MAJLIS PEPERIKSAAN MALAYSIA

SASBADI

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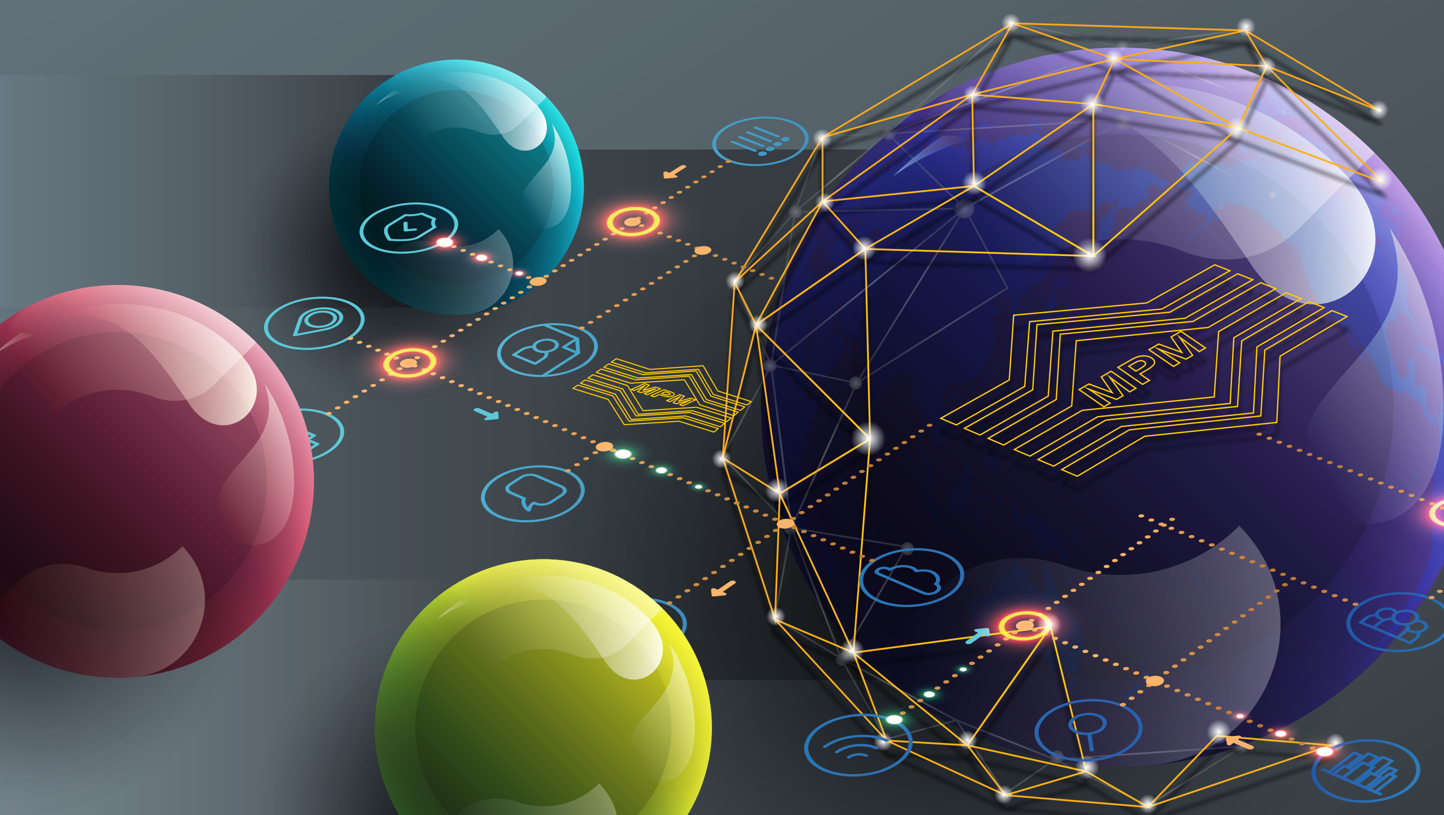
Mathematics (T) (954)



CONTENTS

MATHEMATICS (T) (954/1)

OVERALL PERFORMANCE

The number of candidates for this subject was 3 662. The percentage of candidates who obtained a full pass was 49.15%.

The achievement of candidates according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	5.95	5.02	3.88	6.96	10.16	6.94	10.24	5.11	8.60	4.64	32.50

CANDIDATES' RESPONSES

PAPER 954/1

General comments

Overall, the presentation of the candidates' solutions revealed mixed performances and wide range of mathematical ability. Most answers were clearly shown with required and necessary workings. Candidates were able to answer on direct applications of mathematical formulae but they were weak in answering questions which involved understanding of concepts. Majority of the candidates attempted all the questions and there was no evidence that they were under time pressure. Strengths of candidates could be seen in answering questions on topic vectors whilst weaknesses were seen in topics sequences and series, matrices, and complex numbers.

