# Mathematics S (950)

## OVERALL PERFORMANCE

The number of candidates for this subject was 1741. The percentage of candidates who obtained a full pass was 57.09%, with a decrease of 0.87% compared to the results of the previous year.

The achievement of candidates according to grades is as follows:

| Grade | A | A– | B+ | B | B– | C+ | C | C– | D+ | D | F |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage | 1.95 | 4.94 | 5.23 | 9.42 | 11.66 | 11.14 | 12.75 | 4.37 | 5.00 | 4.99 | 28.55 |

## RESPONSES OF CANDIDATES

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#### General comments

The candidates' performances vary. Overall the candidates' performance was average. For the above average candidates, generally they were able to plan and write their answers well. The good candidates were able to present organized and systematically written answers. In general, questions which involve reasoning, deduction, functions and sketching of curves; a majority of candidates did not put forward well-written answers. Furthermore, candidates tend to depend too much on the use of calculators, and as a consequence, the answers they give were not exact values. Candidates just stated the answers without showing essential steps to convince as to how the answers came about.

#### Comments on individual questions

#### Question 1

Very few candidates obtained full marks. A majority understood and was able to apply the laws of logarithm and was able to solve the equation by removal of ln. Since the problem involves ln, a precise answer is crucial to ensure the equation is satisfied. However, most of the candidates changed e to 2.718 and gave the answer in decimal which was inaccurate. Another common mistake was that quite a number of candidates did not verify their answer. As a result, they gave two answers but since $x > 0$ there was only one correct answer.

*Answer*: $x = \sqrt{(1 + e)} - 1$

#### Question 2

Most of the candidates were able to write $\dfrac{r^2 + r - 1}{r^2 + r}$ as $1 + \dfrac{1}{1 + r} - \dfrac{1}{r}$ using partial fraction. However, quite a number of candidates did not write the $\Sigma$ notation and quite a number missed out on the 1. A majority understood the method of differences whilst some were confused and used the series formula given in the question paper.

**Question 3**

Candidates were able to express the integral in terms of $u$ but failed to apply integration by parts to solve the problem. Weak candidates were not able to do the substitution correctly.

*Answer:* $\dfrac{3}{2} - \dfrac{2}{e}$

**Question 4**

Most candidates were able to split the inequality into two cases and solved them correctly. However, quite a number failed to combine the answers to obtain the final solution set.

Quite a number of candidates also used the graphical method and obtained full marks for it. A common error whilst using the graphical method was not labelling the graph appropriately. A part from that, some candidates did not observe the symmetry of the graph $|x + 1|$.

*Answer:* $(-\infty, 2)$

**Question 5**

For candidates who understood implicit differentiation, they were able to differentiate implicitly to obtain the first derivative but quite a number failed to obtain and prove the second part. There were also quite a number of candidates who still failed to understand implicit differentiation and instead wrote $y \dfrac{\sin x}{\sqrt{x}}$ and differentiate explicitly.

A few of the candidates squared to get rid of the $\sqrt{\phantom{x}}$ sign but could not proceed after second differentiation.

*Answer:* $k = \dfrac{2}{3}$

**Question 6**

Some candidates were able to answer the question systematically well. Quite a number were able to apply the distance formula though some made mistakes in getting the wrong equation of line $PQ$ while others made mistakes in substituting the correct values in the formulae. The question was intended to guide the candidates to determine the area of triangle $PQR$ using the distance obtained in earlier part but most candidates calculated the area using other formulae which is also acceptable.

Common mistakes include not writing $R$ in coordinate form, failure to substitute correct values of $ax + by + c = 0$ into the distance formula, failure to substitute $m = 1$ when required and not simplifying the distance and area obtained.

*Answers:* (a) $\left( \dfrac{(b - a)m}{m^2 + 1}, \dfrac{m^2 b + a}{m^2 + 1} \right)$;

(b) $\dfrac{b^2 - a^2}{2\sqrt{a^2 + b^2}}$ ;

(c) $\dfrac{1}{4}(b^2 - a^2)$

**Question 7**

Nearly all the candidates were able to answer the question in part (*a*) except those weak in calculation. Most of the candidates were able to find |*z*| but a majority failed to determine the arg *z* correctly.

Common mistakes included represent *z* and its conjugate in two separate diagrams, not labeling *z* and *z**, and just sketching the line without indicating the exact location of *z* and *z**.

