when integrating

Candidates' common mistakes

Example 1

$$\text{(b)} \int (6x^2+1)$$
$$3 = \left[\frac{6x^2}{\cancel{3}_1} + x + c\right]$$
$$13 = 2x^2 + x + c$$

Candidate is careless when integrating. Should be 3 and not 2.

Example 2

$$\int (6x^2+1)\,dx = 13$$
$$2x^3 + x = 13$$
$$2x^2 + x - 13 = 0$$
$$2x^3 + x + c = 0$$
compare
$$c = -13$$

Candidate makes wrong comparison.

Question 22(a)

Candidates' Strength

Many candidates know that $\sum x$ is the sum of the seven numbers.

Example

$$\frac{x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7}{7} = 9$$

$$\sum x = 9 \times 7$$

$$= 63.$$

Question 22(b)

Candidates' Strength

Many candidates know that the new mean is old mean x 8 and equates it with $63 + k$.

Example

$$8 \cdot 5(5) = 63 + k$$

$$68 = 63 + k$$

$$k = 5$$

Candidates' Common mistakes

Example 1

$$8 \cdot 5 = \frac{63 + k}{7 + k}$$

Should be 7+ 1 = 8

Example 2

$$8.5 = \frac{63k}{8}$$

Should be $63+k$

$$8.5(8) = 63k$$

$$68 = 63k$$

$$k = \frac{68}{63}$$

Question 23(a)

Candidates' Strength

Some candidates are able apply the concept of permutation correctly.

Example

a) $= {}^{6}P_{4}$

$= 360$

There are others who use the multiplication principle.

Example

(a) $\underline{6} \times \underline{5} \times \underline{4} \times \underline{3} = 360$

Question 23(b)

Candidates' Strength

Some candidates use the multiplication principle to solve part (b).
Example 1

(b) $\underline{5} \times \underline{4} \times \underline{3} \times \boxed{\frac{1}{\text{odd}}} \times 4$

$= 240$

There are other who apply the concepts of permutation and combination.

Example 2

${}^5P_3 \times {}^4C_1 = 240$

Candidates' Weakness

There are candidates who show less command and knowledge on the principles and concepts of permutation and combination. This is evident from the presentation of the candidates' working and answers in (b).

Common mistakes

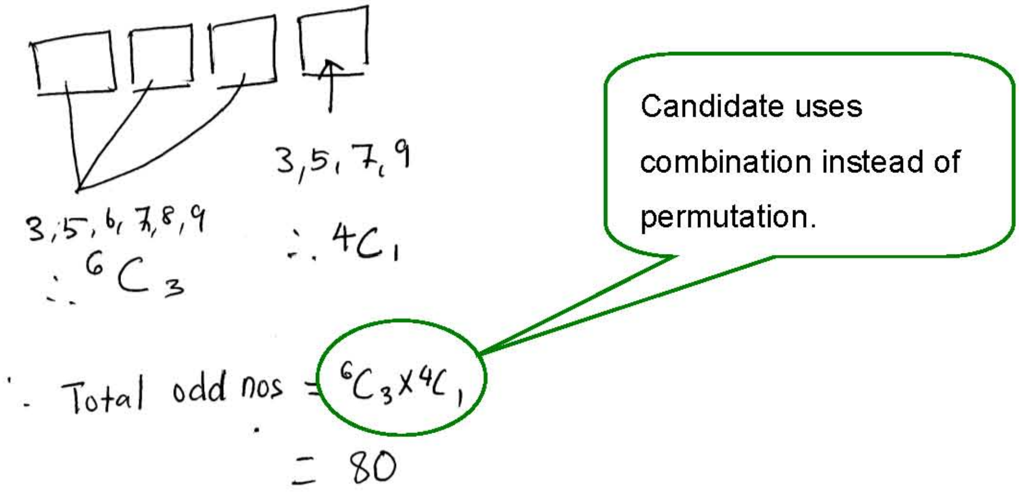
Example

$\underline{4}\ \underline{3}\ \underline{2}\ \underline{1}$

$= 24$

Candidate uses the multiplication principle to find the number of arrangements using the 4 odd digits given.

Example



Question 24(a)

Candidates' Strength

Candidates are able to find the probability of complementary events.