High achiever candidates gave well-ordered answers for the seven questions with systematic and strategised steps presented, showing their full understanding of the questions and concepts. Their performance in questions 6 and 8 were excellent with almost perfect score in these two questions. These candidates excellently employed basic operations of dot product on two vectors to determine its perpendicularity in question 6. As for question 8, these excellent candidates mostly managed to attain perfect score whereby they successfully use the basic operations of cross and dot product to perform the required task of the question. Similarly, these good candidates also presented well-planned answers in questions 1, 3, 5, and 7 but not in questions 2 and 4.

Moderate candidates were able to understand the questions and expressed their answers for the questions they were familiar with. Nonetheless, they had to struggle in answering more challenging questions such as questions 1, 2, 3, and 4. This cluster of candidates could not answer those questions that required further knowledge and applications of the topics.

Weaker candidates were not able to apply the basic concepts learned. They simply memorised, but do not know why, when, and how to apply the concepts. They wrote messy answers using wrong formula and wrong mathematical principles, such as used scalar product instead of cross product, used wrong concept of composite function, overlooked the term "hence" in question 1, 2, 3, and 8, not able to sketch the proper graphs, and not able to determine the correct terms in a series. Quite a number of candidates tried to answer and they wrote a lot, but all were immaterial. Overall, most of the weaker candidates were not able to organise, used wrong concept, not able to plan and wrote their solutions systematically.

Poor attempts were seen in questions 2, 3(*b*), and 4 of Section A. Improper workings were seen by the moderate and weak candidates in dealing with questions relating to proving as in question 3(*a*).

In question 3(b), a substantial number of candidates did not utilise the determinant which had been proved earlier but instead they chose to determine the type of solution for the system given using Elementary Row Operation (ERO) or Gaussian Elimination method.

In section B, most candidates generally answered only one question as instructed. Most candidates who attempted question 7 showed poor presentations and performances as compared with those who selected question 8.

Comments on individual questions

Question 1

SEMESTER 1

Almost all candidates attempted this question and managed to obtain the first 2 marks. Quite a number overlooked the term "hence" and did not obtain any marks even though the answer was correct. Some candidates managed to attain marks for deducing but with improper working which ended up of losing 1 mark. Most candidates were able to attain the two composites, while the good ones managed to deduce $g^{13}(x)$. Quite a number of candidates successfully attained the expression for $h(x)$. Many candidates oversee the word "hence" and find $g^{13}(x)$ without using the previous result. Quite a number of candidates left out the "x" in $h(x)$, which result in wrong answer. Most candidates were unable to proceed in deducing $g^{13}(x)$ whilst some did not show sufficient steps in their working. Quite a number of candidates wrote $g(f(x)) = \dfrac{2}{3x + 2} = \dfrac{2}{3x} + 1$ which shows that their algebraic operations were weak.

Answers: (a) $g(f(x)) = \dfrac{2}{3x + 2}$; $g^2(x) = x$; $g^{13}(x) = \dfrac{2}{x}$

(b) $h(x) = \dfrac{4}{3}g(f(x)) + g^2(x)$ or any equivalent form.

Question 2

Very few candidates scored more than 2 marks for this question. Only few candidates realised that u_{2n} and u_{2n-1} can be written as a geometric progression. Most candidates managed to get 2 marks only, many lose marks while finding the explicit formula for u_{2n} and u_{2n-1} and in part (b). Some candidates who attempted this question managed to gain at least the first two marks in part (a), proving of u_6 and u_8. Few managed to get at least 1 marks for part (b) when they tried to attain u_5 and u_{18} start from scratch. Only a number of candidates were able to work half way through to attain u_{2n} and u_{2n-1}. Candidates could not grasp that the sequences are related to the geometric progression.

