MAJLIS PEPERIKSAAN MALAYSIA

SASBADI

LAPORAN PEPERIKSAAN STPM & MUET 2020

Mathematics (T) (954)

CONTENTS

MATHEMATICS (T) (954/1)

OVERALL PERFORMANCE

The number of candidates for this subject was 3 681. The percentage of candidates who obtained a full pass was 48.45%.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B-	C+	C	C–	D+	D	F
Percentage	6.66	3.45	6.04	5.74	7.45	10.17	8.97	7.26	3.86	6.72	33.68

CANDIDATES' RESPONSES

PAPER 954/1

General comments

Overall, the presentation of the candidates' solutions revealed mixed performances of their mathematical ability. The majority of the candidates attempted all the questions and most answers were clearly shown with required and necessary workings. Questions 4 and 7 were excellently answered, as these questions only required them to use standard mathematical method and basic concepts. Question 4 required candidates to express the complex number in polar form and apply the de Moivre's theorem to determine the power of a complex number. Meanwhile, question 7 asked candidates to perform the elementary row operation (ERO) on the augmented matrix form to determine its inverse. The achievement in questions 2, 3, 6 and 8 were good. The performance in questions 1 and 5 was slightly poor. A number of candidates did not show sufficient steps or make clear reasons that led to their answers. This occurred most frequently when they were working towards the answers. For example, in question 1, the candidates were penalised for the omission of essential working in such cases. Candidates' reliance on calculators in solving questions could be seen as they were not able to provide essential workings on getting the factors of polynomials in question 3 and not showing substitution of values to obtain the coordinates of point R as in question 6. Some candidates did not understand the concepts of singular matrix in question 3, symmetrical matrix in question 7 and had problem in finding the fourth point of a parallelogram as in question 8. Some candidates skipped the essential steps to convince as to how the answers came about. This occurred most frequently when they were working towards the answers. For example, in questions 1(b), 2(b), 3 and 7. Examiners penalised the omission of essential workings in such cases.

High achiever candidates gave well-organised answers with systematic and strategised steps presented, showing their full understanding of the questions and concepts. Their performance in questions 4 and 7 were excellent with almost perfect score in these two questions. Good candidates were able to present exemplary with essential workings, as these questions only required them to use standard mathematical method and basic concepts. Those who attempted question 7 were able to form the three correct equations to determine the values of the unknown using the correct concept of symmetric matrix and proceeded in solving the whole question perfectly. Likewise, these good candidates also displayed well-presented answers in questions 1, 2, 3, 5, 6 and 8. Systematic steps were presented showing their full understanding of the questions and concepts.

Moderate candidates seemed to be able to understand the questions and attempted to answer all the seven questions but the majority gave only partially completed solutions. They presented their answers well for the questions they were familiar with. Nonetheless, they tended to make careless mistakes and had difficulty in answering more challenging questions such as questions 6 and 8. The candidates who attempted question 1 managed to sketch the two graphs correctly but used the improper labelling of the intercepts for the two functions. Generally, for question 1, these moderate candidates mostly managed to score the first three marks and lose the last two marks of part (*a*). As for part (*b*), most of these candidates could not provide proper and complete reason for their final answer. These moderate candidates were able to answer questions 2, 3, 5 and 8 partially.

Weaker candidates were not able to use the basic concepts learned. These candidates did not know how, why and when to use the concepts. They wrote messy answers using wrong formula and wrong mathematical principles and the given solutions were meaningless. Almost all of these weak candidates failed to solve questions 1(*b*), 2, 5, 6 and 8. Poor attempts were seen as the solutions provided by them were untidy and pointless. For example, in question 1, these candidates were not able to sketch the proper graph. A few candidates applied the elementary row operation in question 3, although the question required candidates to find the determinant of the matrix. Quite a number of candidates did not even attempt some questions especially questions 2, 5 and 6. Quite a handful of them did not attempt any question in Section B. Some of these candidates were also not able to make use of the binomial expansion which had been provided in the formula list, as requested in question 2 and also had problems with vectors addition in question 8. They could not even get the right coordinate for the centre of ellipse and used the incorrect formula to find c of the ellipse in question 5 even though the formula was provided in the formula list. These candidates were also not able to express complex numbers in polar form as they did not know how to find the modulus and argument.

