Aga Khan University Examination Board

Notes from E-Marking Centre on SSC I Mathematics Examination May 2016

Introduction

This document has been produced for the teachers and candidates of SSC Part I (Class IX) Mathematics. It contains comments on candidates' responses to the 2016 Secondary School Certificate (SSC-I) Examination, indicating the quality of the responses and highlighting their relative strengths and weaknesses.

E- Marking Notes

This includes overall comments on candidates' performance on every question and some specific examples of candidates' responses which support the mentioned comments. Please note that the descriptive comments represent an overall perception of the better and weaker responses as gathered from the e-marking session. However, the candidates' responses shared in this document represent some specific example(s) of the mentioned comments.

Teachers and candidates should be aware that examiners may ask questions that address the Student Learning Outcomes (SLOs) in a manner that require candidates to respond by integrating knowledge, understanding and application skills they have developed during the course of study. Candidates are advised to read and comprehend each question carefully before writing the response to fulfil the demand of the question.

Candidates need to be aware that the marks allocated to the questions are related to the answer space provided on the examination paper as a guide to the length of the required response. A longer response will not in itself lead to higher marks. Candidates need to be familiar with the command words in the Student Learning Outcomes which contain terms commonly used in examination questions. However, candidates should also be aware that not all questions will start with or contain one of the command words. Words such as 'how', 'why' or 'what' may also be used.

Detailed Comments:

Question 1a

Verify that $\left(\frac{8a^8b^2}{a^2b^5}\right)^{\frac{1}{3}} = \frac{2a^2}{b}$.

Better responses indicated that candidates correctly applied laws of exponents in variety of ways and were able to prove the required result.

Example:

$$\left(\frac{8a^8 b^2}{a^2 b^5}\right)^{1/3} = \frac{2a^2}{b}$$

$$\left(8a^{8-2} b^{2-5}\right)^{1/3} = \frac{2a^2}{b}$$

$$\left(8a^6 b^{-3}\right)^{1/3} = \frac{2a^2}{b}$$

$$\left(2^3 a^6 b^{-3}\right)^{1/3} = 2a^2$$

$$(2^{\cancel{3}})^{1/\cancel{3}} \, (a^{\cancel{6}\,2})^{1/\cancel{3}} \, (b^{-3})^{1/\cancel{3}} = \frac{2a^2}{b}$$

$$2a^2b^{-1} = \frac{2a^2}{b}$$

$$\frac{2a^2}{b} = \frac{2a^2}{b} \quad \text{verified.}$$

Weaker responses exhibited different types of confusions in applying laws of exponents.

Instead of addition, candidates subtracted the exponents, i.e. $\left(\frac{8a^8b^2}{a^2b^5}\right)^{\frac{1}{3}} = \left(8a^{8+2}b^{2-5}\right)^{\frac{1}{3}}$ but still managed to prove the required result by using faulty mathematics. In few other responses, it was noted that candidates wrote $(8)^{\frac{1}{3}} = 512$. The different types of misconception in application of laws of exponents are evident from the following response.

Example:

01:. $\left(\frac{8a^8\ b^2}{a^2\ b^5}\right)^{\frac{1}{3}} = \frac{2a^2}{b}$.

$= \frac{(2\times 3)^{\frac{1}{3}}\ (a^{2\times 3})^{\frac{1}{3}}\ (b^2)^{\frac{1}{3}}}{(a^2)^{\frac{1}{3}}\ (b^5)^{\frac{1}{3}}} = \frac{2a^2}{b}$.

$= \frac{2\ a^{2}\ b^{6}}{a^{6}\ b^{8}} = \frac{2a^2}{b}$.

$= \frac{2}{a^{4}b^{2}} = \frac{2a^2}{b}$.

$= \frac{2a^{4}}{b^{2}} = \frac{2a^2}{b}$

$= \frac{2a^4}{b} \Rightarrow b$ Ans.

Question 1b

Simplify $\dfrac{3+3i+5-2i-6}{2-i}$ to the form $a+ib$.

Better Responses informed that candidates were familiarised with simplification and rationalisation processes of complex numbers. Hence, they systematically solved the given problem to meet the requirements of the questions.

Example:

$$\Rightarrow \frac{3i-2i+3+5-6}{2-i}$$

$$\Rightarrow \frac{i+2}{2-i}$$

$$\Rightarrow \frac{i+2}{2-i} \times \frac{2+i}{2+i}$$

$$\Rightarrow \frac{i(2+i)+2(2+i)}{(2)^2-(i)^2}$$

$$\Rightarrow \frac{2i+i^2+4+2i}{4-i^2}$$

$$\Rightarrow \frac{4i+(-1)+4}{4-(-1)}$$

$$\Rightarrow \frac{4i+3}{4+1}$$

$$\Rightarrow \frac{4i+3}{5}$$

$$\Rightarrow \frac{4i}{5}+\frac{3}{5} \text{ Ans}$$

Weaker responses revealed lack of understanding of the simplification process of complex numbers. In few weaker responses, candidates started with the rationalisation process and made the problem difficult for them and, hence, made different types of mistakes in multiplication, addition and subtraction of complex numbers. It is also noted that in weaker responses, candidates wrote $i^2 = 1$ or $i^2 = -i$. In the following example, one can see conceptual mistakes as well as the error made while writing denominator.

Example:

$$\frac{3+3i+5-2i-6}{2-i}$$

$$\frac{3+5-6+3i-2i}{2+i}$$

$$\frac{\cancel{2}+\cancel{i}}{\cancel{2}+\cancel{i}}$$

$$1+i = a+bi$$

[illegible]

Question 2a

For the sets $U=\{1,2,3,4,5\}$, $A=\{1,2,3\}$ and $B=\{2,4,5\}$, find the value of $(A\cup B)\cap(A\cap B)^C$.

This is generally a well attempted question which offered a choice between part **a** and part **b**. of Candidates mostly attempted part **a**, which is based on sets and its operations.

Better responses displayed that candidates had good commands over operations on sets, i.e. union, intersection and compliment. These responses followed the hierarchy of the operations and solved the question to find the value of $(A\cup B)\cap(A\cap B)^C$.

