**Aga Khan University Examination Board**

**Notes from E-Marking Centre on SSC-II General Mathematics Examination April/ May 2019**

## Introduction

This document has been produced for the teachers and candidates of Secondary School Certificate (SSC) part II General Mathematics. It contains comments on candidates' responses to the 2019 SSC-II 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 SLOs 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.

## General Observations

Generally it is noted that weaker candidates are not well-versed with the hierarchy of arithmetical and algebraic operations. They were unable to understand the word problem situation.

**Detailed Comments:**

**Constructed Response Questions (CRQs)**

**Question 1:**

The candidates were offered choice between part **a** and part **b** of the question. Candidates attempted part **a** quite well as compared to part **b.**

| **Question 1a:** |
|---|
| a. Show, by simplification, the rational expression $1+\left\{1\div\left(1-\frac{1}{x}\right)\div\frac{16x}{4x-4}\right\}$ is free of $x$. |

*Better responses* indicated that candidates had command over the concept of LCM. Candidates correctly found the LCM and converted division sign into multiplication sign accordingly. Finally, they were able to simplify the given rational expression free of $x$.

**Example:**

$$1+\left\{1\div\left(\frac{x-1}{x}\right)\div\frac{16x}{4(x-1)}\right\}$$

$$1+\left\{1\times\frac{x}{x-1}\times\frac{4(x-1)}{16x}\right\}$$

$$1+\left\{\frac{1}{4}\right\} = 1+\frac{1}{4}$$

$$\frac{4+1}{4} = \frac{5}{4} \text{ Ans.}$$

OR 1.25 Ans.

*Weaker responses* showed that candidates have lack of understanding of the concept of LCM. They also made mistakes in applying arithmetic operations to simplify the given algebraic expressions and consequently failed to simplify the given algebraic expression correctly.

In few other responses, it was noted that candidates made mistakes in converting the division sign into multiplication sign and wrote $1\times(1-x)$ instead of $1\times\frac{x}{x-1}$ without taking LCM first which was actually incorrect. Because of this, they could not meet the desired result.

**Example:**

$$1+\left\{1\times(1-x)\times\frac{4x-4}{16x}\right\}$$
$$1+\left\{(1-x)\times\frac{4x-4}{16x}\right\}$$
$$1+\left\{\frac{(4x-4)(1-x)}{16x}\right\}$$
$$1+\left\{\frac{4x-4x^2-4+4x}{16x}\right\}$$
$$1+\left\{\frac{-4x^2+8x-4}{16x}\right\}$$
$$1+\left\{\frac{-4(x^2+2x-1)}{16x}\right\}$$
$$1+\left\{\frac{(x^2+x+x-1)}{16x}\right\}$$
$$1+\left\{\frac{[x(x+1)+1(x-1)]}{16x}\right\}$$
$$1+\left\{\frac{4[x(x+1)+(x-1)]}{16x}\right\}$$
$$1+\left\{\frac{(x+4)(x-)}{\cancel{16x}\;4x}\right\}$$
$$1+\left\{\frac{(1+4)(x-1)}{4x}\right\}$$

**Question 1b:**

b. It is given that $(m-n)^3 = 125$ and $m^3 - n^3 = 500$.

i. Show that $m - n = 5$.

ii. Hence, find the value of *mn*.

*Better responses* displayed that the candidates in part **i** started well to equate $(m-n)^3 = (5)^3$ in order to prove $m - n = 5$. Further in part **ii**, they used the given condition by applying the formula of $(a-b)^3$ and hence, they were able to manage the correct value of *mn*. It was also seen that they used the result $m - n = 5$ and substituted in $(m-n)^3 = 125$ to satisfy the given condition.

**Example:**

i. Show that $m - n = 5$. (2 Marks)

$(m-n)^3 = 125$

$(m-n)^3 = (5)^3$

$m-n = 5$

ii. Hence, find the value of *mn*. (3 Marks)

$(m-n)^3 = m^3 - 3m^2n + 3mn^2 - n^3$

$125 = m^3 - 3m^2n + 3mn^2 - n^3$

$125 = m^3 - n^3 - 3m^2n + 3mn^2$

$125 = 500 - 3mn(m-n)$

$125 - 500 = -3mn(m-n)$

$-3mn = \frac{375}{5}$

$-mn = -75/3$

$+mn = +25$

*Weaker responses* exhibited that candidates were failed to comprehend the question and committed different mistakes in solving the question. They failed to expand the formula of $(a-b)^3$ correctly so that the candidates could not go further in finding the value of *mn*.

**Example:**

b. It is given that $(m-n)^3 = 125$ and $m^3 - n^3 = 500$.

i. Show that $m - n = 5$. (2 Marks)

$(m-n)^3 = 125$ $\quad$ $m^3 - n^3 = 300$

$= m^3 - m^3 = 25$ $\quad$ $m^3 - n^3 = 60$

$= m^{\cancel{3}} - n^{\cancel{3}} = 5$ $\quad$ $m^{\cancel{3}} - n^{\cancel{3}} = 12$

$= m - n = 5$ $\quad$ $m - m = 12$

ii. Hence, find the value of $mn$. (3 Marks)

$m = ?$

$n = ?$

let m be 5 and n be 12.