As a whole, the performance of the candidates of Semester 1 2020 were at par with those repeating candidates of Semester 1 2019. The language used were good and clear, and almost all scripts were answered in English. There were still a few candidates who still used two columns in presenting their workings, split a page to two, squeezing two questions in one side making in a page with solutions of three to four questions which make it hard for the examiners to write marks at the appropriate place. A number of candidates did not indicate the question or the part of the question that they were attempting. The usage of pencil by all the candidates to answer the questions was found in one of the examination centres. Marking were difficult with illegible handwriting.

Comments on individual questions

Question 1

Almost all the candidates attempted this question and mostly they managed to obtain the first three marks. Most candidates were not able to solve the inequality in part (*b*) due to lack of knowledge that e^x is always positive. Due to the wrong reasoning, most candidates lost the last three marks. Good candidates were able to attain the two graphs and managed to exhibit the intercepts and intersection point. They were able to sketch both graphs correctly with asymptotes of $y = -1$ and $y = -2$ were indicated. The x-intercept (ln 3, 0) of $g(x) = e^x - 1$ and y-intercept (0, 4) of $y = 6e^{-x} - 2$ were correctly obtained and indicated. The intersection of the two graphs was located in the first quadrant. In part (*b*), the candidates were able to rewrite inequality or equation in the correct quadratic form which was $e^{2x} + e^x - 6 \geqslant 0$. Candidates successfully obtained the factors: $(e^x + 3)$ and $(e^x - 2)$. Answer was given in the correct set form as required with a correct reasoning. Quite a number of candidates did not label the graph completely i.e (ln 3) and the asymptotes were not clearly indicated. For labelling of the interceptions, some candidates wrote in decimal value, whereas only exact value was accepted.

Quite a number of candidates could not factorise properly and could not give appropriate reason to reject ($e^x + 3$) of the quadratic equation/inequality. Some answers were not given in the set form whislt some candidates gave inexact value; 0.6931 instead of ln 2 (exact answer). Some weak candidates were not able to solve the exponential inequality.

Answer: (*b*) $\{x \mid x \geqslant \ln 2\}$

Question 2

Only a handful of candidates scored full marks for this question. Most candidates successfully got the expansion in part (*a*) but many candidates lost marks in part (*b*). Most candidates excellently completed this task by giving the correct expansion using the provided formula to expand $(1 - 3x)^{\frac{1}{2}}$ and $(1 + 2\boldsymbol{x})^{\frac{1}{2}}$ until x^3. Candidates multiplied both series appropriately and they splendidly continued to find the range of x, knowing that the expansion of $(1 - 3\boldsymbol{x})^{\frac{1}{2}}$ was valid when $|-3x| < 1$ and the expansion of $(1 + 2\boldsymbol{x})^{\frac{1}{2}}$ was valid when $|2x| < 1$. Some careless mistakes occurred when finding the product of the two expansions. Most of the candidates did not apply "and" or did not use the number line to show how they obtained the range of values of x, for the expansion to be valid. A few candidates substituted "$3x$" instead of "$-3x$" which led to the wrong result of expansion. A few answers revealed that instead of finding product of the two expansions obtained, they subtracted the expansion. Some candidates tried to expand $(1 + 2\boldsymbol{x})^{-\frac{1}{2}}$ instead of $(1 + 2\boldsymbol{x})^{\frac{1}{2}}$ and left the answer as $\sqrt{\frac{1-3x}{1+2x}} = \frac{1 - \frac{3}{2}x - \frac{9}{8}x^2 - \frac{27}{16}x^3 + \ldots}{1 + x - \frac{1}{2}x^2 + \frac{1}{2}x^3 + \ldots}$. Very few candidates managed to find the answer by performing long division correctly. Quite a number of candidates stated the validity of the expansion $(1 - 3\boldsymbol{x})^{\frac{1}{2}}$ as $|-3x| < 1$ and quite a few did not show "$+\cdots$" for infinite series. These kind of answers were penalised as not well-presented workings.