Answers: (a) (i) $u_6 = 2u_4 - 7 = 2(2u_2 - 7) - 7 = 2^2q - 2(7) - 7$

(ii) $u_8 = 2u_6 - 7 = 2[2^2u_2 - 2(7) - 7] - 7 = 2^3q - 2^2(7) - 2(7) - 7$

$$u_{2n} = 2^{n-1}q - 7\frac{(2^{n-1} - 1)}{2 - 1} = (q - 7)2^{n-1} + 7$$

$$u_{2n-1} = 2^{n-1}p - 7\frac{2^{n-1} - 1}{2 - 1} = (p - 7)2^{n-1} + 7$$

$$q = \frac{1}{64}(137p - 273)$$

Question 3

Matrices is usually one of the favourite questions and the best performed question. Unfortunately, the pattern of the question was quite different from previous years. Almost all candidates could not attain any marks for part (b) due to the instruction that candidates needed to use previous result in part (a). Mostly, the candidates used the ERO to solve but they were not able to get any marks. Almost all candidates were able to use the determinant formula perfectly. Some candidates were weak in algebraic operation, where they were not able to factorise in order to obtain required expression which could be fairly seen in candidates' solutions. Almost all candidates did not use the determinant of P to solve part (*b*) to reduce their augmented matrix until the last row reached the [000 | *a*] form. Most candidates used $\left(\begin{array}{ccc|c} 3 & 6 & -6 & -6 \\ 1 & -2 & 6 & 6 \\ 2 & 6 & -8 & -8 \end{array}\right)$ instead of $\left(\begin{array}{ccc|c} 1 & 2 & -2 & \frac{4}{3} \\ 1 & -2 & 6 & 5 \\ 1 & 3 & -4 & \frac{3}{2} \end{array}\right)$ to proceed.

Answers: (*a*) $\det(\mathrm{P}) = (r - s)(4 - 2r - s)$

Question 4

Performance of candidates in this question was poor. Only few candidates successfully realised that the conjugate of the given root, 1 + 2i was also a root for the polynomial provided. With the two roots, 1 + 2i and 1 – 2i, candidates managed to factorise the polynomial into two quadratic equations; $(x^2 - 2x + 5)(x^2 - 4x + 13)$ and finally attained the other two roots. Finally, they managed to find roots for the second factor using $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ and made conclusion. More than 50% candidates did not know how to start solving this question. Some candidates used the D'Moivre to start with which directed them nowhere, and some candidates straight away used the calculator to find roots and stated all the roots of the equation without any working shown. Quite a number of candidates listed out all roots including the given root which actually did not answer the question.

Answers: 1 – 2i, 2 + 3i, 2 – 3i

Question 5

This was a moderately performed question. Most candidates managed to get at least 4 marks. Candidates were able to get the standard form of hyperbolic equation. They successfully arranged the equation given using the method of completing the square and obtained the standard form of the equation. Candidates also were able to obtain the centre, foci and determine the equations of asymptotes. They obtained easily the centre and foci from the standard form attained and proceeded brilliantly to gain the equations of the asymptotes. Some average level of candidates did not make use of the information given at the back of the question paper regarding the standard form of a hyperbola.

Quite a number of candidates were not able to obtain the correct standard form of the equation due to weakness in basic completing square operation or mistake in factorising due to incorrect sign for coefficient of y in the process of completing square. Some candidates wrote *c* as ±5. Many candidates were not able to sketch the graph which should appear near to asymptotes. The graph sketched did not approach the asymptotes and drawn far from it. Asymptotes were also seen sketched as bold lines. Few candidates used the coordinates of foci obtained as points of vertices in their sketched graph.

Answers: (a) $\dfrac{(x + 2)^2}{9} - \dfrac{(y - 1)^2}{16} = 1$; Centre = $(-2, 1)$; Foci = $(-7, 1), (3, 1)$

(*b*) $3y - 4x = 11$, $3y + 4x = -5$

Question 6

Good performance from majority of the candidates. Many candidates achieved complete and perfect answers. Almost 95% of candidates succeeded in finding $\overrightarrow{OR}$ using the ratio given. They managed to show that the dot product between the two vectors; $\overrightarrow{PQ} \bullet \overrightarrow{OR} = 0$ and therefore, concluded that both vectors were perpendicular. A small number of candidates mistakenly used incorrect ratio which headed to an incorrect position vector of the point R. Conclusion was impossible when dot product was not zero. Few candidates mistakenly used incorrect ratio which ended up with a wrong vector of $\overrightarrow{OR}$.

Question 7

Candidates who chose this question mostly got less marks as compared with candidates who chose Question 8. Candidates who chose this question managed to find f^{-1}, domain and range correctly. They were also able to find x-coordinate and y-coordinate correctly. A handful of candidates were able to interpret the required tasks of this question as finding the x-intercept for $y = \mathrm{f}(x)$ by solving $\ln(3x - 2) + 5 = 0$, and substituting $x = 0$ in $y = \mathrm{f}^{-1}(x)$ for y-intercept. Most of the candidates did not understand the requirement of the question that the coordinates must be given in exact form. Quite a number of them managed to solve correctly but gave the final answer in decimal form. However, there were some candidates that misread the question as finding x-intercept and y-intercept for $y = \mathrm{f}(x)$. For graph sketching, most of candidates were able to show correct shape of f and f^{-1} but did not realise that the two graphs actually intersect at two points in first quadrant. Almost half of candidates' sketches do not show any intersection between the two graphs. Part (*d*) was poorly answered by most of the candidates. Only a few candidates could state the domain and range of $\mathrm{f} \circ \mathrm{f}^{-1}$ and $\mathrm{f}^{-1} \circ \mathrm{f}$ correctly and so do the sketching of the graph of $y = \mathrm{f} \circ \mathrm{f}^{-1}$ and $y = \mathrm{f}^{-1} \circ \mathrm{f}$.