Example:

$$A\cup B = \{1,2,3\}\cup\{2,4,5\}$$
$$=\{1,2,3,4,5\}$$
$$A\cap B = \{1,2,3\}\cap\{2,4,5\}$$
$$=\{2\}$$
$$(A\cap B)^c = U-(A\cap B) = \{1,2,3,4,5\}-\{2\}$$
$$=\{1,3,4,5\}$$
$$(A\cup B)\cap(A\cap B)^c = \{1,2,3,4,5\}\cap\{1,3,4,5\}$$
$$=\{1,3,4,5\}$$

Weaker responses indicated that the candidates had confusions among hierarchies of operations of sets. They found first $(A \cup B) \cap (A \cap B)$ and then the compliment of the whole $(A \cup B) \cap (A \cap B)$. In some responses, it was also noted that candidates had confusion between intersection and difference of set. Moreover, it was noted that disorganised writing itself give rise to many confusions; This is evident from the example cited below.

Example:

$(A \cup B) = A = \{1, 2, 3\} \cup B = \{2, 4, 5\}$

$(A \cup B) = \{1, 2, 3, 4, 5\}$

$(A \cup B) \cap (A \cap B)^c = A = \{1, 2, 3\} \cap B = \{2, 4, 5\}$

$(A \cup B) \cap (A \cap B)^c = \{2\}$

$(A \cap B)^c = \{1, 2, 3, 4, 5\} \cap \{2\}$

$= \{1, 3, 4, 5\}$ Ans

Question 2b

If $A = \{2,4,6\}$ and $B = \{5,10,15\}$ are the given sets, then

i. decide whether the relation $r = \{(2,5),(4,10),(4,15)\}$ is a function from A to B or not? Justify your answer.

ii. find the domain and range of r.

As reported earlier, this part of the question was less attempted as compared to part **a** of the question. It shows that candidates are more comfortable in sets than the binary relation functions and its types.

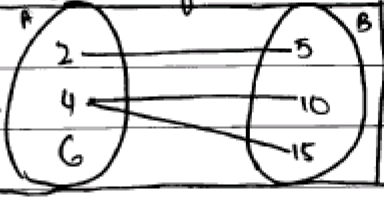
Better responses exhibited that the candidates were able to differentiate between function and relation and they decided correctly about the nature of the relation and subsequently correctly wrote the domain and range of the relation.

Example 1:

① No, it is not a function:

As in set A element "4" has two images and The function is only formed when no element of set A or domain has two images.

A/L to the given function



This is not a function as two images is forming by element 4 which is not satisfying the definition of function.

ii. find the domain and range of *r*. (2 Marks)

Dom r = {2,4}

Rang r = {5,10,15}.

Example 2:

Relation r is not a function from A to B because in a function set A is equals to domain but it's not in this case. One element of set A is missing from the relation so it's not a function. Also in a function each element of set B should be associated with distinct element of set A but it's not so over here.

ii. find the domain and range of *r*. (2 Marks)

domain = {2,4}

range = {5, 10, 15}

Weaker responses displayed that candidates are not clear about the concept of function and, therefore, unable to decide whether the given relation is a function or not. Few wrote correctly that the given relation is not a function but failed to justify their statement as required in the question. While writing domain and range, some candidates enlisted correctly the element of the domain and range but failed to write the domain and range properly. Few examples are as follows:

Domain: {2, 4, 4}, (2, 4), (2, 4, 6) etc.

Range: (5, 10, 15), {2, 4, 6} etc.

Example:

r = {(2, 5), (4, 10), (4, 15)} is a function from A to B.
{(2, 5), (4, 10), (4, 15)} are the subsets of the A to B

ii. find the domain and range of r. (2

Domain = {{2, 4}}
Range = {10, 15}

r = {(2, 5), (4, 10), (4, 15)} is a function from A to B.
{(2, 5), (4, 10), (4, 15)} are the subsets of the A to B

ii. find the domain and range of r. (2

Domain = {{2, 4}}
Range = {10, 15}

Question 3

By applying laws of logarithm, express $\log m - \log n + \frac{1}{2}\log p$ as a single logarithmic term.

Better responses exhibited good understanding of laws of logarithm and application of these laws to the given logarithmic expression to write it as a single logarithm.

Example:

$\log m - \log n + \frac{1}{2}\log p$

$= \log m - \log n + \log p^{1/2}$

$= \log\left(\frac{m}{n}\right) + \log p^{1/2}$

$= \log\left(\frac{m \times p^{1/2}}{n}\right)$ Ans

Weaker responses indicated lack of understanding of the laws and their correct application. The basic reason observed for the various types of mistakes was skipping basic steps needed to approach the problem. Few mistakes noted were $\log m - \log n + \frac{1}{2}\log p = \frac{\log m}{\frac{1}{2}\log n \times \log p}$ or $\log m - \log n + \frac{1}{2}\log p = \frac{\log m}{\log n} + \frac{1}{2}\log p$ **or** $\log m - \log n + \frac{1}{2}\log p = \log mn + \frac{1}{2}\log p$ etc.

Example:

$\log m - \log n + \frac{1}{2}\log P$

$\therefore \log\frac{m}{n} = \log m - \log n$, $\therefore \log m \times n = \log m + \log n$, $\therefore \log m^{\frac{1}{2}} = \frac{1}{2}\log m$

Hence $\therefore \frac{\log m}{\log n + \frac{1}{2}\log P} = \frac{\log m}{\log n \times P^2} = \frac{\log m}{\log n P^2} = \frac{\log m}{(np^2}$

The choice was offered between part **a** and part **b.** Mostly candidates opted for part **a** and generally it was well attempted question. The question was based upon the simplification of algebraic expression by applying algebraic operations and formula.

Question 4a

Reduce $\dfrac{xy(x-y)}{2(x+y)} \div \dfrac{x^2y - xy^2}{2(x^2 + 2xy + y^2)}$ to its simplest form.

Better responses correctly converted the division sign to multiplication sign, applied the required formula of $(x+y)^2$, and took common and aptly did the cancellation to convert the given algebraic expression to its simplest form.