Answer: $1 - \frac{5}{2}x + \frac{15}{18}x^2 - \frac{85}{16}x^3 + \ldots$; $-\frac{1}{3} < x < \frac{1}{3}$

Question 3

Almost all the candidates attempted this question but quite a number carelessly forgot the concept of singular matrix and were not sensitive about the form of cubic equation. Many candidates only obtained the first three marks. Almost all the candidates were able to find the det (M) perfectly by expanding along the row or column of choice. Up to this level, most candidates managed to form the cubic equation in terms of t successfully. The candidates then solved the cubic equation by factorisation or factor theorem and continued with other correct method such as long division or formula, and eventually obtained the three values of t successfully. Quite a number of candidates did not equate the determinant obtained to zero due to misunderstanding of the meaning of singular matrix. They only formed the cubic expression but not cubic equation. Some candidates could not even factorise the cubic equation attained and therefore could not get the possible values of t.

Answer: (*a*) $-t^3 + 2t^2 + t - 2 = 0$; (*b*) $t = -1, 1, 2$

Question 4

Many candidates achieved complete and perfect answers. Almost 95% of the candidates were able to get the correct modulus and argument and finally, obtained the correct polar form. The candidates were able to use de Moivre's theorem correctly to find the power of a complex number, $z^2 = 4\left(\cos\frac{\pi}{2} + \text{i}\sin\frac{\pi}{2}\right)$ and $w^5 = 32\left[\cos\frac{5\pi}{3} + \text{i}\sin\left(-\frac{5\pi}{3}\right)\right]$. They managed to get $\frac{z^2}{w^5}$ which were expressed in the polar form. Some candidates converted $\frac{z^2}{w^5}$ from the polar form to Cartesian form and then multiplied with the conjugate of the denominator in order to find the value of $\frac{z^2}{w^5}$. They successfully obtained the value of $\frac{z^2}{w^5}$ which was $\frac{1}{8}$ and concluded that it was a real number. Quite a number of candidates omitted the negative part in calculating $|w|$. These candidates wrote $\sqrt{1 + (\sqrt{3})^2}$ instead of $\sqrt{1 + (-\sqrt{3})^2}$. Consequently, these candidates lost five marks in this question. Some of the candidates wrote the arg (w) as $\frac{5}{3}\pi$. As for the modulus, a few candidates did not simplify the value and left the answer as $\frac{4}{32}$. Quite a number of candidates did not conclude that $\frac{1}{8}$ was a real number to attain the last mark.

Answer: (a) $w = 2\left[\cos\left(-\frac{\pi}{3}\right) + \text{i}\sin\left(-\frac{\pi}{3}\right)\right]$, $z = 2\left(\cos\frac{\pi}{6} + \text{i}\sin\frac{\pi}{6}\right)$; (b) $\frac{z^2}{w^5} = \frac{1}{8}$

Question 5

The performance of the candidates in this question was moderate even though the formula was given in the question paper. Candidates were able to obtain the values of a and b as 3 and 2 respectively. They successfully wrote the correct standard form of equation of ellipse using the values of a, b and the centre obtained. Candidates managed to find c using the formula $c = \sqrt{a^2 - b^2}$ and then achieved the coordinates of the foci separately which were $(3 + \sqrt{5}, 2)$ and $(3 - \sqrt{5}, 2)$. Quite a number of candidates produced the wrong centre of the ellipse which was $(0, 0)$ and wrote $c = \pm\sqrt{5}$. Some average candidates did not make use of the formula given at the back of the question paper and due to this, they used the wrong formula to find c. A few candidates stated the foci as $(3 \pm \sqrt{5}, 2)$ which was not accepted as the correct answer.

Answer: (a) $\frac{(x-3)^2}{9} + \frac{(y-2)^2}{4} = 1$; (b) $(3 + \sqrt{5}, 2)$ and $(3 - \sqrt{5}, 2)$

Question 6

Most of the candidates were able to relate the two coordinates of points $P(3, -1, 8)$ and $Q(5, -4, 7)$ with position vectors of P and Q respectively to find $\overrightarrow{PQ}$ or $\overrightarrow{QP}$ correctly. Most of them knew that they needed to find the direction of l to form the vector equation of the line. Quite a number of candidates realised that they needed the vector equation of line in order to obtain the parametric equations. The candidates were able to find the intersection of l and plane by substituting the vector equation of

l into the equation of the plane to attain the coordinates of R. A few candidates performed the cross product while trying to get the direction of line which was a wrong concept. Quite a number of candidates did not understand the meaning of parametric equations and they wrote the vector equation instead. A number of candidates gave the point R in vector form, $\begin{pmatrix} 7 \\ -7 \\ 6 \end{pmatrix}$, which was not in coordinate form.