Example

a) Sarah $= \frac{3}{5}$ $\quad S' = \frac{2}{5}$

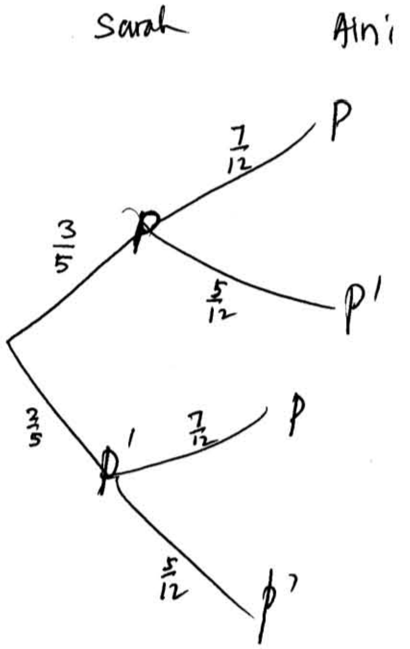
Aini $= \frac{7}{12}$ $\quad A' = \frac{5}{12}$

Question 24(b)

Candidates' Strength

Candidates are able to apply the concepts of probability of combined events

Example



a) $\frac{2}{5} \times \frac{5}{12} = \frac{10}{60}$

b) $\frac{3}{5} \times \frac{5}{12} + \frac{2}{5} \times \frac{7}{12}$

$= \frac{15}{60} + \frac{14}{60}$

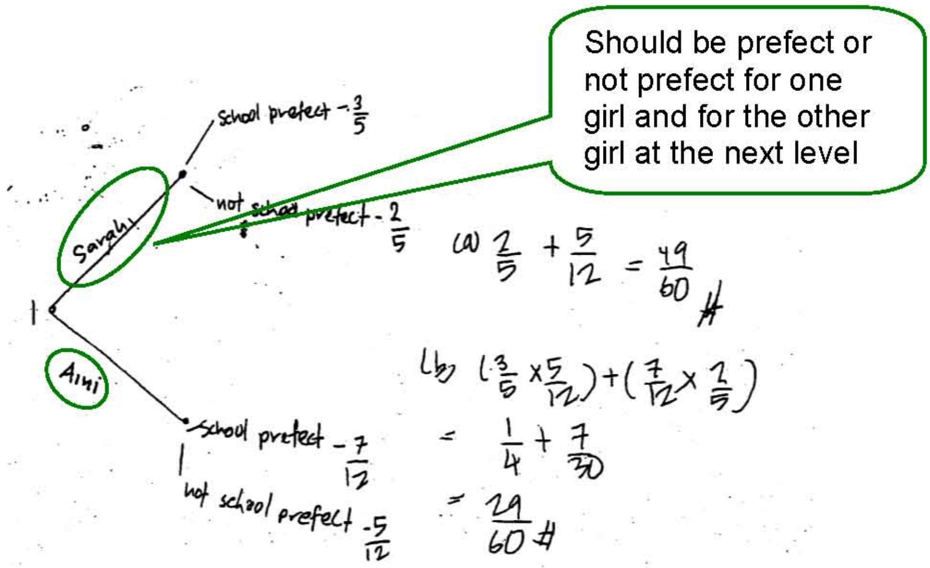
$= \frac{29}{60}$

Candidates' Weakness

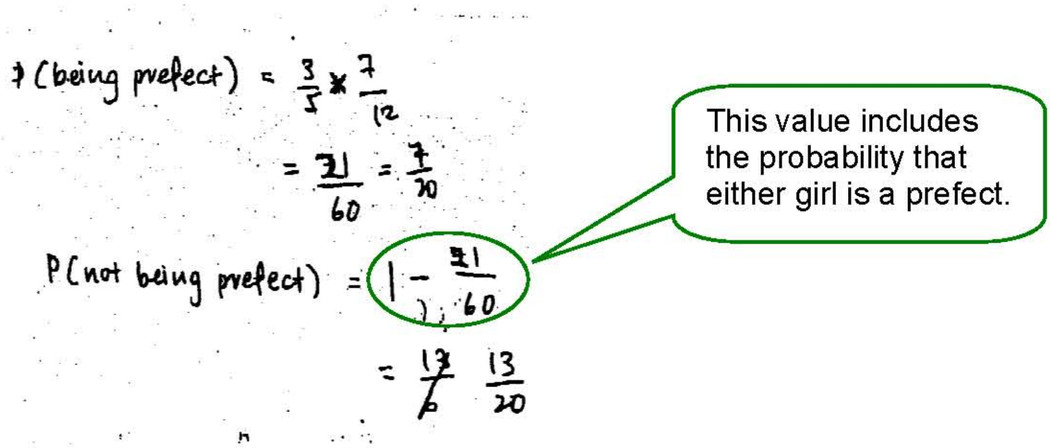
Some candidates are not able to draw the correct tree diagram

Candidates' common mistakes

Example 1



Example 2



Question 25

Candidates' Strength

Candidates are able to standardise the score given using the formula $z = \dfrac{X - \mu}{\sigma}$, determine the area under the standard normal distribution for a<Z<b and find the probability of z>a correctly.