$m - n$

$5 - 12$

$= -7$

**Question 2:**

The candidates were offered choice between part **a** and part **b** of the question. Almost equal number of candidates opted both parts.

**Question 2a:**

a. Given that $P(x) = x^3 - m\left(x^2 - x\right) + 4$,

i. find the remainder when $P(x)$ is divided by $2x-2$.

ii. show that $m^2 + 2m = 3$, when $P(x)$ is divided by $1+x$ which leaves a remainder of $m^2$.

*Better responses* showed a clear understanding of remainder theorem and its application. They solved part **i** systematically by application of remainder theorem to find remainder first. Similarly, in part **ii**, they used the given condition very well to reach the required form $m^2 + 2m = 3$.

**Example:**

a. Given that $P(x) = x^3 - m\left(x^2 - x\right) + 4$,

i. find the remainder when $P(x)$ is divided by $2x-2$. (2 Marks)

$2x-2 \Rightarrow 2x-(2) = 0$ $\quad (x)^3 - m(x^2 - x) + 4$

$2x = 2$ $\quad \cancel{(x)^3}\ x^3 - mx^2 + mx + 4$

$x = \frac{2}{2} = 1$ $\quad (1)^3 - m(1)^3 + m(1) + 4$

$1 - m + m + 4 = 5$ The remainder is 5

ii. show that $m^2 + 2m = 3$, when $P(x)$ is divided by $1+x$ which leaves a remainder of $m^2$. (3 Marks)

$x^3 - mx^2 + mx + 4$

$(-1)^3 - m(-1)^2 + m(-1) + 4$

$m^2 = -1 - m - m + 4$

$m^2 = -1 + 4 - 2m$

$m^2 = 3 - 2m$

$m^2 + 2m = 3$ proved

*Weaker responses* showed that the candidates were familiar with the remainder theorem but could not connect the condition correctly to get the required form in part **ii**, although they were able to manage to find the remainder in part **i**. Some of them used the remainder of part **i**, instead of given remainder in part **ii**, that lead to an incorrect answer.

**Example:**

a. Given that $P(x) = x^3 - m\left(x^2 - x\right) + 4$.

i. find the remainder when $P(x)$ is divided by $2x-2$. (2 Marks)

$2x-2=0$ | $P(1) = 1-m(0)+4$

$2(x-1)=0 \quad x-1=0 \quad \boxed{x=1}$ | $P(1) = 1+4$

$P(1) = (1)^3 - m((1)^2 - (1)) + 4$ | $P(1) = -3$

$P(1) = 1 - m(1-1) + 4$

ii. show that $m^2 + 2m - 3$, when $P(x)$ is divided by $1+x$ which leaves a remainder of $m^2$. (3 Marks)

$m^2 - 2m - 3 \qquad P(1+x)=0$

$(-1)^2 + 2m = 3 \qquad x = -1$

$+1 + 2m = 3$

$1 - 2m = 3 \qquad -2m = 3-1 \qquad x = \frac{-2}{2}$

$-2m = 2$

$m \qquad \boxed{x = -1}$

**Question 2b**:

Factorise $2x^3 - 2y^2x - 2\,(x-y)\left(x^2 + 2xy + y^2\right)$ completely.

*Better responses* displayed that the candidates factorised the given algebraic expression with correct technique. They arranged the terms appropriately to take $2x$ as common from $2x^3 - 2y^2x$ and then properly applied the formula of $(a+b)^2 = a^2 + 2ab + b^2$. This helped the candidates to factorise the given expression quite comfortably.

**Example:**

b. Factorise $2x^3 - 2y^2x - 2\,(x-y)\left(x^2 + 2xy + y^2\right)$ completely.

$2x^3 - 2y^2x - 2(x-y)(x^2+2xy+y^2)$

$2x^3 - 2y^2x - 2(x^3 + 2x^2y + xy^2 - x^2y - 2xy^2 - y^3)$

$\cancel{2x^3} - 2y^2x - \cancel{2x^3} - 4x^2y - 2xy^2 + 2x^2y + 4xy^2 + 2y^3$

$-2y^2x - 4x^2y + 2x^2y + 4xy^2 + 2y^3 - 2xy^2$

$-4xy^2 + 4xy^2 - 2x^2y + 2y^3$

$\cancel{-2xy + 2y^3} \qquad -2x^2y + 2y^3$

$\cancel{y(-2x+y^2)}$ ~~Ans~~ $-2y(x^2 - y^2)$

$-2y\,(x-y)(x+y)$ ~~Ans~~

*Weaker responses* showed candidates' lack of understanding of basic algebraic operations, concept of factorisation and algebraic formulae. One example is cited below.

- $x^3 - y^3 = (x-y)(x^2 + 2xy + y^2)$

They were unable to find the factors of the given expressions as they were just multiplied the whole expression which showed the lack of practice as well.