Answer: (*a*) $x = 5 + 2t$, $y = -4 - 3t$, $z = 7 - t$; (*b*) $R(7, -7, 6)$

Question 7

Candidates who chose this question mostly got more marks as compared with candidates who chose question 8. Candidates were able to form the three correct equations, $a^2 = 2a - 1$, $b^2 = 4b - 4$, $bc = b + c$, and obtained the correct values of a, b and c. Candidates successfully formed the augmented matrix by appending matrix A with identity and worked on the ERO. They finally got the inverse and solved the system of linear equations using the inverse. A few candidates formed the equations to find a, b and c using the incorrect concept of symmetric matrix. There were also candidates who wrote improper ERO instructions such as missing of short and long arrow, usage of " = " or " : ". Some candidates did a few careless mistakes when performing ERO and quite a number of candidates overlooked the word "hence". Due to that, the Gaussian elimination was used by some candidates to solve the matrix equation. A few candidates used incorrect law of multiplication of matrix when using the inverse of the matrix to solve the equation such as $\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 3 \\ 11 \\ 8 \end{pmatrix} \begin{pmatrix} \frac{1}{2} & -\frac{1}{2} & 0 \\ -\frac{1}{2} & \frac{7}{26} & \frac{4}{13} \\ 0 & \frac{4}{13} & -\frac{1}{13} \end{pmatrix}$ which was actually undefined.

Answer: (*a*) $a = 1$, $b = 2$, $c = 2$; (*b*) $\boldsymbol{A}^{-1} = \begin{pmatrix} \frac{1}{2} & -\frac{1}{2} & 0 \\ -\frac{1}{2} & \frac{7}{26} & \frac{4}{13} \\ 0 & \frac{4}{13} & -\frac{1}{13} \end{pmatrix}$, $x = -4$, $y = \frac{51}{13}$, $z = \frac{36}{13}$

Question 8

Candidates who attempted this question mostly attained moderate marks. Candidates with excellent understanding of vector concept managed to attain better marks. Candidates were able to use equal vectors of parallelogram or midpoint concept to find $\overrightarrow{QR}$. They also managed to use the concept of dot product and showed that $\overrightarrow{PR}$ was not perpendicular to $\overrightarrow{QS}$, and deduced that $PQRS$ was not a rhombus. Many candidates splendidly calculated the area of parallelogram $PQRS$ with any two vectors from adjacent sides, connected vectors or using the two diagonals. Some candidates could not find the position vector of the point of intersection of $\overrightarrow{PR}$ and $\overrightarrow{QS}$. A few candidates applied the wrong concept, which was $\overrightarrow{PR} = \overrightarrow{QS}$ to find the position vector of R. A number of candidates were not able to apply dot product to determine whether $\overrightarrow{PR}$ and $\overrightarrow{QS}$ were perpendicular vectors nor deduce whether $PQRS$ was a rhombus. Some candidates applied incorrect concept to find the area of the parallelogram.

Answer: (*a*) $\overrightarrow{OR} = \mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$; (*c*) $\sqrt{114}$

MATHEMATICS (T) (954/2)

OVERALL PERFORMANCE

The number of candidates for this subject was 3 638. The percentage of candidates who obtained a full pass was 53.47%.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	8.63	5.25	8.66	7.04	7.78	7.78	8.33	3.90	2.03	4.10	36.50

CANDIDATES' RESPONSES

PAPER 954/2

General comments

Generally, most answers to questions 1, 3 and 6 were well done. But answers to questions 2 and 4 were moderately performed. Question 5 was poorly performed. Overwhelming majority of the candidates preferred to answer question 8. Only a few candidates chose to attempt question 7, and almost all of them performed poorly. There were still instances of candidates who divided a page into two columns. This caused examiners difficulty to indicate clearly where marks were awarded. Many good and excellent scripts were seen and the standard of presentation was usually good. The paper seemed to give all the candidates the opportunity to show what they had learned and understood on the questions. Many candidates were able to demonstrate their mathematical abilities on this paper. This was a paper which enabled the well-prepared candidates 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 they performed very poorly. This was obviously seen in questions 3, 5 and 7.

Comments on individual questions

Question 1

Most of the candidates were able to choose the correct function for both left and right limits and multiplied with correct conjugate. A few candidates were not able to factorise $16 - x^2$ correctly and therefore, obtained wrong right limit which led to wrong conclusion that $\lim_{x \to -4} f(x)$ did not exist and hence, f was not continuous at $x = -4$. Some candidates did not state $f(-4) = -\frac{3}{4}$ before comparing.