Answers: (a) $\mathrm{f}^{-1}(x) = \dfrac{2 + e^{x-5}}{3}$; Domain of f^{-1}: $\{x \mid x \in \mathbb{R}\}$; Range of f^{-1}: $\left\{x \mid x > \dfrac{2}{3}\right\}$

(*b*) $x = \dfrac{1}{3}(2 + e^{-5})$; $y = \dfrac{1}{3}(2 + e^{-5})$

(*d*) Domain of $\mathrm{f} \circ \mathrm{f}^{-1}$: $\{x \mid x \in \mathbb{R}\}$; Range of $\mathrm{f} \circ \mathrm{f}^{-1}$: $\{x \mid x \in \mathbb{R}\}$

Domain of $\mathrm{f}^{-1} \circ \mathrm{f}$: $\left\{x \mid x > \dfrac{2}{3}\right\}$; Range of $\mathrm{f} \circ \mathrm{f}^{-1}$: $\left\{x \mid x > \dfrac{2}{3}\right\}$

Question 8

Candidates who attempted this question mostly succeeded in getting good marks. Almost all candidates who chose this question managed to get the two vectors which lied on the first plane and proceeded to get the normal vector. A small number of candidates used wrong concept to obtain the normal of the plane by using direction vector of point A and point B. Most candidates attained the correct answer for the Cartesian equation. Candidates were also able to calculate the angle correctly either by using dot or cross product of the normal from the two planes.

Quite a number of candidates attempted part (*c*) by substituting $x = 0$ into the plane equations and solve for y and z. After getting $y = -1$ and $z = 3$, they could conclude correctly for *m* and *n*. Candidates got easily the angle between two planes, mostly they used the cosine formula; $\cos\theta = \dfrac{\overline{n}_1 \bullet \overline{n}_2}{|\overline{n}_1||\overline{n}_2|}$ which involved the dot product. Some candidates successfully obtained $\theta = 51.8°$ from the correct formula which involved dot product but proceeded further with subtraction to attain the obtuse angle of the planes. Quite surprisingly, few candidates used $\sin\theta = \dfrac{\underset{\sim}{n}_1 \bullet \underset{\sim}{n}_2}{|\underset{\sim}{n}_1||\underset{\sim}{n}_2|}$, which was a wrong formula to find the angle between two planes.

For weak candidates, they gave vector equation of plane instead of Cartesian equation in part (*a*) and were not able to find the vector equation of the line since they could not find the directional vector using the two normal vectors. There were also candidates could not write the vector equation of a line correctly such as $\ell = \mathbf{a} + \lambda\mathbf{b}$ instead of ℓ: $\mathrm{r} = \mathbf{a} + \lambda\mathbf{b}$. Few candidates did not conclude for values of m and n. When candidates used different method, they calculated the values as y and z.

Answers: (*a*) $6x + 2y + 3z = 7$; (*b*) $\theta = 51.8°$; (*c*) $m = -1$; $n = 3$; ℓ: $\mathrm{r} = \begin{pmatrix} 0 \\ -1 \\ 3 \end{pmatrix} + \lambda$

MATHEMATICS (T) (954/2)

OVERALL PERFORMANCE

The number of candidates for this subject was 3 632. The percentage of candidates who obtained a full pass was 54.07%.

The achievement of candidates according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	9.66	7.35	6.44	8.23	7.08	8.56	6.75	3.33	3.08	3.83	35.68

CANDIDATES' RESPONSES

SEMESTER 2

PAPER 954/2

General comments

Generally, for Section A, candidates' answers to questions 1, 5 and 6 were well done. But answers to questions 2, 4 and 8 were moderately performed. Questions 3 and 7 were poorly performed. For Section B, majority of candidates preferred to answer question 7. Only a very small amount of candidates chose to attempt Question 8, and almost all of them performed nicely. There were still instances of candidates divided pages into two columns. This caused the examiners very difficult to indicate clearly where marks were awarded and should be actively discouraged.