Example

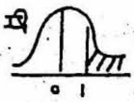
X : Mass of a group of students

$X \sim N(40, 5^2)$

(a) $P(X > 45)$

$= P\left(Z > \dfrac{45-40}{5}\right)$

$= P(Z > 1)$

= 

$= Q(1)$

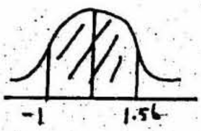
$= \cancel{1.587}$

$= 0.1587$ 4

(b) $P(35 < X < 47.8)$

$= P\left(\dfrac{35-40}{5} < Z < \dfrac{47.8-40}{5}\right)$

$= P(-1 < Z < 1.56)$

= 

$= 1 - Q(1) - Q(1.56)$

$= 1 - \cancel{1.587}\ 0.1587 - 0.05938$

$= 0.7819$

Candidates' Weakness

There are some candidates who use the wrong formula to standardize the score. A few candidates confuse the z-score with probability.

Candidates' common mistakes

Example 1

$$z = \frac{x-40}{25}$$

Substitute $\sigma^2=25$ into the formula $z=\dfrac{x-\mu}{\sigma}$ instead of $\sigma=5$

(a) $P = \left(z > \dfrac{45-40}{25}\right)$

$= \left(z > \dfrac{5}{25}\right)$

$= (z > 0.2)$

$= 0.4207$

(b) $P = \left(\dfrac{35-40}{25} < z < \dfrac{47.8-40}{25}\right)$

$= \left(-\dfrac{5}{25} < z < \dfrac{7.8}{25}\right)$

$= 1 - P\left(z > \dfrac{5}{25}\right) - P\left(z > \dfrac{7.8}{25}\right)$

$= 1 - 0.4207 - 0.3776$

$= 0.2017$

Example 2

b) $P(35 < x < 47.8)$

$= \dfrac{35-40}{5} - \dfrac{47.8-40}{5}$

Find the difference between the z-scores instead of the probability.

$= \dfrac{-5}{5} -$

$= -1 - 1.56 = -2.56$

Suggestions to candidates

1. Candidates are advised to do a lot of exercises to improve mathematical skills and to have a better command and understanding of concepts involved in Additional Mathematics.
2. Candidates have to practise answering clone SPM and past year SPM exam questions so as to be familiar with the format of questions asked.
3. Make sufficient preparation by showing clear, organized and systematic working during practice so as to be well trained in mathematical skills and methods when answering actual exam questions.
4. Candidates must be skillful in using the scientific calculator. Learn up the useful functions in the scientific calculator and practise using them all the time.
5. In the process of calculating, candidates are not encouraged to do premature approximation until the final answer is obtained. If a non-exact number is involved in the working, it must be correct to at least 4 significant figures..
6. The final answer obtained should be in the simplest form. If the final answer is a non exact number, then it should be correct to at least 4 significant figures.
7. Candidates are advised to transfer their answers from the working space to the answer space carefully and accurately.
8. Make full use of the list of mathematical formulae provided in the question paper.
9. Candidates are advised to read and understand the requirement for each question carefully. Highlight important information or key words in order to give accurate answers and also not to misinterpret the task given.
10. Allocate time for double-checking the answers to ensure every question has been answered.
11. Show clear, organized and systematic working required for each question in the space provided.

Suggestions to teachers

1. Teachers should give more exercises to students to practise in order to reinforce their basic mathematical skills.
2. Teachers should guide students to master additional mathematics concepts so that they are able to apply them effectively and accurately when solving problems.
3. Teachers should train and guide students to show accurate, organised and systematic working.
4. Teachers should train students to use decimal numbers correct to at least 4 significant figures in their working.
5. Teachers should train students to simplify their final answers or give approximation correct to at least 4 significant figures if they are non-exact numerical answers.
6. Teachers must guide students to master techniques in answering questions efficiently and precisely.
7. Teachers should understand the actual exam mark scheme in order to guide students to use precise methods when solving problems.
8. Teachers should teach students according to their levels of ability. They can follow the guidelines given in the ‘Minimum Adequate Syllabus’ for weaker students so that they are not burdened with all the topics in the syllabus.
9. Teachers should give graded exercises to students.
10. Teachers should guide students to use the scientific calculator efficiently and effectively.
11. Teachers should identify students’ weaknesses and plan strategies for improvement.
12. Teachers should always motivate students to think positive and try hard.