*Answers:* (*a*) $z = -\sqrt{3} - i$ ; (*b*) $-\dfrac{5\pi}{6}$

**Question 8**

A majority of them could differentiate $e^{x^2}$ but failed to relate integration with differentiation. Many candidates failed to appropriately set the correct *u* and *dv* before performing integration by parts so that the result from the first part can be used. One possible choice is letting $\int x^3 e^{x^2} dx = \dfrac{1}{2}\int x^2 (2x e^{x^2}) dx$. Many of them just use normal integration by parts.

*Answers:* $2x e^{x^2}$, $a = 3$, $b = 2$, $c = 4$

**Question 9**

Almost all candidates were able to find f ∘ f but failed to deduce f⁻¹. Instead they found the solution by using the conventional way.

*Answers:* (*a*) $x$; $f^{-1}: x \mapsto \dfrac{x}{2x-1}$, $x \neq \dfrac{1}{2}$; (*b*) $a = 1$, $b = 0$, $c = -1$; (*c*) h(*x*) = (f ∘ p)(*x*)

**Question 10**

A majority of candidates answered question (*a*) well and obtained full marks. For those that did not get full marks, their errors are usually in the calculation of |**A**|. There are weak students who get confused and get mixed up with finding the adjoint, determinant and cofactor.

Many candidates just used their calculators to find **A**⁻¹ and as a result they did not get any marks since they did not use the adjoint to obtain the answer.

A majority of the candidates were able to find **B**. The common error in this question is that candidates post multiplied instead of pre-multiplying.

*Answers:* (*a*) |**A**| = 2, adj **A** = $\begin{pmatrix} -2 & 3 & 0 \\ 2 & 0 & 4 \\ 0 & 2 & 2 \end{pmatrix}$ **A**⁻¹ = $\begin{pmatrix} -1 & \frac{3}{2} & 0 \\ 1 & 0 & 2 \\ 0 & 1 & 1 \end{pmatrix}$; (*b*) **B** = $\begin{pmatrix} -8 & 27 & 0 \\ 9 & 2 & 18 \\ 0 & 18 & 10 \end{pmatrix}$

**Question 11**

Almost all the candidates answered well using the remainder and factor theorem to obtain the values for *a* and *b* as well as factorised p(*x*) completely. However, in part (*b*), a majority of the candidates did not state or indicate that $x \neq 3$.

In part (*c*), a common error amongst the answers given is that they wrote $2x^2 + x - 1 = x^2 + \dfrac{x}{2} - \dfrac{1}{2}$.

Some candidates were also confused between the minimum value and minimum point and as a result gave their answers in coordinate form.

*Answers:* (a) $a = 2$, $b = -5$; $p(x) = (x + 1)(2x - 1)(x - 3)$;

(b) $\left\{x : x \leqslant -1, \; x \geqslant \dfrac{1}{2}, \; x \neq 3\right\}$; (c) min value is $-\dfrac{9}{8}$ when $x = -\dfrac{1}{4}$

## Question 12

This is the question that very few candidates were able to answer completely.

There were some candidates who were able to state the asymptotes but a majority did not actually give the exact answer. They usually gave more than the required which indicated that the candidates did not understand what asymptotes are about.

Most of candidates could not differentiate ln $2x$ correctly as required in part (b).

They used the calculator to solve the equation f′$(x) = 0$ for $x$ which does not give the exact answer in terms of e. In general, candidates knew how to find and determine the type of stationary points but due to careless differentiation in earlier parts resulted in the loss of marks.

Almost all candidates did not understand the concept of concavity and inflexion points as required in part (c). This particular part of the question was poorly answered. The graph also was not perfectly sketched.

*Answers:* (a) $x = 0$, $y = 0$,

(b) $\left(\dfrac{1}{2}e^{\frac{1}{2}}, \dfrac{2}{e}\right)$ is a maximum point.

(c) (i) concave up when $(1.15, \infty)$

(ii) concave down when $(0, 1.15)$

The inflexion point $= \left(\dfrac{1}{2}e^{\frac{5}{6}}, \dfrac{10}{3}e^{-\frac{5}{3}}\right)$ or $(1.15, 0.630)$

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### General Comments

In general, candidates' performance was moderately good. Candidates were able to demonstrate a wide range of mathematical concept, they were very much aware the course content and well prepared. The mastery of the syllabus is well covered. However, some centre are quite weak, especially candidates from centre with few candidates. Most candidates did not do well on the comment or interpretation question. It shows they knew how to do mathematics mechanically but had less understanding on the concept.