Answer: (*a*) $\frac{3}{4}$; (*b*) f is not continuous at $x = -4$

Question 2

Usually, candidates were able to form equation of tangent correctly if candidates managed to obtain the gradient of tangent. However, many candidates were not able to differentiate $\sin(x - y)$ implicitly. Some candidates expanded $\sin(x - y) = \sin x - \sin y$ and $\cos(y + \frac{\pi}{4}) = \cos y + \cos\frac{\pi}{4}$ which were incorrect.

Answer: (*b*) $y = \frac{4x}{4 - \pi} - \frac{\pi}{4 - \pi} + \frac{\pi}{4}$

Question 3

Most of the candidates were able to eliminate all the x terms and expressed it into partial fraction correctly. Many candidates were able to do this question correctly and managed to attain more marks. However, the weak candidates were not able to eliminate all the x terms and were not able to proceed with the working which then left the answer without a solution.

Answer: $\frac{1}{3}\ln\frac{8}{5}$

Question 4

Most of the candidates were able to find the integrating factor correctly. However, many candidates were not able to integrate $\frac{1}{\cos^2 x}$ correctly. Some candidates converted the function to $\cos 2x$ and then used double angle formula to solve it.

Answer: $y = x\tan x + \frac{x}{3}$

Question 5

Most of the candidates used the correct formula of Maclaurin theorem. They were able to integrate $7^x \sin x$ if the series was correctly obtained. Many candidates were not able to find the derivative of 7^x correctly. Some candidates used the wrong concept by differentiating 7^x as $x7^{x-1}$. Due to this, the candidates were not able to estimate the approximate value correctly since the series of 7^x was wrongly obtained.

Answer: (*a*) $1 + (\ln 7)x + \frac{(\ln 7)^2}{2}x^2 + \frac{(\ln 7)^3}{6}x^3 + \ldots$, $x + (\ln 7)x^2 + \left[\frac{(\ln 7)^2}{2} - \frac{1}{6}\right]x^3 + \ldots$; (*b*) 0.005692

Question 6

Many candidates were able to carry out Newton-Raphson method with the correct steps. Quite a number of candidates did some careless mistakes in substitution/evaluation during computation. Therefore, they could not find the correct stopping criteria.

Answer: Root = –0.5737 (4 d.p.)

Question 7

Most of the candidates were able to get at least y-intercept correctly. Many candidates were able to find $\frac{dy}{dx}$ by correct product rule and then equated $\frac{dy}{dx} = 0$ before trying to solve the trigonometric equation. Some candidates were able to find $\frac{d^2y}{dx^2}$ by correct product rule and then equated $\frac{d^2y}{dx^2} = 0$ before they tried to solve the trigonometric equation. Quite a numbers of candidates were not able to find two x-intercepts because they were not aware that $0 \leqslant x \leqslant \pi$ and then $0 \leqslant 2x \leqslant \pi$. Many candidates could not find two extremum points and two inflexion points correctly. Consequently, they were not able to sketch the graph correctly because only one extremum point and one inflexion point were found.

Answer: (*a*) $x = \frac{\pi}{4}, \frac{3\pi}{4}$, $y = 1$; (*b*) Max point = (0.232, 1.128) and min point = (1.803, –5.425);
(*c*) (1.249, –2.789) and (2.820, 13.425)

Question 8

Most of the candidates were able to find the intersection point correctly. Quite a number of candidates could find $\int \frac{\sqrt{10x}}{3}\,dx$ and $\int \left(\frac{9y^2}{10}\right)^2 dy$ correctly. Many candidates were not able to sketch the graphs correctly. Therefore, the candidates were not able to define the required area and were not able to carry out $\int \sqrt{\frac{36 - 4x^2}{9}}$ by using correct trigonometry substitution. Some candidates thought that $\sqrt{\frac{36 - 4x^2}{9}} = \frac{6 - 2x}{3}$. Other than that, many candidates were not able to define the required volume correctly, which led to the wrong value of volume.