Many good and excellent scripts were seen and the standard of presentation was usually good. The paper seemed to give all candidates the opportunity to show what they had learned and understood on a number of questions. Many candidates were able to demonstrate their mathematical ability on this paper.

This was a paper which enabled the well prepared candidate to perform well, demonstrating a good understanding of the syllabus content and how to apply the associated skills learned. It was also evident that some candidates had not done enough preparation and as a result performed very poorly. This obviously seen in questions 3 and 7.

Comments on individual questions

Question 1

Good candidates were able to multiply with correct conjugate. They were able to recognise x^2, the highest power of x from the denominator. Then, they were able to carry out the division by x^2. Weak candidates did the wrong factorization, where $9 - x^2$ was wrongly factorised as $(x - 3)(x + 3)$ and therefore, they were not able to cancel out factor $(3 - x)$ correctly. Some weak candidates simplified $\sqrt{8 - \frac{3}{x^2} + \frac{5}{x^4}}$ as $\sqrt{8} - \frac{\sqrt{3}}{x} - \frac{\sqrt{5}}{x^2}$ which was considered as very serious mistake for a Form 6 student. Few candidates also wrongly used and evaluated $\frac{k}{0}$ as 0.

Answers: (*a*) $-\frac{5}{3}$; (*b*) $\frac{1}{\sqrt{2}}$

Question 2

A group of good candidates were able to obtain $d = -2$ correctly and they could form two simultaneous equations by substituting $x = -1$ and $x = -\frac{1}{3}$ into $\frac{dy}{dx} = 0$. Then, this group of candidates equated $\frac{d^2y}{dx^2} = 0$ to find point of inflexion and used the second derivative test to determine the nature of the stationary points. For weak candidates, there were careless mistake occurred when solving the system of linear equations. Candidates were not able to use the information that the curve passed through the point (1, 2) by forming quadratic equation using $x = -1$ and $x = -\frac{1}{3}$, and then just compared $3x^2 + 4x + 1$ with $\frac{dy}{dx} = 3ax^2 + 2bx + c$ to obtain the values of *a*, *b* and *c*. Candidates did not aware that there was another condition to be satisfied. Furthermore, when solving system of linear equation with three unknowns, it should have three conditions to look for. Other cases, candidates did not check the condition of $\frac{d^3y}{dx^3} = 0$ for the inflexion point.

Answers: (*a*) $a = 1$, $b = 2$, $c = 1$, $d = -2$; (*b*) (i) $-\frac{2}{3}, -\frac{56}{27}$

SEMESTER 2

Question 3

For this question, candidates were able to proceed correctly until the last step if initial step of $f(x)e^{f(x)}dx$ was written correctly. Most of candidates used wrong technique of integration. Many candidates used integration by parts or used wrong concept of integration such as $(12x + 9)e^{2x^2 + 3x}dx = \frac{12x + 9}{4x + 3}e^{2x^2 + 3x}$. Some candidates separated $\int_0^k (12x + 9)e^{2x^2 + 3x}dx$ into $\int_0^k 12xe^{2x^2 + 3x}dx + \int_0^k 9e^{2x^2 + 3x}dx$ and had no idea how to proceed.

Answer: $k = \frac{1}{2}$

Question 4

Good candidates were able to identify that the given differential equation was a first order linear differential equation that could be solved by means of an integrating factor, and they were able to find the integrating factor correctly. The candidates were able to proceed by multiplying the linear differential equation with the integrating factor found and managed to obtain LHS as $\frac{1}{(x + 1)^2}y$. Some candidates did not aware that when the integrand was in improper fraction, long division needed to be carried out. Therefore, they were not able to express $\frac{x - 1}{x + 1}$ in the form $1 - \frac{2}{x + 1}$ or express $\frac{x^2 - 1}{(x + 1)^2}$ in the form $1 - \frac{2x + 2}{x^2 + 2x + 1}$ to get ready for the process of integration. Some candidates used wrong concept of integration such as $\int \frac{x - 1}{x + 1}dx = \int \frac{x}{x + 1} - \frac{1}{x + 1}dx = x \ln (x + 1) - \ln (x + 1) + c$ or $\int 1 - \frac{2x + 2}{x^2 + 2x + 1}dx$ $= x - \frac{(2x + 2) \ln (x^2 + 2x + 1)}{x^2 + 2x + 1} + c$.

Few candidates left their final answer in the form of $\frac{y}{(x + 1)^2} = f(x)$ instead of $y = (x + 1)2f(x)$.