### Comments on individual questions

### Question 1

Most of the candidates could answer the question satisfactorily. However, in part (a), they could comment on the shape of the distribution by giving correct reason. In part (b), many candidates could state the best measure of central location but failed to explain why the "median" is the choice.

*Answers:* (a) 0.33; (b) 0.2375

**Question 2**

Many candidates were able to answer part (*a*) by finding $\frac{^8C_3}{^{12}C_3}$ but failed to multiply with $\frac{3!}{3!}$ to show the understanding of probability concept which brought to a 1 mark deduction due to poor presentation of work. The candidates did badly in part (*b*) probably due to lack of conceptual understanding on probability.

*Answers*: (*a*) $\frac{14}{55}$;  (*b*) $\frac{4}{55}$

**Question 3**

Almost all o the candidates could answer correctly. However, there were a few candidates who failed to find the mode. Beside that, some candidates wrongly calculated the mean by dividing the sum by 7.

*Answers*: (*a*) $\frac{41}{162}$;  (*b*) mode = 1,  mean = $3\frac{1}{2}$

**Question 4**

This question was poorly attempted especially for part (*b*) and (*c*) which may be due to the unfamiliar way the data was presented.

*Answers*: (*a*) 187.50;  (*b*) 120.42;  (*c*) 20.42%

**Question 5**

The performance of candidates was moderate. They could calculate the smallest sample size and state the effect on the sample size with the changes in error and confidence interval. However, no candidates able state correct assumption.

*Answer*: (*a*) 174

**Question 6**

The performance of candidates was good. Many candidates could answer part (*a*) correctly but did poorly in part (*b*) where they calculated the coefficient of correlation instead.

*Answers*: (*a*) $b = -2.33, a = 48.01$;  (*b*) $r^2 = 0.861$

**Question 7**

The performance of candidates was good. However, some candidates were unable to construct a two-way classification table. They drew a tree diagram instead of the required table. However, many candidates were able to prove independent events.

*Answers*: (*b*) 0.25;  (*c*) 0.9

**Question 8**

Part (*a*) was well answered but part (*b*) was poorly attempted. Most of the candidates could not understand question part (*b*) well.

*Answers*: (*a*) 0.954;  (*b*) 0.08704

**Question 9**

The performance of candidates was good. Some candidates were not familiar with the activity on node diagram. The candidates could find the critical path and the minimum completion time of the project (but without any working). Some of them did not fully understand the meaning of total float and calculated wrongly.

*Answers*: (*a*) $r = 9$, $s = 12$;

(*b*) 23 weeks;

(*c*) Total float: $A = 0$ week, $J = 1$ week

**Question 10**

Candidates did not do well in this question. In part (*a*), the probability was written as $P(X < 42)$ instead of $P(\bar{X} < 42)$. The deviation used was $\sqrt{25}$ instead of $\sqrt{2.5}$. Some candidates used the wrong notation for sample mean. In part (*c*), the candidates could use the formula to find the confidence interval but failed to find the standard deviation for the sample. Beside that, the candidates were weak in giving the correct conclusion.

*Answers*: (*a*) 0.8971;

(*b*) 0.9332;

(*c*) (33.3, 54.2)

**Question 11**

The performance of candidates was good. Many candidates could determine the decision variables, find some of the constraints but failed to produce the objective function in correct units. They provided the objective function as $f = 5x + 4x$ which is in kilogram and considered other constraints in gram. They failed to use single units for the entire model such as gram. Many candidates did not recognize $x, y \geqslant 0$ as constraints which should be included in the model. Some used the wrong scale and wrongly produced feasible region.

*Answers*: (*b*) oats = 30g, rice = 40g, cost = RM0.31

**Question 12**

This question was poorly presented by the candidates. Many candidates could not label the vertical axis correctly. Most of the candidates could find the mode but failed to find the median from the histogram. The candidates could calculate the mean but did not leave it as the exact answer; they rounded up to 3 significant figures. Not many candidates could answer part (*d*) correctly.

*Answers*: (*b*) mode = 6.80, median = 6.90;

(*c*) 7.00875;

(*d*) 11.5%