Example:

$$a\text{-}\ \frac{xy(x-y)}{2(x+y)} \div \frac{x^2y-xy^2}{2(x^2+2xy+y^2)}$$

$$= \frac{\cancel{xy(x-y)}}{\cancel{2}(x+y)} \times \frac{\cancel{2}(x^2+2xy+y^2)}{\cancel{xy(x-y)}}$$

$$= \frac{x^2+2xy+y^2}{(x+y)}$$

$$= \frac{(x+y)^2}{(x+y)}$$

$$= (x+y)$$

Weaker responses executed different types of mistakes in performing algebraic operations, which are evident from the examples cited below.

Example 1:

$$(a)\quad \frac{xy(x-y)}{2(x+y)} \times \frac{2(x^2+2xy+y^2)}{x^2y-xy^2}$$

$$\frac{xy(\cancel{x-y})}{2(\cancel{x+y})} = \frac{2(x+y)^2}{xy(x-y)}$$

$$\frac{x\cancel{y}}{\cancel{2}} = \frac{\cancel{2}(x+y)^2}{x\cancel{y}(x-y)}$$

$$\frac{(x+y)^2}{x-y)}$$

Example 2:

$$\frac{xy(x-y)}{\cancel{2}(\cancel{x+y})} \times \frac{\cancel{2}(\cancel{x+y})^{\cancel{2}}}{x^2y-xy^2}$$

$$= xy\,(x-y) \times \frac{x+y}{(x+y)(x-y)}$$

$$= xy(\cancel{x-y}) \times \frac{\cancel{x+y}}{(\cancel{x+y})(\cancel{x-y})}$$

$$= xy \text{ Answer.}$$

Question 4b

Apply continued product to verify
that $(2x+1)(2x-1)(4x^2+2x+1)(4x^2-2x+1) = 64x^6 - 1$.

Better responses exhibited correct arrangement of the terms in order to apply the formulae of $a^3 - b^3$ and $a^3 + b^3$ and systematically simplified the expression to verify the required result.

Example:

$$(2x+1)(2x-1)(4x^2+2x+1)(4x^2-2x+1) = 64x^6-1$$
$$(2x+1)(4x^2-2x+1)(2x-1)(4x^2+2x+1) = 64x^6-1$$
$$\{(2x)^3+(1)^3\}\{(2x)^3-(1)^3\} = 64x^6-1$$
$$(8x^3+1)(8x^3-1) = 64x^6-1$$
$$(8x^3)^2-(1)^2 = 64x^6-1$$
$$64x^6-1 = 64x^6-1$$

L·H·S is equal to R·H·S

Weaker responses displayed various types of mistakes like $2x+1=3x$, wrong arrangement of terms and mistake of signs while applying formulae. Some candidates opted for long multiplication method instead of application of formulae and made mistakes in the multiplication process and handling of signs and consequently failed to verify the required result.

Example 1:

$$(16x^4-4x^2+1)\,\cancel{(2x}\,(4x^2+1) = 64x^6-1$$
$$64x^6 - (\cancel{4x^2})(\cancel{4x^2}) - 1 = 64x^6-1$$
$$64x^6-1 = 64x^6-1$$

Example 2:

$(2x+1)^2(4x^2+2x+1)^2 : x :: x = 64x^6-1$

$x^2 = (2x+1)^2(4x^2+2x+1)^2(8x^3-1)^2$

take Square root on both side

$\sqrt{x^{\cancel{2}}} = \sqrt{(2x+1)(4x^2+2x+1)(8x^3-1)^{\cancel{2}}}$

$x = (2x+1)(4x^2+2x+1)(8x^3-1)$

Question 5a

Factorise $(z^2 - z - 3)(z^2 - z + 1) + 4$ completely.

The choice was offered between part **a** and part **b** of the question and candidates mostly opted for part **b**.

Better responses reported that most candidates comprehended the question well and after required supposition, they correctly broke the middle term to complete the factorisation process.

(a) ~~(b)~~ $\Rightarrow$ let $z^2 - z = y$

$\Rightarrow (y-3)(y+1)+4$

$\Rightarrow y(y+1) - 3(y+1) + 4$

$\Rightarrow y^2 + y - 3y - 3 + 4$

$\Rightarrow y^2 - 2y + 1$

$\Rightarrow y^2 - y - y + 1$

$\Rightarrow y(y-1) - 1(y-1)$

$\Rightarrow (y-1)(y-1)$

$\Rightarrow (z^2-z-1)(z^2-z-1)$

$\Rightarrow \boxed{(z^2-z-1)^2}$ Ans

Weaker responses indicated that candidates expanded the brackets and, therefore, were unable to solve the problem to factorise the given expression. Some candidates made correct supposition, i.e. $z^2 - z = x$ but failed to break the middle term properly to completely factorise the given expression.

$$(z^2 - z - 3)(z^2 - z + 1) + 4$$
$$z^2(z^2 - z + 1) - z(z^2 - z + 1) - 3(z^2 - z + 1) + 4$$
$$z^4 - z^3 + z^2 - z^3 + z^2 - z - 3z^2 + 3z - 3 + 4$$
$$z^4 - z3 - z^3 + z^2 + z^2 - z - \cancel{3z^2} + \cancel{3z} - 3 + 4$$
$$z^4 + 2z^3 + 2z^2 - z - z - 3 + 4$$
$$z^4 + 2z^3 + 2z^2 - z - 5 + 4$$
$$z^4 + 2z^3 + 2z^2 - z - 1$$

Question 5b

Find the zeros of the polynomial $y^2 - 5y + 6$. Hence find the remainder when $y^2 - 5y + 6$ is divisible by $y - 3$.

This was generally a well attempted question. Most of the candidates opted for trial and error method instead of factorising $y^2 - 5y + 6$ and comparing each of the factors with zero to find the zeros of the polynomial.

Better responses indicated the clear concept of zeros of polynomial and applied the concept successfully to find the zeros of the given polynomial $y^2 - 5y + 6$. Examples of two methods employed by the candidates are cited in the given examples.

Example 1:

$y-2=0 \Rightarrow y=2$

$P(2)=(2)^2-5(2)+6$

$P(2)=4-10+6$

$P(2)=4+6-10$

$P(2)=10-10$

$P(2)=0 \Rightarrow \therefore y-2$ is a factor

$y-3=0 \Rightarrow y=3$

$P(3)=(3)^2-5(3)+6$

$P(3)=9-15+6$

$P(3)=9+6-15$

$P(3)=15-15$

$P(3)=0 \Rightarrow \therefore y-3$ is a factor.