Answer: $y = (x + 1)^3 - 2(x + 1)^2 \ln (x + 1)$

Question 5

Most of the good candidates were able to perform $\frac{d}{dx}(e^{\sin^{-1}x}) = \frac{1}{\sqrt{1-x^2}}e^{\sin^{-1}x}$. They were able to proceed from $(1-x^2)\frac{d^2y}{dx^2} - x\frac{dy}{dx} = y$ to find higher derivative and obtained Maclaurin series for y correctly. Some candidates never thought of square $\sqrt{1-x^2}\frac{dy}{dx} = y$ to get $(1-x^2)\left(\frac{dy}{dx}\right)^2 = y^2$, but instead they tried the other more complicated steps that caused some careless mistakes in between.

Answer: $y = 1 + x + \frac{1}{2}x^2 + \frac{1}{3}x^3 + \frac{5}{24}x4 + \ldots$

Question 6

Most of candidates were able to determine h, the six x-ordinates and the values of y correctly, and substituted into correct trapezium rule to obtain the approximation. Many candidates could not provide a good reason to determine whether the result in (*a*) was over-estimated or under-estimated. Mostly, they used graph sketching or stated the value of $\int_0^4 \frac{4}{1+\sqrt{x}}dx$ using calculator. There were also some candidates who still confused with decimal point and significant figures when giving the approximation value.

Answer: (*a*) 7.638

SEMESTER 2

Question 7

Most of candidates chose this question. However, the performance was not as good as question 8. Many candidates were able to find x and y-intercepts of both curves correctly, and they were able to sketch the correct shape of graph $y = \ln(x+2)$ and $y = |x| - 1$ even though the graphs sketched were not perfect. Some candidates could find the area of triangle and the volume of cone, which at least they integrated correctly any one term of the integrand for both area and volume.

For average and weak candidates, they could not find the x-intercept for $y = |x| - 1$ correctly, where the answer given was only $x = 1$. Many candidates of that group of candidate were not able to shade the required region correctly. Many of them shaded both left and right sides of *y*-axis. Besides that, this group of candidates were wrongly defined the area as $\int_{-1}^{0}(-y-1)dy + \int_{-1}^{\ln 2}(e^y - 2)dy$ or $\int_{-1}^{0}\ln(x+2) - (|x| - 1)dx = \int_{-1}^{0}\ln(x+2) - (x-1)dx$

Answers: (*a*) $y = \ln(x+2) : x = -1,\ y = \ln 2;\ y = |x| - 1 : x = -1,\ 1,\ y = -1$

(*c*) $2\ln 2 - \frac{1}{2}$;   (*d*) $4\ln 2 - \frac{13}{6} \div \pi$

Question 8

Many candidates who chose this question managed to solve the differential equation by separating the variables and expressed $\frac{1}{(p-x)(q+x)}$ into correct partial fraction. Then, they integrated correctly $\frac{1}{(p-x)}$ and $\frac{1}{(q+x)}$ However, there were some candidates mistook coefficient of partial fractions

$\dfrac{1}{(p + q)}$ as $(p + q)$. Many candidates also were not able to show the given differential equation that satisfied the conditions given with sufficient information. The candidates could not use the condition when $t = 0$, $x = 0$, to find the constant of the integration and therefore express x in terms of k, p, q, t and c. Some candidates wrongly interpreted that when $t = 0$ and $x = q$. Lastly, when the candidates were not able to find the answer for part (*b*), this caused them to not able to proceed the part (*c*) to find the limiting value of x with positive powers of e.

Answers: (*b*) $x = pq\dfrac{1 - e^{-k(p + q)t}}{q + pe^{-k(p + q)t}}$; (*c*) p

MATHEMATICS (T) (954/3)

OVERALL PERFORMANCE

The number of candidates for this subject was 3 625. The percentage of candidates who obtained a full pass was 61.32%.

The achievement of candidates according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	10.12	8.22	10.07	8.17	8.22	9.60	6.92	6.21	5.68	6.12	20.66

CANDIDATES' RESPONSES

PAPER 954/3

General comments

Generally, candidates were good in answering quantitative questions but poor in answering questions related to qualitative questions such as defining a concept such as in question 3(a) and 8(a). For example, many of them were not able to do mathematical reasoning in answering question 8(c)(ii).

Good candidates showed competence over a wide range of topics. They were able to understand the statistic concept well and gave well-organised answers in terms of planning and presentation. They showed all the essential workings accurately and systematically with correct statements where ever needed. Their handwriting was neat, clear and easily understood. They were able to give appropriate descriptions and explanations as requested in the questions.