Answer: (*a*) $\left(2, \frac{2\sqrt{5}}{3}\right)$; (*b*) 1.6923; (*c*) 7.1021

MATHEMATICS (T) (954/3)

OVERALL PERFORMANCE

The number of candidates for this subject was 3 628. The percentage of candidates who obtained a full pass was 61.84%.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	8.41	8.19	11.14	9.40	9.37	6.73	8.60	6.50	5.62	4.58	21.47

CANDIDATES' RESPONSES

PAPER 954/3

General comments

The overall performance in terms of quality of the answers including planning and presentation was appropriate. Good candidates could understand the concepts well and managed to perform calculations accurately. They could also present their solutions well and showed the steps systematically. As expected, weak candidates showed a lack of understanding of the requirements of the questions and their answer were not well-presented. They were not able to manage the information given in the question in order to find the solutions. Hence, they could not show the proper and correct working.

Most of the candidates were good in answering quantitative questions especially in questions 1(a), 2, 4(c), 5 and 6, but some candidates were weak in answering probability distribution, the underlying assumptions and conceptual questions as in questions 1(b), 3, 4(a) and 4(b). Quite a number of candidates answered the questions without proper understanding of the concept and the correct way of presentation including not using the proper symbols particularly in questions 3, 4, 5, 7 and 8. For example, in question 1(b), many candidates were not able to determine the appropriate measure of central tendency. They showed various measures of central tendency and measures of dispersion. In question 3, candidates were not able to differentiate discrete and continuous random variables. They obtained the probability by using integration. In addition, many candidates were not able to write a proper mathematical equation. Furthermore, almost all the candidates were not able to deduce the mean.

As for question 4, candidates were not able to define population clearly. In addition, they did not answer the distribution of the sample mean and did not state any assumption made correctly. The presentations of the candidates' answers were poor in question 5. For example, the correct answer should be $m < 88.79$, but they rounded it off to the nearest integer and gave the answer as $m < 88$ or $m = 88$. Some candidates faced the problems when using the sign 'more than' and 'more than and equal to' in question 8(d). As for question involving sample proportion and population proportion, some candidates were confused when to use the value of p or $\hat{p}$ in the standardisation.

Comments on individual questions

Question 1

Most of the candidates attempted this question. Good candidates were able to answer well. However, the average students were not able to choose suitable scale for the y-axis and it affected the accuracy of the height of the histogram. The majority of the candidates were able to use suitable scale for the x-axis. Quite a number of candidates were not able to comment on the skewness of the distribution based on the histogram. The majority of the candidates were not able to grasp the concept of measure of central tendency and not able to calculate the median even though formula was provided in the question paper. There were some candidates who used the correct formula but not able to identify the correct median class. Hence, they did not find the correct median value. Meanwhile, weak candidates listed out all the measures of central tendency instead of giving an appropriate measure of central tendency.

Answer: (*b*) 1.61

Question 2

This question was clearly stated and could be easily understood by candidates. Some candidates were able to use the concept of conditional probability correctly. The most common mistakes made were assuming events A and B were independent events and hence, they used the formula $\mathrm{P}(A \cap B) = \mathrm{P}(A) \times \mathrm{P}(B)$ and $\mathrm{P}(A \cap B') = \mathrm{P}(A) \times \mathrm{P}(B')$. The weak candidates were poor in conditional probability. They were not able to use the conditional probability correctly and gave $\mathrm{P}(B|A') = \dfrac{\mathrm{P}(B \cap A')}{\mathrm{P}(B)}$ instead of $\mathrm{P}(B|A') = \dfrac{\mathrm{P}(B \cap A')}{\mathrm{P}(A')}$.

Answer: (*a*) 0.21; (*b*) 0.847; (*c*) 0.248 or $\dfrac{30}{121}$

Question 3

Most of the candidates managed to show $r = \dfrac{1}{8}$. However, some candidates did not use $8r = 1$, but $r + 3r + 5r + 7r = 2$, which was not acceptable. Only some candidates managed to answer parts (*b*) and (*c*) correctly. In order to find $\mathrm{P}(2 < X \leqslant 5)$, some candidates calculate $\dfrac{5}{8} - \dfrac{2}{8}$, which was not right. For part (*c*), not many candidates were able to determine the probability distribution of X correctly. They applied integration in finding $\mathrm{P}(X = x)$. Some candidates listed out the x not as 1, 3, 5, 7 and 9 but they used all the values from 0 to 9. Some candidates even calculated the corresponding values of $\mathrm{P}(X = x)$ wrongly. A few candidates wrote the probability distribution of X with the wrong interval form. For the last part of the question, most of the candidates calculated the mean instead of deducing it.