$y-3 \,\big)\, y^2-5y+6 \,\big(\, y-2$

$\cancel{y^2}-3y$

$\cancel{-}\;+$

$-2\cancel{y}+\cancel{6}$

$\cancel{-2y}\cancel{+6}$

$\cancel{+}\;\cancel{-}$

$\times$

y^2-5y+6 is completely divisible by $y-3$.

Example 2:

zeros of the polynomial y^2-5y+6 are

(1) $(y-3) \rightarrow y=3$

$p(3)=(3)^2-5(3)+6 \Rightarrow 9-15+6 \Rightarrow 0$

(2) $(y-\cancel{2}) \Rightarrow \cancel{2}\ y=2$

$p(2)=(2)^2-5(2)+6 \Rightarrow 4-10+6 \Rightarrow 0$

y^2-5y+6

$y^2-2y-3y+6$

$y(y-2)-3(y-2)$

$(y-3)(y-2)$

when y^2-5y+6 is divided by $(y-3)$ then the remainder is 0. ~~meaning that~~

i.e $(y-3)$ is the zero of the polynomial ~~$p(y)$~~

$P(y)=y^2-5y+6$ are.

Weaker Responses indicated that candidates lack the correct concept of zeros of polynomial but were unsuccessful in applying the concept to the given polynomial. Some responses were indicative of the fact that candidates were unable to correctly simplify the expression after substituting the value of *x,* i.e.

$$p(3) = 3^2 - 5(3) + 6$$

$$p(3) = 6 - 15 + 6 = -3$$

Example:

$y - 3 = 0, \; y = 0 + 3.$

$y = +3.$

$p(y) = y^2 - 5y + 6.$

$p(3) = (+3)^2 - 5(3) + 6.$

$= 6 - 15 + 6$

$= 12 - 15$

$= -3.$

$p(y) = y^2 - 5y + 6.$

$p(3) = (3)^2 - 5(3) + 6.$

$\cancel{p(3) = 9 - 15 + 6.}$

$p(3) = 15 - 15$

$= 0.$

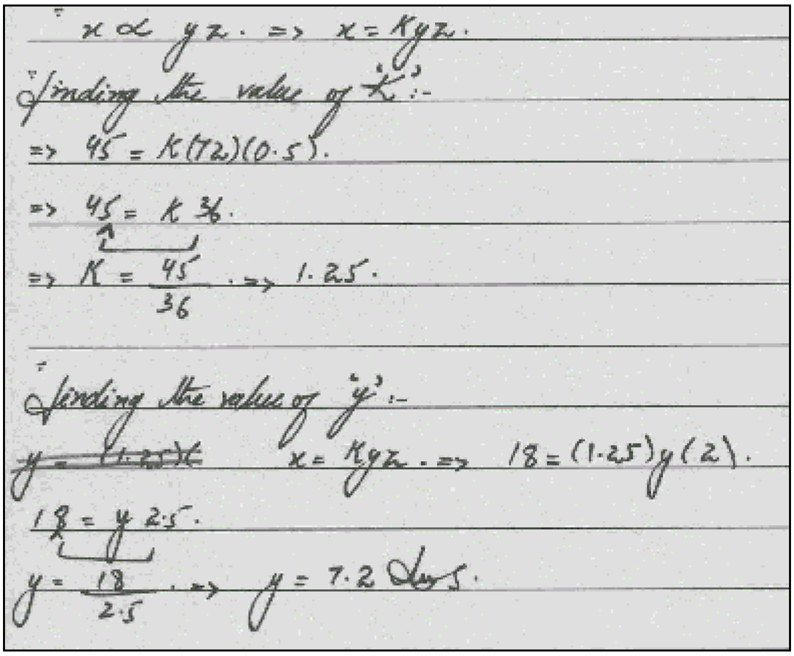
The remainder is -3.

Question 6a

x varies jointly as the values of *y* and *z*. If the value of *x* is 45 when $y = 72$ and $z = 0.5$, then find the value of *y* when $x = 18$ and $z = 2$.

Better responses displayed that candidates were successful in developing the correct relation between *x, y* and *z* and, subsequently, correctly found the value of proportionality constant and the required value of *y.*

Example:



$x \propto yz. \Rightarrow x = kyz.$

finding the value of 'k':-

$\Rightarrow 45 = k(72)(0.5).$

$\Rightarrow 45 = k\,36.$

$\Rightarrow k = \frac{45}{36} . \Rightarrow 1.25.$

finding the value of 'y':-

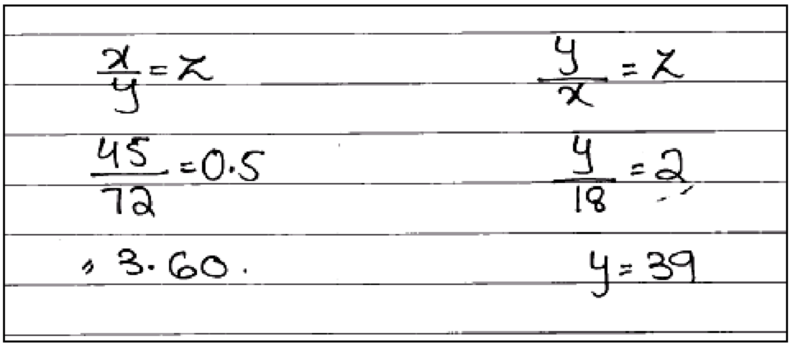
~~$y = (1.25)x$~~ $x = kyz. \Rightarrow 18 = (1.25)y(2).$

$18 = y\,2.5.$

$y = \frac{18}{2.5} . \Rightarrow y = 7.2$ days.

Weaker Responses exhibited that candidates incorrectly translated joint variation in variety of ways, for example, $x \propto \frac{y}{z}, x \propto \frac{1}{yz}$, $x\,yz = k$ and $x \propto y + z$, or made mistakes in simplification after substituting the values in the relation to find the value of *k* and *y*.