Moderate candidates performed well in easy and moderate questions but they were weak in qualitative questions. They were not good in reasoning and defining a concept. They were able to present their answers well for the questions or the parts they were familiar with. Most of them managed to get the first part or some parts correctly in their workings. They could not answer questions that required further knowledge and applications of the topics such as in questions 1, 2, 3, 7 and 8.

Weak candidates with the poor foundations in their basic statistic concepts, lacked the aptitude and understanding of what were required in the questions. Answers given were not according to the requirement of the questions, inorganised in their steps and methods and not properly presented. Their presentations reflected their weakness in many aspects, such as understanding the question, not knowing the concept, not knowing or remembering the formulae. Sometimes they did not try to attempt even the easy part.

Comments on individual questions

Question 1

This question was well answered by most of the candidates. Majority of candidates were able to construct the stem and leaf diagram correctly. However, some candidates did not provide a perfect diagram because it was not shown with uniform stem, including some errors in the spacing of the leaves, putting comma between the numbers and no key was provided. Many candidates were able to find mean, mode and median. However, some candidates made careless mistake in calculating the sum of the values. Majority of the candidates were not able to suggest the appropriate measure of central tendency, where they gave mode as the answer. Many candidates could not give a correct reasoning for the choice of the appropriate central tendency measurement.

Answers: (*b*) Mode = 75, median = 67.5, mean = 68.955

Question 2

Performance for this question was very poor. Majority of the candidates did not understand the question and were not able to construct the tree diagram because they could not relate it to conditional probability. However, those who could understand the problem were able to use conditional probability with the help of tree diagram, Venn diagram or set theory to answer this question. For part (*a*), quite a number of the candidates were able to answer correctly. But for part (*b*), majority of candidates could not interpret the information correctly. They were not able to identify correct mathematical symbols for the given mathematical statement on probability, that $\mathrm{P}(G1_D \cap G2_D) + \mathrm{P}(G1_D \cap G2_D) = 0.0294$. Hence, the candidates did not obtain a quadratic equation. Some candidates also assumed that $\mathrm{P}(G1_D \cap G2_D) = \mathrm{P}(G1_D) \times \mathrm{P}(G2_D)$.

Answers: (*a*) 0.98; (*b*) $p = 0.02$

Question 3

For part (a), most of the candidates were not able to define the '*relevant random variable*' correctly but some candidates were able to identify the Poisson distribution with mean of one. In part (*b*), some candidates were able to find $P(Y \leqslant 2)$ with correct Poisson formula but could not use the correct $\lambda = 5$. For part (*c*), majority of the candidates were able to use binomial distribution and used the correct binomial formula to obtain the correct answer.

Answers: (*b*) 0.12465; (*c*) 0.091523

Question 4

For part (*a*), the candidates' answers was poorly performed. Majority of the candidates did not find the unbiased estimate for population variance. Hence, many of them did not obtain correct confidence level even though correct method was used for the calculation. Some candidates did not know how to determine the confidence level from $Z_{\alpha/2}$ and some candidates did not understand well the meaning of α.

For part (*b*), majority of the candidates were able to comment correctly the effect of the confidence level on the width of the interval. However, there were some candidates who could not relate confidence level with the width of a confidence interval.

Answer: (*a*) 96.43%

Question 5

Most candidates could do the standardisation and gave the rejection region correctly. Hence, they could make correct decision to reject or not to reject H_0. Therefore, those who wrote hypothesis correctly could easily score full mark. However, quite a number of candidates stated the wrong alternative hypothesis such as $\mathrm{H}_1 : p \neq 0.85$. Subsequently, the candidates gave the wrong critical value. Some candidates did not make correct conclusion, they missed out either the key word "insufficient" or "5% significant level". About 10% of the candidates still gave hypothesis in sentence which was not accepted. Some conclusion given by candidates were not completed or not properly written. Some candidates could not relate the word "sufficient" and "insufficient" evidence with the word "maintained". There were also candidates expressed standard error as $\sqrt{\frac{0.80 \quad 0.20}{50}}$, which was not right.

Question 6

Since this question was straightforward and popular among the candidates, it was well attempted. Good and moderate candidates could solve this question well. They stated the hypothesis correctly and were able to find the expected frequencies (E_i) and combined the last three adjacent classes to obtain new E_i. They carried out chi-squared goodness-of-fit test systematically and obtained correct answer. However, the weak candidates stated the hypothesis either wrongly or not complete. Some did not state the value of *p* or missed "fits the data and does not fit the data" from the statement. There were candidates who could not use a correct binomial formula to find the related probability and to determine the expected values. Some candidates even used the wrong size (*n*) in the calculation of binomial probability or used equal probability to calculate the expected frequencies. Quite a number of candidates did not combine the last three adjacent classes which led to wrong degree of freedom and the critical value. Some candidates did not make the correct conclusion, and missed out either the key word "insufficient" or "1% significant level".