Answer: (*b*) $\dfrac{1}{2}, \dfrac{7}{8}$; (*c*) 5

Question 4

The majority of the candidates did not manage to define population correctly for part (*a*). They assumed the population was "the masses of steel". For part (*b*), some candidates did not understand the distribution of the sample mean. They were confused between the sample mean and the population mean and also were not able to differentiate between the population variance and the sample variance. There were still some candidates who used the sample mean notation ($\overline{X}$) for population mean (μ). Part (*c*) was also poorly answered. The majority of the candidates did not know that a modulus should be used in order to find the probability that the difference between the sample mean and the population mean was at least 0.75 kg. Only good candidates were able to write down the expression $P(|\overline{X} - \mu| \geqslant 0.75)$ correctly.

Answer: (*c*) 0.1858

Question 5

This was a poorly performed question. Most of the candidates were not able to give the correct *z*-value from the table and could not apply the correct standard error, which resulted in incorrect solutions. Some candidates used the wrong standard error. For example, $\frac{\frac{m}{120} - 0.80}{\sqrt{0.8 \times 0.2}} < -1.645$. Some candidates used the wrong symbols. For example, $\frac{X - 0.80}{\sqrt{\frac{0.8 \times 0.2}{120}}} < -1.645$. Some candidates used the wrong test that was upper tail test. For example, $\frac{\frac{m}{120} - 0.80}{\sqrt{\frac{0.8 \times 0.2}{120}}} > 1.645$.

Answer: $m < 88.79$

Question 6

Overall, the performance was good. Well presented answer and most candidates got full marks. Minority of the candidates did not state the correct hypothesis. They wrote:

H_0: There is an association between gender and the preferred type of transport

H_1: There is no association between gender and the preferred type of transport

Some candidates wrote the conclusion "accept H_0" or did not mention 'enough' or 'sufficient' in the conclusion. Therefore, no mark was rewarded for this conclusion.

Answer: –

Question 7

Not many candidates attempted this question. Those who attempted this question scored well for part (*a*). They were able to standardise and found the correct values of μ and σ. If the candidates could obtain the values of μ and σ in part (*a*) correctly, then they were able to solve part (*b*) correctly. Some candidates did not know that the probability used comes from part (*b*). For part (*c*), majority of the candidates obtained correct mean and variance in normal approximation to binomial distribution. Some candidates did not apply the continuity correction. Good candidates were able to use the probability in part (*b*) to solve question in part (*c*).

Answer: (*a*) $\mu = 70$, $\sigma = 10$; (*b*) 0.30854; (*c*) 0.10618

Question 8

For part (*a*), most of the candidates used the correct symbol for unbiased estimate for population proportion. However, there were some candidates who used the wrong symbol, i.e. not using $\hat{p}$. The majority of the candidates used correct formula for confidence interval in part (*b*). But, there were a few candidates who used incorrect value of *z*. They used 1.645 instead of 1.960. For part (*c*), majority of the candidates managed to state hypotheses correctly. But there were quite a number of candidates who used incorrect *p* for calculating standard error and test statistics. Some candidates used the wrong symbols in the H_0 and H_1. For example, H_0: $p_s = 0.6$ and H_0: $p_s < 0.6$. There were also some candidates used the wrong test (upper tail test). For example, H_0: $p = 0.6$ and H_0: $p > 0.6$.

A few candidates used the wrong standard error. For example, $Z = \dfrac{0.59 - 0.60}{\sqrt{0.6 \times 0.4}}$ and $Z = \dfrac{0.59 - 0.60}{\sqrt{\dfrac{0.59 \times 0.41}{400}}}$.

Some candidates used the wrong values for p_0 and $\hat{p}$. For example, $Z = \dfrac{0.60 - 0.59}{\sqrt{\dfrac{0.59 \times 0.41}{400}}}$. For part (*d*), many candidates did not manage to write $P(|\hat{p} - p| \leqslant 0.04) = 0.95$, but they were able to find the sample size 581. Some candidates were not able to interpret the term "within 0.04" correctly which lead candidates interpreted as "... < 0.04" and "... $= 0.04$" instead of "... $\leqslant 0.04$".

Answer: (*a*) $\hat{p} = 0.59$; (*b*) (0.54180, 0.63820); (*d*) 581

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