**Example:**

$2x^3 - 2y^2x - 2 \quad (x-y)(x^2+2xy+y^2)$

$2(x^3 - y^2x - 1) \quad (x-y)(x^2+2xy+y^2)$

$2x(x^2 - y^2 - 1) \quad (x-y)(x^2+2xy+y^2)$

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

$2x(x+y) \quad (x^2+2xy+y^2)$

$2x\cancel{(x+y)} \quad (x+y)^{\cancel{2}}$

$2x(x+y)$

Ans

**Question 3:**

The candidates were offered choice between part **a** and part **b** of the question. Candidates well attempted part **a** as compared to part **b.**

**Question 3a**:
Find the highest common factor (HCF) of $8a^3 - 1$, $4a^2 - 1$ and $(2a-1)(2a-1)$.

In *better responses,* candidates used correctly the formula of $a^3 - b^3$ and $a^2 - b^2$ in $8a^3 - 1$ and $4a^2 - 1$. This helped candidates to move further in finding the highest common factor which actually showed the good command over the understanding of given question**.**

**Example:**

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

$4a^2 - 1 = (2a-1)(2a+1)$

$2a - 1 = (2a-1)(2a-1)$

$HCF = 2a - 1$

*Weaker responses* revealed that candidates were unable to use the formula of $a^3 - b^3$ and $a^2 - b^2$ in $8a^3 - 1$ and $4a^2 - 1$. As a result, they did not meet the actual requirement of the question. Fewer candidates even though used the formula correctly but made mistakes and calculated LCM rather than HCF.

**Example:**

i. $8a^3 - 1$ ii. $4a^2 - 1$ iii. $(2a-1)(2a-1)$

$= (2a^3 - 1)^3$ $= (2a-1)^2$ $= (2a-1)^2$

~~ii. $(2a-1)^2$~~

~~iii. $(2a-1)^2$~~

H.C.F $= (2a-1)$

| **Question 3b:** |
|---|
| Simplify the expression $\dfrac{x^3 - 27}{(x-3)(x+3)} \div \dfrac{x^2 + 3x + 9}{(x-3)^2}$. |

In *better responses,* candidates used the formula of $a^3 - b^3$ and wrote $(x+3)^2$ in place of $x^2 + 3x + 9$ correctly. Further, they converted division sign into multiplication sign and as a result, they were able to fulfil the requirement of the question, i.e. simplified form of the given expression.

**Example:**

$$\frac{x^3 - 27}{(x-3)(x+3)} \times \frac{(x-3)^2}{x^2+3x+9}$$

$$\frac{(x-3)(a^2+3ab+b^2)}{(x+3)} \times \frac{(x-3)}{x^2+3x+9}$$

$$\frac{(x-3)(x^2+3(x)(3)+(3)^2)}{(x+3)} \times \frac{(x-3)}{(x^2+3x+9)}$$

$$\frac{(x-3)^2}{(x+3)} \text{ Ans}$$

*Weaker responses* showed that candidates failed to apply the formula correctly. This was due to lack of understanding of algebraic operations of multiplication and division.The weaker responses also showed that candidates have confusions in factorising $x^3 - 27$ as they wrote $(x-3)^3$ which was actually incorrect. Hence, they could not find the right answer.

**Example:**

$$= \frac{(x^3 - (3)^3}{(x-3)(x+3)} \div \frac{x^2+3x+9}{(x-3)(x-3)}$$

$$= \frac{x^2+3\cancel{x}+9}{(x-\cancel{3})(x+3)} \times \frac{(\cancel{x-3})(x-3)}{x^2+3\cancel{x}+9}$$

$$= (x-3) \text{ Ans.}$$

**Question 4:**

Given that $m - 1 + 2\sqrt{x-1} = 4\sqrt{x-1}$,

a. show, by working, that the above equation reduces to $x - 1 = \frac{(m-1)^2}{4}$.

b. express $x$ in terms of $m$.

c. show that the value of $x$ is 5, when $m = 5$.

*Better responses* revealed that few candidates did well to solve this question. They collected the like terms, i.e. $\sqrt{x-1}$ and were able to simplify accordingly. This helped them in finding the required form. As a result, they expressed $x$ in terms of $m$ successfully and so the required value of $x$.

**Example:**

Given that $m-1+2\sqrt{x-1} = 4\sqrt{x-1}$,

a. show, by working, that the above equation reduces to $x-1=\frac{(m-1)^2}{4}$. (3 Marks)

$m-1 = 4\sqrt{x-1} - 2\sqrt{x-1}$

$m-1 = 2\sqrt{x-1}$

Squaring both sides.

$(m-1)^2 = (2\sqrt{x-1})^{\cancel{2}}$

$\frac{(m-1)^2}{4} = \frac{\cancel{4}(x-1)}{\cancel{4}}$

$x-1 = \frac{(m-1)^2}{4}$

Shown that the equation reduces to $x-1=\frac{(m-1)^2}{4}$

b. express $x$ in terms of $m$. (1 Mark)

$4x-4 = m^2-m-m+1$

$4x = m^2-2m+5$

c. show that the value of $x$ is 5, when $m=5$. (1 Mark)

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

$4x = 25-10+5$

$4x = 20$

$\frac{\cancel{4}x}{\cancel{4}} = \frac{\cancel{20}^{5}}{\cancel{4}}$

$x = 5$ (Hence shown)

*Weaker responses* showed that candidates had various misconceptions about solution of radical equation; therefore, they were failed to get the required form. It was also seen that they failed in collecting the like terms i.e. $\sqrt{x-1}$ and got stuck in further steps. They showed their lack of practice in the process of simplification and hence, they could not get the required form and so the required value of *x*.