Question 7

For part (*a*), most candidates who attempted this question were able to use the complement concept to answer, that was, $\mathrm{P}(D' \cap H') = \mathrm{P}(D \cup H)' = 1 - \mathrm{P}(D \cup H)$. Hence, they were able to obtain $\mathrm{P}(D \cup H)$ correctly. Weak candidates could state $\mathrm{P}(D \cup H) = \mathrm{P}(D) + \mathrm{P}(H) - \mathrm{P}(D \cap H)$ but they were not able to obtain correct answer because they could not find $\mathrm{P}(D)$ and $\mathrm{P}(H)$ in terms of $\mathrm{P}(D \cap H)$. In part (*b*), multiple ways were shown by the candidates to prove the independency of events D and H. Good candidates showed all the steps and calculations clearly, and they made a conclusion as required. Weak candidates did not understand the requirement of the question to determine whether D and H were independent. They just wrote any of the following expression $\mathrm{P}(D) \times \mathrm{P}(H) \neq \mathrm{P}(D \cap H)$ or $\mathrm{P}(D \mid H) \neq \mathrm{P}(D)$ or $\mathrm{P}(H \mid D) \neq \mathrm{P}(H)$ without finding the values and make a conclusion. Some candidates could relate conditional probability $\mathrm{P}(D\ H) = \frac{\mathrm{P}(D \cap H)}{\mathrm{P}(H)} = \frac{1}{3}$, but they did not state it in the form $\mathrm{P}(H) = 3\mathrm{P}(D \cap H)$ to continue. In part (*c*), almost 50% of the candidates were able to convert the given mathematical statement on probability into correct mathematical symbols. For instance part (*c*)(i), candidates could convert into $\mathrm{P}(D \cap H') + \mathrm{P}(D' \cap H)$ or $\mathrm{P}(D \cap H) - \mathrm{P}(D \cap H)$, and they were able to calculate the value correctly. For part (*c*)(ii), the candidates could define the statement as $\mathrm{P}(H' \mid D')$, and they were able to use formula for conditional probability correctly. However, the weak candidates were poor in identifying the correct mathematical symbols and they were not able to use any formula correctly. For example, the candidates mostly defined it as $\mathrm{P}(D \cup H)$ only, instead of $\mathrm{P}(D \cup H) - \mathrm{P}(D \cap H)$.

Answer: (*a*) $\frac{2}{5}$; (*c*) (i) $\frac{1}{3}$; (*c*) (ii) $\frac{9}{11}$

Question 8

In part (*a*), most candidates could not state the correct meaning of randomly chosen. They were not able to include the keywords "each", "every" or "all" mangosteens and the word "equal chance" of being chosen. However for part (*b*), most of the candidates were able to carry out the two tails hypothesis test because of the word "different" stated clearly in the question. A very small number of candidates did not use a correct mathematical notation for sample mean. Some candidates were confused between sample mean and population mean. As usual, there were some candidates who did not give complete conclusion or conclusion was not properly written. Answers given by some candidates were not focused on the claim "weight of mangosteens produced is different from 98.0 g", instead they simply wrote "reject H0". In part (*c*)(i), most candidates who attempted this question did not understand the requirement of the question that H0 is rejected. Hence, they were not able to write the inequality $\frac{\bar{x} - 98}{\frac{4.95}{\sqrt{55}}} > 1.645$. Some weak candidates, they did not know how to find standard error.

For sample mean, some candidates did not use the symbol $\overline{X}$, instead they used the symbol μ which was population mean. For part (*c*)(ii), most candidates were not able to give an appropriate reason to support his statistical conclusion.

Answer: (*c*) (i) $\overline{x} > 99.098$

LAPORAN PEPERIKSAAN STPM & MUET 2021

SASBADI SDN. BHD. 198501006847
(Anak syarikat milik penuh Sasbadi Holdings Berhad 201201038178)
Lot 12, Jalan Teknologi 3/4, Taman Sains Selangor 1,
Kota Damansara, 47810 Petaling Jaya, Selangor Darul Ehsan.
Tel: +603-6145 1188 Faks: +603-6145 1199
Laman web: www.sasbadisb.com E-mel: enquiry@sasbadi.com

MAJLIS PEPERIKSAAN MALAYSIA
Persiaran 1, Bandar Baru Selayang,
68100 Batu Caves, Selangor Darul Ehsan.
Tel: +603-6126 1600 Faks: +603-6136 1488
Laman web: www.mpm.edu.my E-mel: ppa@mpm.edu.my