Example:



$\frac{x}{y} = z$ $\qquad$ $\frac{y}{x} = z$

$\frac{45}{72} = 0.5$ $\qquad$ $\frac{y}{18} = 2$

$= 3.60.$ $\qquad$ $y = 39$

Question 6b

If $\dfrac{a}{b} = \dfrac{c}{d} = \dfrac{e}{f} = k,$ then verify that $k^2 = \dfrac{a^2 + c^2 + e^2}{b^2 + d^2 + f^2}$.

There was choice between part **a** and part **b** of the question and mostly candidates opted for part **b**.

This part of the question is based on the k-method.

Better responses reported that the candidates followed all the necessary steps required to verify $k^2 = \dfrac{a^2 + c^2 + e^2}{b^2 + d^2 + f^2}$. The candidates started from finding values of *a, c* and *d* in terms of *k,* substituted the values on the R.H.S. of the equation and correctly simplified to verify the required result.

Example:

$a = bk,\ c = dk,\ e = fk$

R.H.S

$= \dfrac{a^2 + c^2 + e^2}{b^2 + d^2 + f^2}$

$= \dfrac{(bk)^2 + (dk)^2 + (fk)^2}{b^2 + d^2 + f^2}$

$= \dfrac{b^2k^2 + d^2k^2 + f^2k^2}{b^2 + d^2 + f^2}$

$= \dfrac{k^2\cancel{(b^2 + d^2 + f^2)}}{\cancel{b^2 + d^2 + f^2}}$

$= k^2 =$ L.H.S proved

$\Rightarrow x \propto yz \Rightarrow x = kyz$

$\Rightarrow 45 = k(12)(0.5) \Rightarrow 45 = k\,36$

$\Rightarrow k = \dfrac{45}{36} = \dfrac{5}{4}$

$x = kyz$

$=$

Weaker responses indicated that candidates were not well-versed with steps involved in the K-method and attempted the question in different ways but failed to verify the required result.

Following common errors were noted:

I. Candidates started by taking square of $\frac{a}{b}=\frac{c}{d}=\frac{e}{f}=k$ as $\left(\frac{a}{b}=\frac{c}{d}=\frac{e}{f}=k\right)^2$

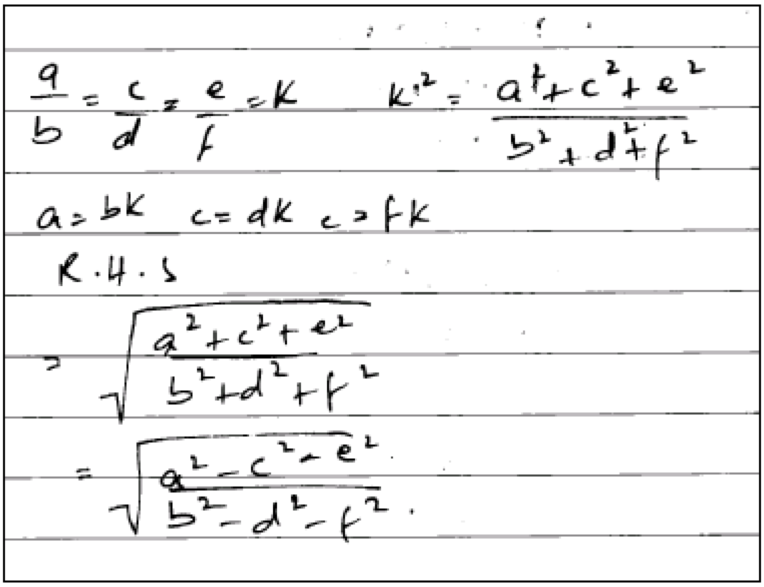
II. In few responses, candidates started with $k=\frac{a+b+c}{b+d+f}$ and took square as

$k^2=\frac{a^2+b^2+c^2}{b^2+d^2+f^2}$ or as $k^2=\left(\frac{a+b+c}{b+d+f}\right)^2=\frac{a^2+b^2+c^2}{b^2+d^2+f^2}$.

III. In few other cases, candidates took the square root and wrote $k=\sqrt{\frac{a^2+b^2+c^2}{b^2+d^2+f^2}}$

and then they were clueless how to go further to verify the result.

Example:



$\frac{a}{b}=\frac{c}{d}=\frac{e}{f}=K \qquad K^2=\frac{a^2+c^2+e^2}{b^2+d^2+f^2}$

$a=bK \quad c=dK \quad e=fK$

R.H.S

$=\sqrt{\frac{a^2+c^2+e^2}{b^2+d^2+f^2}}$

$=\sqrt{\frac{a^2-c^2-e^2}{b^2-d^2-f^2}}$.

Question 7

The determinant of a matrix $A = \begin{bmatrix} 5 & x \\ 3 & 10 \end{bmatrix}$ is -4. Find the value of x and also find the multiplicative inverse of the matrix A.

Better responses revealed that candidates correctly found the determinant of the matrix and compared it with – 4 to find the value of *x*. After substituting the value of *x* in the given matrix, they found adjoint of the matrix and finally got the multiplicative inverse of the matrix.

Example:

For the value of x :

$$A = \begin{vmatrix} 5 & x \\ 3 & 10 \end{vmatrix} = -4.$$

$$= 5 \times 10 - 3 \times x = -4.$$

$$= 50 - 3x = -4$$

$$\Rightarrow -3x = -4 - 50$$

$$\Rightarrow -3x = -54$$

$$\Rightarrow 3x = 54.$$

$$\Rightarrow x = \frac{54}{3}.$$

$$\Rightarrow x = 18.$$

$$A = \begin{bmatrix} 5 & 18 \\ 3 & 10 \end{bmatrix} \Rightarrow |A| = -4.$$

$$[\text{Adj of } A] = \begin{bmatrix} 10 & -18 \\ -3 & 5 \end{bmatrix}.$$

$$A^{-1} = \frac{1}{|A|} [\text{Adj of } A].$$

$$= \frac{1}{-4} \begin{bmatrix} 10 & -18 \\ -3 & 5 \end{bmatrix}.$$

$$= \begin{bmatrix} \frac{+\cancel{10}\,5}{-\cancel{4}\,2} & \frac{+\cancel{18}\,9}{+\cancel{4}\,2} \\ \frac{+3}{+4} & \frac{+5}{-4} \end{bmatrix} \Rightarrow \begin{bmatrix} -\frac{5}{2} & \frac{9}{2} \\ \frac{3}{4} & -\frac{5}{4} \end{bmatrix}$$

$$A^{-1} \Rightarrow \begin{bmatrix} -\frac{5}{2} & \frac{9}{2} \\ \frac{3}{4} & \frac{-5}{4} \end{bmatrix}.$$

Weaker responses indicated that candidates have various confusions regarding inverse of the matrices. Some examples of weaker responses are as follows:

i. $A^{-1} = \begin{bmatrix} \frac{1}{5} & \frac{1}{18} \\ \frac{1}{3} & \frac{1}{10} \end{bmatrix}$

ii. $A^{-1} = \begin{bmatrix} \frac{5}{4} & -\frac{18}{4} \\ -\frac{3}{4} & \frac{10}{4} \end{bmatrix}$

iii. $A^{-1} = \begin{bmatrix} -5 & -x \\ -3 & -10 \end{bmatrix}$ etc.