**Example:**

Given that $m-1+2\sqrt{x-1} = 4\sqrt{x-1}$,

a. show, by working, that the above equation reduces to $x-1=\frac{(m-1)^2}{4}$. (3 Marks)

$m-1+2\sqrt{n-1} = 4\sqrt{n-1}$ $\quad$ $m^2-2m+1 = 4n-4$

$m-1 = 4\sqrt{n-1} - 2\sqrt{n-1}$ $\quad$ $m^2-2m = 4n-4-1$

$m-1 = 2\sqrt{n-1}$ $\quad$ $m^2-2m = 4n-5$

SBS $\quad$ $m(m-2) = 4n-5$

$(m-1)^2 = (2)^2(\sqrt{n-1})^2$

$(m)^2-2(m)(1)+(1)^2 = 4(n-1)$

b. express $x$ in terms of $m$. (1 Mark)

$x-1+2\sqrt{n-1} = 4\sqrt{n-1}$

c. show that the value of $x$ is 5, when $m=5$. (1 Mark)

$n=5$ , $m=5$

shown .

**Question 5**

The question offered choice a between part **a** and part **b**. Almost equal number of candidates opted both parts.

**Question 5a:**

Given that the half of a negative number *x* and its square adds up to 18,

i. show that $2x^2+x-36=0$.

ii. hence, find *x* with the help of factorisation method.

This was a word problem based on the concept of quadratic equation. Very fewer candidates were able to solve it correctly.

*Better responses* indicated that candidates did well to translate a word problem into mathematical statement. This helped candidates to get the required equation $2x^2+x-36=0$. After that, they were very much comfortable to find the required value of *x*.

**Example:**

Q.5. (Total 5 Marks)

a/ Given that the half of a negative number $x$ and its square adds up to 18.

i. show that $2x^2+x-36=0$. (3 Marks)

$\left(\frac{1}{2}x\right)+x^2=18$ $\quad 2x^2+x=36$

$2x^2+x-36=0$

$\frac{x}{2}+x^2=18$ $\quad$ verified!

$\frac{x+2x^2}{2}=18$

$\frac{2x^2+x}{2}=18$

ii. hence, find $x$ with the help of factorisation method. (2 Marks)

$2x^2+x-36=0$

$2x^2-8x+9x-36=0$

$2x(x-4)+9(x-4)=0$

$(2x+9)(x-4)=0$

$2x+9=0$, $x-4=0$

$2x+9=0$

$2x=-9$

$\boxed{x=\frac{-9}{2}}$

$x-4=0$

$\boxed{x=4}$

*Weaker responses* indicated that candidates were failed to convert the word problem into the mathematical statement. Some candidates wrote $\frac{1}{2}\left(x^2+x\right)=18$ instead of $\frac{1}{2}x^2+x=18$ which was actually incorrect. Because of this, they could not reach the required form and so the required value of $x$. It was also noticed that majority of the candidates left part **i**, and just got the value of $x$ with the help of given equation in part **i** and as a result they were not able to get maximum.

**Example:**

Given that the half of a negative number $x$ and its square adds up to 18,

i. show that $2x^2 + x - 36 = 0$. (3 Marks)

$2x^2 + x - 36 = 0$

$= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ $= \frac{-1 \pm \sqrt{287}}{4}$

$= \frac{-1 \pm \sqrt{(1)^2 - 4(2)(36)}}{2(2)}$

$= \frac{-1 \pm \sqrt{1 - 288}}{4}$

ii. hence, find $x$ with the help of factorisation method. (2 Marks)

$2x^2 + x - 36 = 0$

$2x^2 + 8x + 9x - 36 = 0$

$= 2x = 2x^2 - 36 = x$

$= (2x - 6)^2 = \cancel{4x^2 - 24x}$ $(2x+6)(2x-6)$

$x = (2x+6)(2x-6)$

**Question 5b:**

i. Convert $(6x+5) = \frac{1}{x}$ into $x^2 + \frac{5}{6}x = \frac{1}{6}$.

ii. Hence, show that this equation can also be represented in completing the square form as $\left(x + \frac{5}{12}\right)^2 = \frac{49}{144}$.

*Better responses* indicated that candidates in part **i**, successfully convert the given equation into the required form. This helped them to go further in part **ii**, as they were able to manage the completing square form which led them to the correct form, i.e. $\left(x + \frac{5}{12}\right)^2 = \frac{49}{144}$.

**Example:**

i. Convert $(6x+5)=\frac{1}{x}$ into $x^2+\frac{5}{6}x=\frac{1}{6}$. (2 Marks)

$\frac{(6x+5)}{1} \cancel{\times} \frac{1}{x}$ $\Rightarrow$ $6x+5\,(x) = 1$ $\Rightarrow$ $6x^2+5x=1$

Dividing the whole equation by 6

$\frac{\cancel{6}x^2}{\cancel{6}} + \frac{5x}{6} = \frac{1}{6}$ hence $\left[x^2+\frac{5x}{6}=\frac{1}{6}\right] = \left[x^2+\frac{5x}{6}=\frac{1}{6}\right]$

L.H.S = R.H.S.

ii. Hence, show that this equation can also be represented in completing the square form as $\left(x+\frac{5}{12}\right)^2=\frac{49}{144}$. (3 Marks)