In fewer weaker responses, it was also observed that $\begin{bmatrix} 5 & 18 \\ 3 & 10 \end{bmatrix}$ is multiplied by $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ to get the inverse of the matrix and candidate ended up with the original matrix $\begin{bmatrix} 5 & 18 \\ 3 & 10 \end{bmatrix}$.

Example:

$A = \begin{bmatrix} 5 & 15\cdot3 \\ 3 & 10 \end{bmatrix}$

Adj of A

$\begin{bmatrix} 10 & -15\cdot3 \\ -3 & 5 \end{bmatrix}$

$(-3 \times -(15\cdot3)) - (10 \times 50)$

$46 - 50$

-4

$A^{-1} = \dfrac{\begin{bmatrix} 5 & -15\cdot3 \\ -3 & 10 \end{bmatrix}}{-4}$

$A^{-1} = \begin{bmatrix} 5/-4 & +15\cdot3/+4 \\ +3/+4 & 5\ 10/-4 \end{bmatrix}$

$A^{-1} = \begin{bmatrix} 5/-4 & 15\cdot3/+4 \\ 3/4 & 5/-2 \end{bmatrix}$

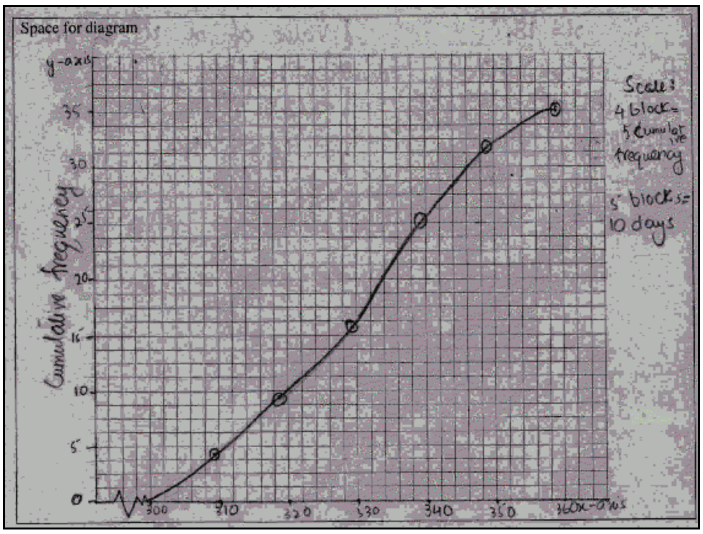
Question 8

In the given space, draw the cumulative frequency curve to represent the given frequency distribution.

Life of Bulb (Days)	Frequency (*f*)	Cumulative Frequency	Upper Class Boundary
300 – 309	4	4	309.5
310 – 319	5	9	319.5
320 – 329	7	16	329.5
330 – 339	9	25	339.5
340 – 349	7	32	349.5
350 – 359	3	35	359.5
Total	**35**	**-**	**-**

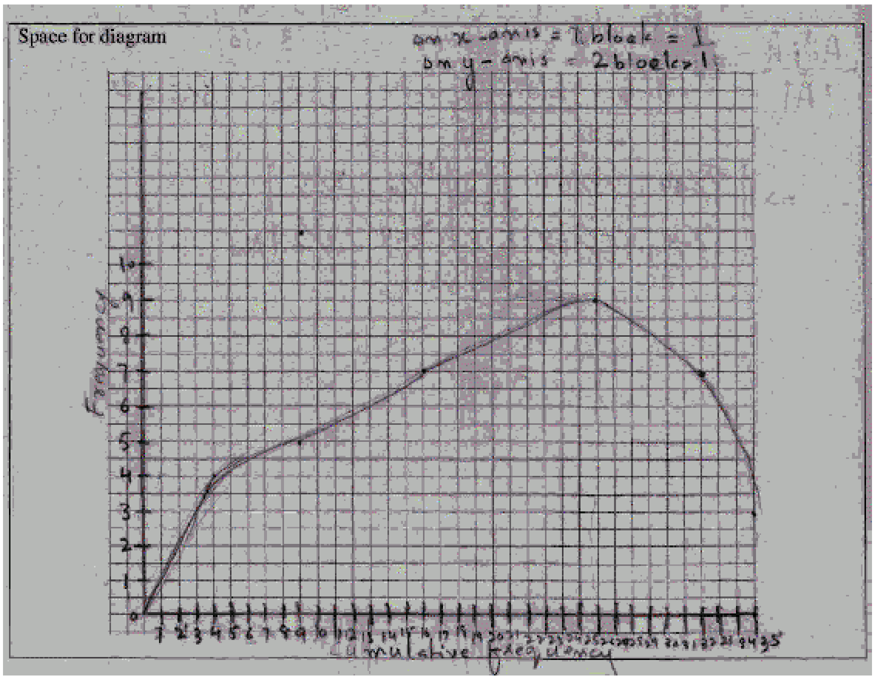
Better responses indicated that candidates took proper scale on the *x* and *y* axes, labeled the axes properly, plotted the point correctly and finally drew the required cumulative frequency curve properly.

Example:

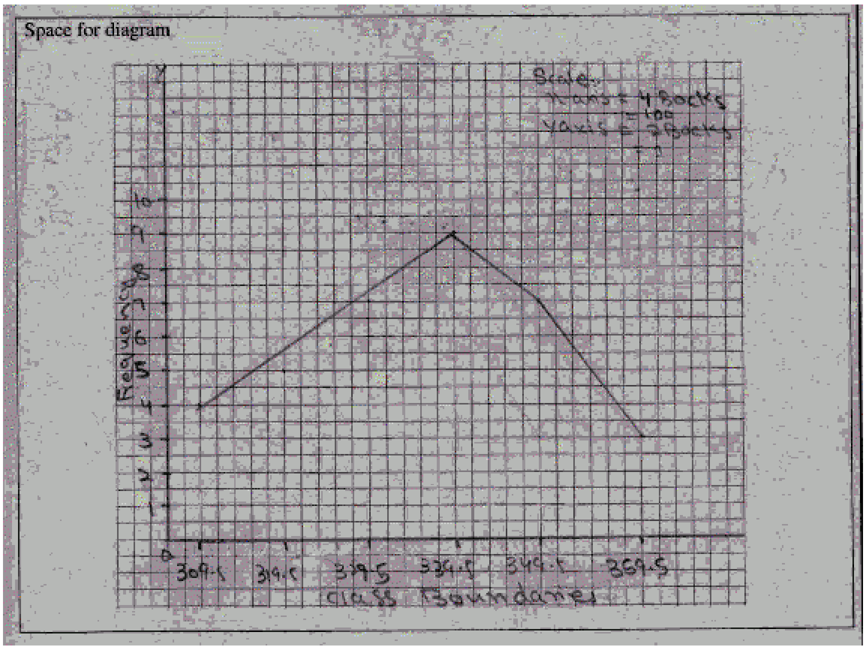


Weaker responses showed that candidates were unable to label and take proper scale on axes. As a result, points were allocated incorrectly and, therefore, they were unable to draw the cumulative frequency curve.

Example 1:



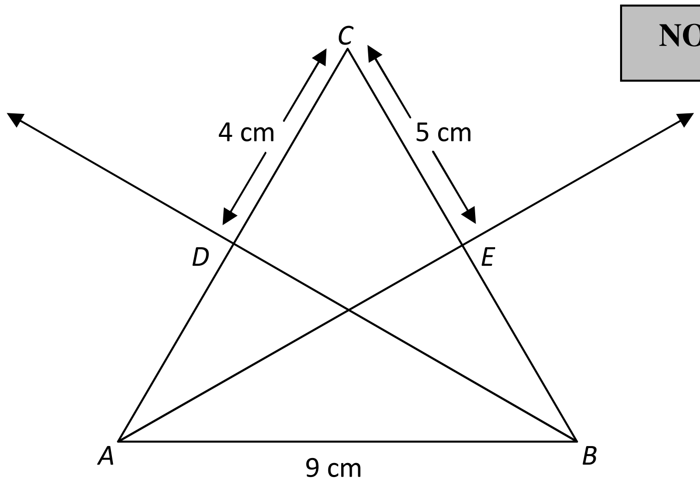
Example 2:



Question 9

In the given triangle *ABC, BD* and *AE* are the medians of the triangle.

NOT TO SCALE



i. Find $m\overline{DE}$ and $m\overline{BC}$.

ii. Is $\overline{DE}$ parallel to $\overline{AB}$? Give a reason to justify your answer.

Better responses displayed that student have command over the theorems and applied the relevant theorems to find the value of $m\overline{DE}$ and $m\overline{BC}$. They applied the relevant theorem to answer the question asked in part ii and justified their answers.

Example:

i. Find $m\overline{DE}$ and $m\overline{BC}$. (2 Marks)

$m\overline{DE} = \frac{1}{2} m\overline{AB}$

$m\overline{BC} = m\overline{EC} + m\overline{BE}$

$= 5cm + 5cm$

$m\overline{DE} = \frac{1}{2} \times 9 = 4.5cm$

$m\overline{BC} = 10 cm$

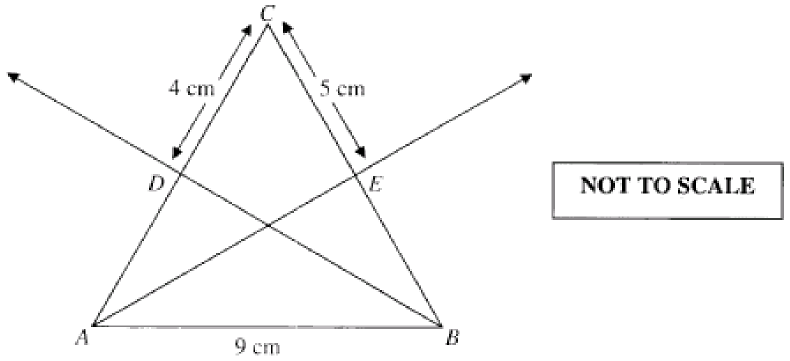
Ans

ii. Is $\overline{DE}$ parallel to $\overline{AB}$? Give a reason to justify your answer. (2 Marks)

Yes, $\overline{DE}$ is parallel to $\overline{AB}$ because the line segment joining the mid points of two sides of a Δ is parallel to the third side.

Weaker responses displayed that the candidates were unable to comprehend the theorem to be applied in the given situation. Therefore, they were unable to find correctly the required measurements and found it difficult to justify their answer.

Example:



i. Find $m\overline{DE}$ and $m\overline{BC}$. (2 Marks)

$m\overline{DE}$	$m\overline{BC}$
4 cm + 5 cm	9 cm + 5 cm
$m\overline{DE}$ = 9 cm	~~mDB~~ $m\overline{BC}$ = 14 cm
Ans	Ans

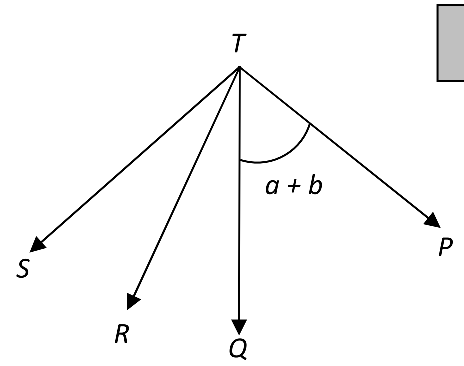
ii. Is $\overline{DE}$ parallel to $\overline{AB}$? Give a reason to justify your answer. (2 Marks)

They are parallel to $\overline{AB}$ because they are ~~supplementry angles~~ opposite and equal to each other.