$x^2+\frac{5x}{6}=\frac{1}{6}$

$\left(\frac{b}{2a}\right)^2$ $\therefore$ $x^2+\frac{5x}{6}+\left(\frac{5}{6\times 2}\right)^2 = \frac{1}{6} \times \left(\frac{5}{12}\right)^2$

$x^2+\frac{5x}{6}+\left(\frac{5}{12}\right)^2 = \overset{24}{\cancel{144}} \times \frac{1}{\cancel{6}} \times \frac{25}{144} \times 144$

$\left(x+\frac{5}{12}\right)^2 = \frac{24+25}{144}$ $\Rightarrow$ $\left(x+\frac{5}{12}\right)^2 = \frac{49}{144}$

*Weaker responses* indicated that candidates failed to convert the given equation into the quadratic form and so for completing the square form. Because of lack of practice, they did not follow the steps required in completing the square form. It was seen that candidates directly wrote $\left(x+\frac{5}{12}\right)^2$ but forgot to add $\left(\frac{5}{12}\right)^2$ with $\frac{1}{6}$ and hence, they could not get the required answer.

**Example:**

i. Convert $(6x+5)=\frac{1}{x}$ into $x^2+\frac{5}{6}x=\frac{1}{6}$. (2 Marks)

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

$6x^2+5x=1$

$6x^2+5x-1=0$

$6x^2+6x-x-1=0$

$6x(x+1)-1(x+1)=0$

$(6x-1)(x+1)=0$

$6x-1=0$

$\frac{6x}{6}=\frac{1}{6} = \frac{1}{6}$

$x+1=0$

$x=-1$ = Ans $\{\frac{1}{6}, -1\}$

ii. Hence, show that this equation can also be represented in completing the square form as $\left(x-\frac{5}{12}\right)^2=\frac{49}{144}$. (3 Marks)

$x^2+\frac{25}{144}=\frac{49}{144}$

$=0.26\overline{0}$

$x^2+0.173=0.340$

$x^2+0.173+0.0074822=0.340+0.0074822$

$\sqrt{(x+0.0864997)^2}=0.3474822$

$x=-0.3474822-0.0864997$

$=-0.4\overline{33}$

$=+0.3474822-0.0864997$

## Question 6

The candidates were offered choice between part **a** and part **b** of the question. Candidates attempted part **a** quite well as compared to part **b.**

**Question 6a:**

It is given that the adjoint of a matrix $N$ is $\begin{bmatrix} 2 & -1 \\ 2 & 4 \end{bmatrix}$.

i. By finding matrix $N$, show that $|N|=10$.

ii. Hence, find the inverse of matrix $N$.

iii. Find the transpose of matrix $\frac{1}{2}N$.

*Better responses* showed that candidates had good understanding of the concepts of inverse of matrix and transpose of matrix. Therefore, they were able to find the inverse of matrix $N$ with the help of the given condition and so for the transpose of matrix $\frac{1}{2}N$ systematically and followed all the necessary steps.

**Example:**

a. It is given that the adjoint of a matrix $N$ is $\begin{bmatrix} 2 & -1 \\ 2 & 4 \end{bmatrix}$.

i. By finding matrix $N$, show that $|N| = 10$. (2 Marks)

$$N = \begin{bmatrix} 4 & 1 \\ -2 & 2 \end{bmatrix}$$

$$|N| = 8 - -2$$

$$= 8 + 2 = 10$$

ii. Hence, find the inverse of matrix $N$. (1 Mark)

$$N^{-1} = \frac{Adj\,N}{|N|} \quad \frac{\begin{bmatrix} 2 & -1 \\ 2 & 4 \end{bmatrix}}{10} = \begin{bmatrix} 1/5 & -1/10 \\ 1/5 & 2/5 \end{bmatrix}$$

iii. Find the transpose of matrix $\frac{1}{2}N$. (2 Marks)

$$N^t = \cancel{\begin{matrix} 4 & -2 \\ 1 & 2 \end{matrix}} \quad \frac{1}{2}N = \frac{1}{2}\begin{bmatrix} 4 & 1 \\ -2 & 2 \end{bmatrix} = \begin{bmatrix} 2 & 1/2 \\ -1 & 1 \end{bmatrix}$$

$$\frac{1}{2}N^t = \begin{bmatrix} 2 & -1 \\ 1/2 & 1 \end{bmatrix}$$

*Weaker responses* exhibited lack of practice in finding the matrix $N$ with the help of adjoint of matrix. They made mistakes in finding the matrix $N$ and wrote adjoint of $N$ directly as matrix $N$ without using a correct method. It was noticed that fewer candidates wrote $\begin{bmatrix} 4 & -1 \\ -2 & 2 \end{bmatrix}$ as matrix $N$ which led to an incorrect answer.

**Example:**

a. It is given that the adjoint of a matrix $N$ is $\begin{bmatrix} 2 & -1 \\ 2 & 4 \end{bmatrix}$.

i. By finding matrix $N$, show that $|N| = 10$. (2 Marks)

for $= \dfrac{adj}{|A|}$

$|N| = ad - bc$

$= (2)(4) - (-1)(2)$

$= 8 + 2 = 10$ proved.

ii. Hence, find the inverse of matrix $N$. (1 Mark)

Inverse $= \begin{bmatrix} 4 & 1 \\ -2 & 2 \end{bmatrix}$ ans.

iii. Find the transpose of matrix $\frac{1}{2}N$. (2 Marks)

$\frac{1}{2}\begin{bmatrix} 2 & -1 \\ 2 & 4 \end{bmatrix} = \begin{bmatrix} 2 \times \frac{1}{2} & -1 \times \frac{1}{2} \\ 2 \times \frac{1}{2} & 4 \times \frac{1}{2} \end{bmatrix}$

$= \begin{bmatrix} 1 & -\frac{1}{2} \\ 1 & 2 \end{bmatrix}$ ans.

**Question 6b:**

If $\begin{bmatrix} 1 & n \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}\begin{bmatrix} 5 & -1 \end{bmatrix}^t = \begin{bmatrix} 12 \end{bmatrix}$, then find the value of $n$.

*Better responses* informed that candidates found the multiplication of matrices very systematically and followed all the necessary steps. This helped them to equate with $[12]$ in order to find the value of $n$ successfully.

**Example:**

$$\begin{bmatrix}1 & n\end{bmatrix}\begin{bmatrix}1 & 2\\ 2 & 1\end{bmatrix}\begin{bmatrix}5\\ -1\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$\begin{bmatrix}(1\times 1)+(n\times 2) & (1\times 2)+(n\times 1)\end{bmatrix}\begin{bmatrix}5\\ -1\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$\begin{bmatrix}1+2n & 2+n\end{bmatrix}\begin{bmatrix}5\\ -1\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$\begin{bmatrix}(5\times(1+2n))+(-1\times(2+n))\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$\begin{bmatrix}5+10n-2-n\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$5-2+10n-n = 12 \qquad 3n = 3$$

$$3+9n = 12 \qquad n = \frac{3}{3}$$

$$3(1+3n) = 12 \qquad \boxed{n=1}$$

$$1+3n = \frac{12}{3}$$

$$1+3n = 4$$

$$3n = 4-1$$

*Weaker responses* demonstrated that candidates had a weak understanding of multiplication of matrices. They were unable to use the correct way of multiplication and failed to do the necessary steps required in the process of multiplication. It was also noted that they directly multiplied the matrix with $\begin{bmatrix}5 & -1\end{bmatrix}^t$ without taking the transpose which definitely led to an incorrect way. Thus, they could not reach the required answer.

**Example:**

$$\begin{bmatrix}1 & n\end{bmatrix}\begin{bmatrix}1 & 2\\ 2 & 1\end{bmatrix}\begin{bmatrix}5 & -1\end{bmatrix}^t = \begin{bmatrix}12\end{bmatrix}$$

$$\underset{(1\times 2)}{\begin{bmatrix}1 & n\end{bmatrix}}\underset{(2\times 2)}{\begin{bmatrix}1 & 2\\ 2 & 1\end{bmatrix}}\underset{(2\times 1)}{\begin{bmatrix}5\\ -1\end{bmatrix}} = \begin{bmatrix}12\end{bmatrix}$$

$$\begin{bmatrix}1 & n\end{bmatrix}\begin{bmatrix}(1\times 5)+(2\times -1)\\ (2\times 5)+(1\times -1)\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$\begin{bmatrix}1 & n\end{bmatrix}\begin{bmatrix}5 + (-2)\\ 10 + (-1)\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$\begin{bmatrix}1 & n\end{bmatrix}\begin{bmatrix}3\\ 9\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$(1\times 2)\quad (2\times 1)$$

$$\begin{bmatrix}1\times 3\\ n\times 9\end{bmatrix} = \begin{bmatrix}12\end{bmatrix}$$

$$\begin{bmatrix}3\\ 9n\end{bmatrix} = 12$$

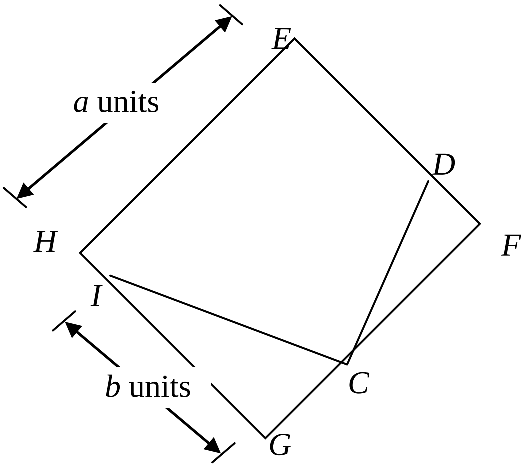
$$9n = 12$$

$$n = \frac{\cancel{12}\,4}{\cancel{9}\,3}$$

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

**Question 7:**

In the given diagram, $EFGH$ is a square, where $EH = a$ units and $IG = b$ units.
Points $C$, $I$ and $D$ lie on $GF$, $GH$ and $EF$ respectively such that $DE = FC = IG$.




a. State the length of $CG$ in terms of $a$ and $b$.
b. Prove that triangle $FDC$ is congruent to triangle $GCI$. Give all the reasons to support your proof.
c. Hence, state the property of congruency that is used in the proof.
d. Give a reason why triangle $FDC$ is similar to triangle $GCI$.

The question was based on the concept of congruency and similarity. Few candidates attempted this question very well.

*Better responses* displayed that candidates were able to comprehend the diagram and applied the properties of congruent triangle correctly. Proof and reasons were required and they had done very well which showed good concept of congruency and similarity.

**Example:**

a. State the length of $CG$ in terms of $a$ and $b$. (1 Mark)

$a - CF$

b. Prove that triangle $FDC$ is congruent to triangle $GCI$. Give all the reasons to support your proof. (2 Marks)

$\angle G = \angle F$ (As it is square, so both angles are equal to $90^\circ$)

Given that $\overline{IG} = \overline{CF}$ (Both sides are equal)

$\overline{GC} = \overline{DF}$ ($GF - GF = EF - ED$)

Proved $\triangle FDC \cong GCI$ ~~by SAS~~

c. Hence, state the property of congruency that is used in the proof. (1 Mark)

SAS

d. Give a reason why triangle $FDC$ is similar to triangle $GCI$. (1 Mark)

As they are congruent too, their ratios also are same. So they are similar.

*Weaker responses* indicated candidates' lack of understanding of the concept related to congruency and similarity. They were unable to get the required proof as they had no idea of using the property of congruent triangles. They failed to give the reason in part **d** as well.

**Example:**

a. State the length of $CG$ in terms of $a$ and $b$. (1 Mark)

~~b a-b~~ lenght of CG = a-b

b. Prove that triangle $FDC$ is congruent to triangle $GCI$. Give all the reasons to support your proof. (2 Marks)

IG = b units

IG = FC

GC = DF

c. Hence, state the property of congruency that is used in the proof. (1 Mark)

Property of same lenght and angle

d. Give a reason why triangle $FDC$ is similar to triangle $GCI$. (1 Mark)

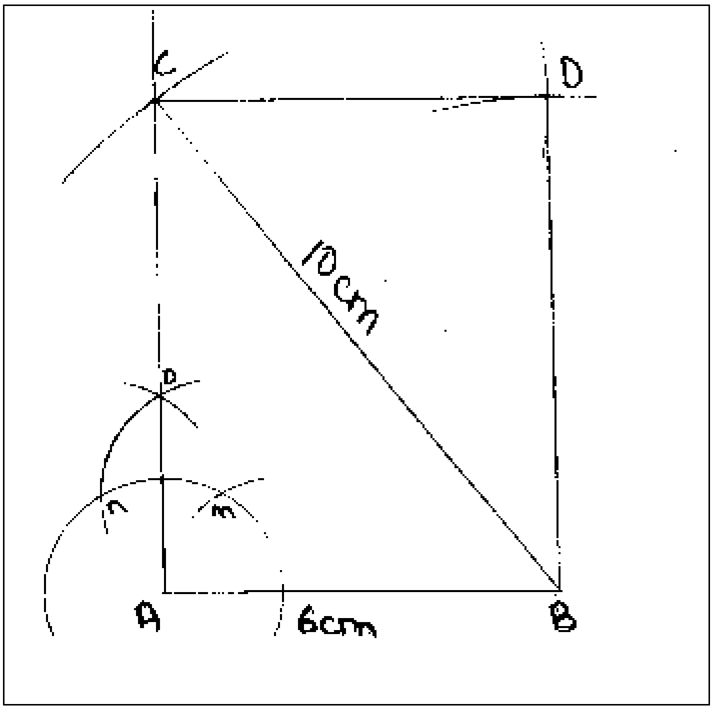
All the angles and lenghts are same.

**Question 8:**

In the given space, draw a rectangle whose one of side is 6 cm and diagonal is 10 cm long**.**

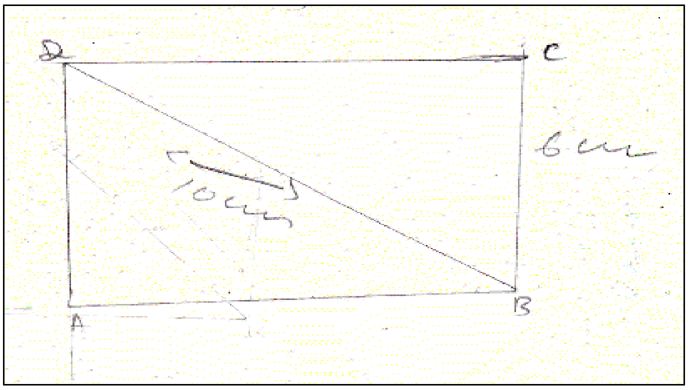
*Better responses* exhibited that candidates have good understanding of the construction of geometrical figures with the given measurements. They drew the rectangle by using all the necessary steps with the help of given condition quite easily and correctly to achieve the maximum marks.

**Example:**




*Weaker responses* displayed that candidates were unable to draw the rectangle with the given measurements. They did not use the necessary steps that were required to draw the rectangle. It was noted that fewer candidates just measured one side of 6 cm and rest of the sides and diagonals were drawn directly without any measurement which showed the lack of inability.

**Example:**



**Question 9:**

(**Formula**: Volume of cone $=\frac{1}{3}\pi r^2 h$)

It is given that the volume of a cone is 15 cubic units.

a. Find the volume of the cylinder whose radius and height are same as the cone.

b. Hence, show that the square of radius of cone is $\frac{45}{11}$ units, when height is $\frac{7}{2}$ units.

(**Note**: Take $\pi = \frac{22}{7}$)

*Better response* reported that candidates understood the question very well and rightly applied the condition used in the question to find the volume of cylinder and rest of the part accordingly. It was also noticed that candidates solved this question in different way as well by using the values of the square of radius of cone and height to show that the volume of cone is 15 cubic units.

**Example:**

It is given that the volume of a cone is 15 cubic units.

a. Find the volume of the cylinder whose radius and height are same as the cone. (2 Marks)

Volume of cone $= \frac{22 \times r^2 \times h}{7 \times 3}$

$15 \times 21 = 22r^2h$

$315 = 22r^2h$

$\frac{315}{22} = r^2h$

$14.318 = r^2h$

Volume of cydinder $= \pi r^2 h$

$= \frac{22}{7} \times 14.318$

Volume of cyclinder $= 45cm^3$

b. Hence, show that the square of radius of cone is $\frac{45}{11}$ units, when height is $\frac{7}{2}$ units. (2 Marks)

(**Note**: Take $\pi = \frac{22}{7}$)

$r^2 = \frac{45}{11}$, $H = \frac{7}{2}$, Volume of cone $= 15cm^3$

Volume of cone $= \frac{1}{3}\pi r^2 h$

$15 = \frac{22}{7} \times \frac{45}{11} \times \frac{7}{2} \times \frac{1}{3}$

$15 = \frac{\cancel{6930}\ 15}{\cancel{462}\ 1}$

$15 = 15$

It is Proved as the volume of cone $15m^3$

*Weaker responses* showed that the candidates were unable to understand the question and applied wrong approach to get the volume of cylinder. They also failed to prove the square of radius of cone and height while simplifying. This must be done by the candidates as formula is also given in the question and they just needed to read the formula efficiently.

**Example:**

It is given that the volume of a cone is 15 cubic units.

a. Find the volume of the cylinder whose radius and height are same as the cone. (2 Marks)

Volume of cone $= \frac{1}{3}\pi r^2h$

$15 \times 3 = \pi r^2 h$

$45 = \pi r^2 h$

Cylinder $= \frac{4}{3} \times \pi r^2 h \Rightarrow \frac{4}{3} \times 45$, Cylinder $= 60$

b. Hence, show that the square of radius of cone is $\frac{45}{11}$ units, when height is $\frac{7}{2}$ units. (2 Marks)

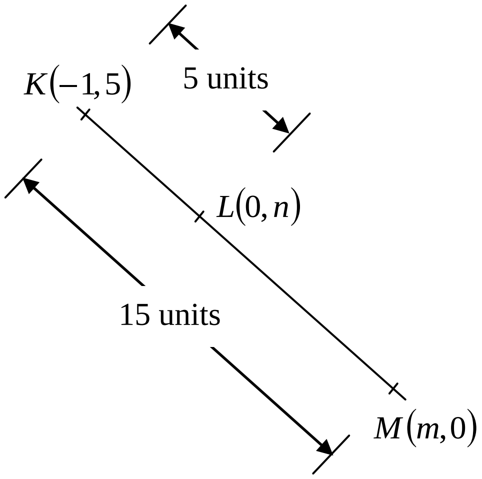
(**Note**: Take $\pi = \frac{22}{7}$)

Cone $= \frac{2}{3} \pi r^2 h$

$= \frac{2}{3} \times \frac{22}{7} \times \frac{45}{11} \times \frac{7}{2}$

**Question 10:**

Three points $K$, $L$ and $M$ lie on a straight line such that $KL = 5$ units and $MK = 15$ units.




**NOT TO SCALE**

Show that the distance between two points $M$ and $L$ is given by the equation $m^2 + n^2 = 100$.

*Better responses* reported that candidates used the distance formula between the given points correctly and were able to establish the relation $ML = 10$ units to achieve the condition mentioned in the question, i.e. $m^2 + n^2 = 100$. It was also seen that candidates used the value of $m^2 + n^2$ i.e. 100 and substituted this value in finding $ML$. As a result, they got correctly $ML$ = 10 units which can easily see or calculated from the diagram.

**Example:**

Show that the distance between two points $M$ and $L$ is given by the equation $m^2 + n^2 = 100$.

$= \sqrt{(m-0)^2 + (0-n)^2} = 15 - 5$

$= \sqrt{(m)^2 + (-n)^2} = 10$

$= \sqrt{m^2 + n^2} = 10$

Squaring both sides.

$\left(\sqrt{m^2 + n^2}\right)^2 = (10)^2$

$m^2 + n^2 = 100$

Hence shown.

*Weaker responses* revealed that candidates failed to read the diagram correctly in order to establish the correct relationship. They were confused in using the relation $ML = 10$ units and because of this, they could not go further in finding $m^2 + n^2 = 100$. Although, fewer candidates just managed to find the distance between two points $M$ and $L$.

**Example:**

Distance formula:- $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = 100$

$\sqrt{(m-0)^2 + (n-0)^2} = 100$

$\sqrt{(m)^2 + (n)^2} = 100$

$\sqrt{m^2 + n^2} = 100$