Question. 10a

Given that *TQ* and *TR* are the angle bisectors of $\angle STP$ and $\angle STQ$ respectively, as shown in the diagram, find the following.

NOT TO SCALE



i. $m\angle STR$

ii. $m\angle STP$

This was generally a well attempted question. It was based on the concept of angle bisector. This question also offered choice between part **a** and part **b** and most of the candidates opted part **a** of the question.

Better responses exhibited that candidates were able to find the measurement of required angles by using the properties of angle bisector.

Example:

i. $m\angle STR$

$m\angle STR = \dfrac{a+b}{2}$

As it is an angle bisector so $m\angle STR$ will be $\dfrac{a+b}{2}$.

ii. $m\angle STP$

$m\angle STP = (a+b) + (a+b)$

$= a + b + a + b$

$= 2a + 2b$ ~~ans~~. answer.

Weaker response exhibited that candidates failed to apply the concept of angle bisector and, therefore, were unable to find the required measurement.

Example:

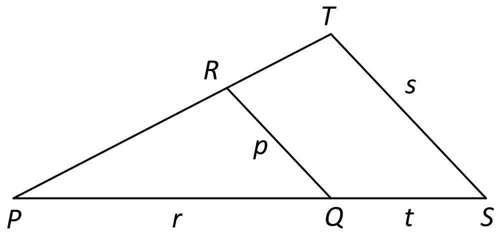
i. $m\angle STR$ (2 Marks)

m<STR is equal to $\frac{1}{2}$ of m< STQ

ii. $m\angle STP$ (2 Marks)

m<STP is equal to $\frac{1}{2}$ of m<STP

Question. 10b



Comprehend the diagram to complete the following statements.

i. $m\angle PRQ$ is equal to ______________________

ii. ΔRPQ is similar to ______________________

iii. $\frac{PR}{PT}$ is equal to ______________________

iv. In terms of r and t, $\frac{p}{s}$ is equal to ______________________

This part was attempted by fewer candidates and generally it was not a well attempted question. It was based on the concept of properties of similar triangles.

Better responses reported that candidates had command over the properties of similar triangles and applied them aptly on the given situation to complete the given statements.

Example:

Comprehend the diagram to complete the following statements.

i. $m\angle PRQ$ is equal to $\boxed{m\angle PTS}$ as $m\angle R \sim m\angle T$

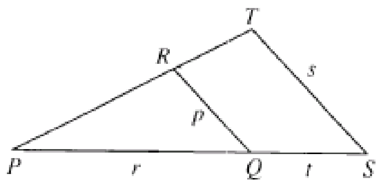
ii. ΔRPQ is similar to ΔTPS

iii. $\frac{PR}{PT}$ is equal to $\frac{PQ}{PS}$

iv. In terms of r and t, $\frac{p}{s}$ is equal to $\frac{r}{r+t}$

Weaker responses indicated that candidates did not have command of properties of similar triangle and, hence, failed to complete the given statements correctly.

Example:



Comprehend the diagram to complete the following statements.

i. $m\angle PRQ$ is equal to $\angle RTS$

ii. ΔRPQ is similar to $\angle RST$

iii. $\frac{PR}{PT}$ is equal to $\frac{SR}{ST}$

iv. In terms of r and t, $\frac{p}{s}$ is equal to $\frac{R}{t}$.

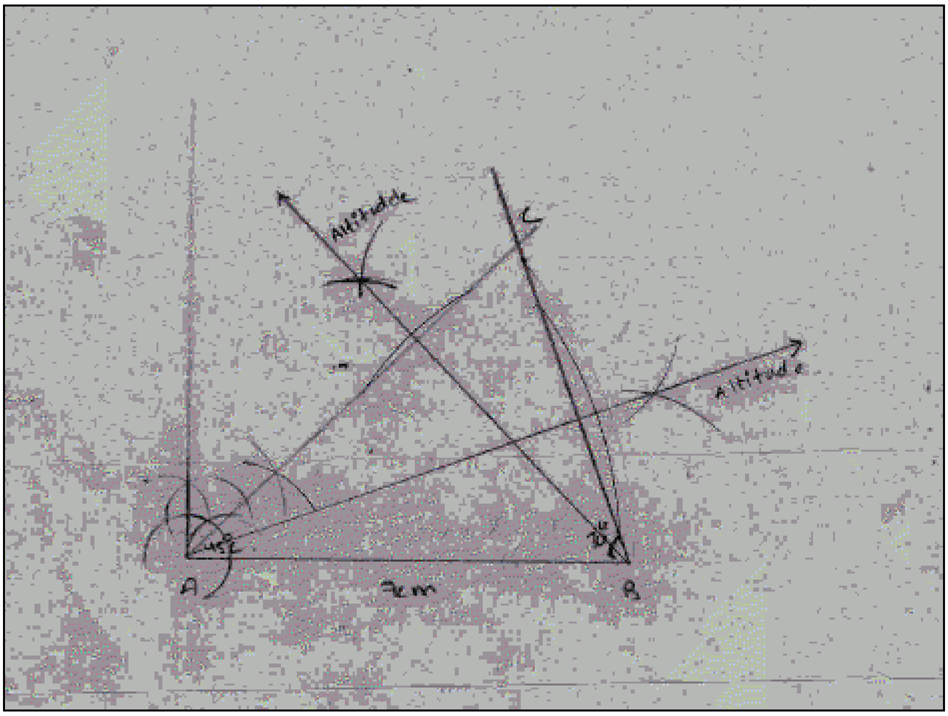
Question 11

Construct a triangle ABC with $m\overline{AB} = 7\,\text{cm}$, $m\angle A = 45^{\circ}$ and $m\angle B = 70^{\circ}$. Draw any two altitudes of the triangle.

Generally it is a well attempted question and most candidates score good marks.

Better responses showed that candidate have good command over the geometrical construction and have clear understanding of altitudes and steps needed to construct them.

Example:



Weaker responses showed that candidates were unable to construct the triangle with given measurements and were clueless about how to draw altitudes.

Example: