Aga Khan University Examination Board

Notes from E-Marking Centre on SSC-II General Mathematics Examination May 2018

Introduction:

This document has been produced for the teachers and candidates of Secondary School Certificate (SSC-II) General Mathematics. It contains comments on candidates' responses to the 2018 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, algebraic operations, appropriate formulae and their application. This is generally obstructing their performance in overall paper of General mathematics.

Detailed Comments:

Constructed Response Questions (CRQs)

Question 1a:

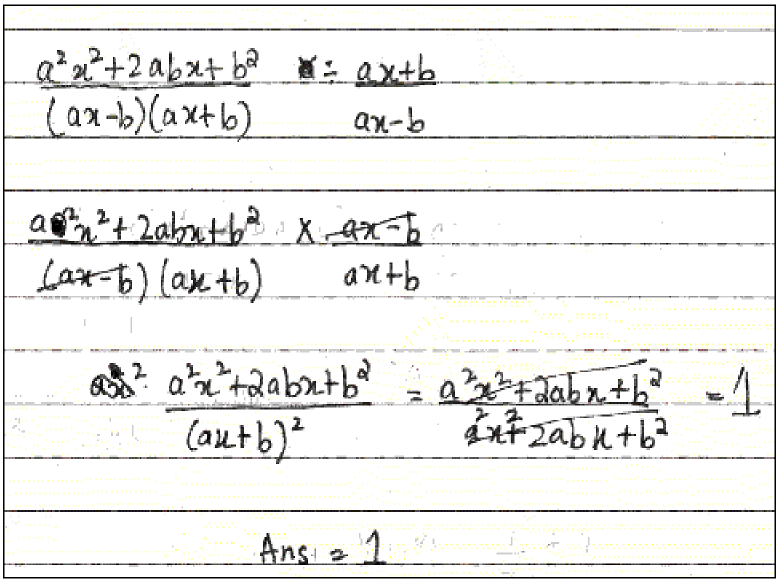
Simplify the following expression into the lowest term.

$$\frac{a^2x^2+2abx+b^2}{(ax)^2-b^2} \div \frac{ax+b}{ax-b}$$

Better responses exhibited that candidates were able to apply the desired formulae of

$x^2-y^2=(x+y)(x-y)$ and $(x+y)^2=x^2+2xy+y^2$ correctly to simplify the given algebraic expression. The candidates were also clear about the concept of division of algebraic expressions.

Example 1:



$$\frac{a^2x^2+2abx+b^2}{(ax-b)(ax+b)} \div \frac{ax+b}{ax-b}$$

$$\frac{a^2x^2+2abx+b^2}{\cancel{(ax-b)}(ax+b)} \times \frac{\cancel{ax-b}}{ax+b}$$

$$\frac{a^2x^2+2abx+b^2}{(ax+b)^2} = \frac{a^2x^2+2abx+b^2}{a^2x^2+2abx+b^2} = 1$$

Ans = 1

Example 2:

(a) $\dfrac{a^2x^2+2abx+b^2}{(ax)^2-b^2} \div \dfrac{ax+b}{ax-b}$

$= \dfrac{a^2x^2+2abx+b^2}{(ax-b)(ax+b)} \times \dfrac{ax-b}{ax+b}$

$= \dfrac{(ax+b)^2}{\cancel{(ax-b)}(ax+b)} \times \dfrac{\cancel{(ax-b)}}{\cancel{(ax+b)}}$

$= \dfrac{\cancel{ax+b}}{\cancel{ax+b}}$

$= 1$ Ans

Weaker responses indicated that candidates have confusions in writing and applying formulae. Some mistakes are cited below.

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

In many such responses, it was noted that candidates cancelled the terms in numerator and denominator incorrectly and consequently, failed to simplify the given expression to the lowest term as observed in the given examples.

Example 1:

$\dfrac{a^2x^2+2abx+\cancel{b^2}}{(ax)^2-\cancel{b^2}} \times \dfrac{ax+b}{ax-b}$

$\dfrac{\cancel{(ax)^2}+2abx}{\cancel{(ax)^2}} \times \dfrac{ax+b}{ax-b}$

$2abx \times \dfrac{ax+b}{ax-b}$

Example 2:

$$\frac{a^2x^2+2abx+b^2}{(ax)^2-b^2} \div \frac{ax+b}{ax-b}$$

$$\frac{a^2x^2+2abx+b^2}{(ax+b)\cancel{(ax-b)}} \times \frac{\cancel{ax-b}}{ax+b}$$

$$\frac{ax(2b+b^2)}{ax+b}$$

Example 3:

Option: A

$$\frac{a^2x^2+2abx+b^2}{(ax)^2-b^2} \div \frac{ax+b}{ax-b}$$

$$\frac{(ax)^2+2abx+b^2}{(ax)^2-b^2} \div \frac{ax+b}{ax-b}$$

$$\frac{\overset{(a+b)^2}{\cancel{a^2+2ab+b^2}}}{(a+b)(a-b)} \div \frac{ax+b}{ax-b}$$

$$\frac{2a^2x^2b^3x}{(\cancel{ax+b})^{2}(\cancel{ax+b})} \div \frac{\cancel{ax+b}}{\cancel{ax-b}}$$

$$2a^2x^3b^3$$

Question 1b:

Without using calculator, if $x = \dfrac{1}{7-\sqrt{48}}$, then find the value of $x + \dfrac{1}{x}$.

Better responses displayed that the candidates started with rationalisation of the surd $\dfrac{1}{7-\sqrt{48}}$ and applied the formula of $a^2 - b^2 = (a+b)\times(a-b)$ and got unity, i.e. 1 in the denomaitaor to acquire the simplified value of *x*. They found the value of $\dfrac{1}{x} = 7-\sqrt{48}$ by taking the reciprocal of $\dfrac{1}{7-\sqrt{48}}$ and added the values of x and $\dfrac{1}{x}$ to meet the requirement of the given question.

Example:

$\Rightarrow x = \dfrac{1}{7-\sqrt{48}}$

$\Rightarrow$ Rationalizing.

$\Rightarrow \dfrac{1}{7-\sqrt{48}} \times \dfrac{7+\sqrt{48}}{7+\sqrt{48}}$

$\Rightarrow \dfrac{7+\sqrt{48}}{(7)^2-(\cancel{\sqrt{}}48)^{\cancel{2}}}$

$\Rightarrow \dfrac{7+\sqrt{48}}{49-48}$

$\Rightarrow \dfrac{7+\sqrt{48}}{1} \Rightarrow 7+\sqrt{48}$

$\Rightarrow x+\dfrac{1}{x} = (7-\sqrt{48})+(7+\sqrt{48})$

$= 7-\cancel{\sqrt{48}}+7+\cancel{\sqrt{48}}$

$\Rightarrow x+\dfrac{1}{x} = 14$. Answer

Weaker responses exhibited that candidates were failed to comprehend the question and committed different mistakes in solving the question. The mistakes entail flawed process of rationalisation by selecting incorrect conjugate to find the value of *x*. They failed to apply the formula of $a^2 - b^2 = (a+b)\times(a-b)$ or made other mistakes as cited in the following examples.

Example 1:

$x = \frac{1}{7-\sqrt{48}}$

$x = \frac{1}{7-\sqrt{48+1}}$

$x = \frac{1}{7-\sqrt{49}}$

$x = 7-(7)^2$

$x = -7-49$

$x = -56$

$x + \frac{1}{x} = \frac{-56+1}{-56}$

$x + \frac{1}{x} = \frac{-55}{-56}$

$x + \frac{1}{x} = -111$ Ans.

Example 2:

$x = \frac{1}{7-\sqrt{48}}$

$\Rightarrow x + \frac{1}{x}$

$\frac{1}{7-\sqrt{48}} + \frac{1}{x}$

$\frac{1}{-41} + \frac{1}{x}$

$x = \frac{1}{-41} + 1$

$x = 20.5$

$x = \frac{2}{-41}$

Question 2a:

The algebraic expression $x^3 + 3x^2 + ax - b$ is divided by $x-1$ and $x+2$. The remainders are 3 and -12 respectively. Find the value of a.

The candidates were offered choice between part **a** and part **b** of the question. Less number of candidates opted for part **a.**

Better responses showed a clear understanding of remainder theorem and its application. They solved the question systematically by application of remainder theorem to form the equations in terms of *a* and *b* and finally, found the value of *a*.

Example 1:

$x-1=0 \quad x=1$	$x+2=0 \quad x=-2$
$P(1) = x^3+3x^2+ax-b=3$	$P(-2) = x^3+3x^2+ax-b=-12$
$= 1+3+a-b=3$	$= (-2)^3+3(-2)^2+a(-2)-b=-12$
$= 4-3+a-b=0$	$= -8+12-2a-b+12=0$
$= 1+a=b$ — (i)	$= 16-2a-b=0$
	$= \frac{16-b}{2}=a$ — (ii)
substituting the value of a in eq (i)	
$1+\left(\frac{16-b}{2}\right)=b$	substituting the value of b in eq ii
$\frac{2+16-b}{2}=b$	$\frac{16-6}{2}=a$
$\frac{18-b}{2}=b$	$\frac{10}{2}=a$
$18-b=2b$	$5=a$
$18=3b \quad b=6$	

Example 2:

a. x^3+3x^2+ax-b.	$= 2-2b-b = -16$.
$(1)^3+3(1)^2+a(1)-b=3$.	$= -2b-b = -16-2$.
$1+3(1)+a-b=3$.	$= -3b = -18$.
$4+a-b=3$.	$= b = \frac{+18}{+3}$ 6.
$a-b=4-3$.	
$a-b=-1$.	$= \boxed{b=6.}$
$a=-1+b$ -eq. i.	Putting value of b in (eq i)
$(-2)^3+3(-2)^2+a(-2)-b=-12$.	$a=-1+6$
$-8+12-2a-b=-12$.	$\boxed{a=5.}$
$-2a-b=-12-12+8$.	
$-2a-b=-16$. -eq ii.	
putting value of (eq i) in (eq ii)	
$= -2(-1+b)-b=-16$	

Weaker responses showed that the candidates were familiar with the remainder theorem but failed to apply it correctly and made mistakes in substituting the values of *x* or in the process of arithmetic operations to find the required equations in terms of *a* and *b.* As a result they failed to find the value of *a.* Few common mistakes noted in the responses are cited in the examples to highlight the misconceptions of the candidates.

Example 1:

$P(x-1) = (1)^3 + 3(1)^2 + a(1) - (b)$
$= -1 + 3 + a - b$
$= 3 + ab$
$= 3ab$
$P(x-2) = (2)^3 + 3(2)^2 + a(2) - (b)$
$= 8 + 36 + 2a - b$
$= 44 + 2a - 1b$
$= \overset{11}{\cancel{44}}\overset{2\cancel{x}}{} + 1 = ab$
$\cancel{2}\ 1$
$= -12ab.$

Example 2:

$x^3 + 3x^2 + ax - b$	
divided by $x-1$	divided by $x+2$
$(-1)^3 + 3(-1)^2 + a(-1) + b$	$(+2)^3 + 3(+2)^2 + a(+2) + b$
$(-1) \cdot 3 - 1a + b$	$(+8) + 3(+4) + a + 2 + b$
$-1 - 3 - 1a + b$	$+8 + 3 + 4 + a + 2 + b$
$a + b = -1 - 3 - 1$	$+11 + 4 + a + 2 + b$
$a + b = 4 - 1$	$+11 + 4 - 2 - a + b$
$a + b = 3$	$a + b = +11 + 4 - 2$
	$a + b = 15 - 2$
	$a + b = 13$

Question 2b:

Factorise the following expressions completely.

i. $ax + 2y + 2x + ay$

ii. $x^2 + 2bx + b^2 - y^2$

Generally this was a well attempted question.

Better responses displayed that the candidates factorised the given algebraic expression with correct technique. In the first question, they arranged the terms appropriately to take common to factorise the given expression. In the second part, candidates properly applied the formulae of $(a+b)^2 = a^2 + 2ab + b^2$ and $a^2 - b^2 = (a-b)(a+b)$ to completely factorise the expression $x^2 + 2bx + b^2 - y^2$.

Example 1:

i. $ax+2y+2x+ay$

Arrange: $ax+2x+ay+2y$

$= x(a+2)+y(a+2)$

$= (x+y)(a+2)$

ii. $x^2+2bx+b^2-y^2$

$(x)^2+2(x)(b)+(b)^2-(y)^2$

$(x+b)^2-(y)^2$

$(x+b-y)\ (x+b+y)$

Example 2:

i) $ax + 2y + 2x + ay$

$ax + 2x + ay + 2y$

$x(a+2)\ y(a+2)$

$(x+y)(a+2)$

ii) $x^2 + 2bx + b^2 - y^2$

$(x)^2 + 2(b)(x) + (b)^2 - y^2$

$(x+b)(x+b) - y^2$

$(x+b)^2 - (y^2)$

$\{(x+b) - y\}\ \{(x+b) + y\}$

$\{x+b+y\}\ \{x+b-y\}$

Weaker responses showed candidates' lack of understanding of basic algebraic operations, concept of factorisation and algebraic formulae. Some examples are cited below.

- $a^2 + b^2 = (a+b)(a-b)$
- $a^2 - b^2 = (a-b)(a-b)$
- $(2y + ay) = y(2+1)$

The following examples indicate few other misconceptions in finding the factors of the given expressions.

Example 1:

i= $ax + 2y + 2x + ay$

$= ax + 2x + 2y + ay$

$= x(a+2) + y(2+1)$

$= (x+y)(a+2)(2+1)$

$= (x+y)(2a+2)$

$= 2ax + 2y$

ii) $x^2 + 2bx + b^2 - y$

$a^2 + b^2 = (a+b)(a-b$

$= (x^2 + 2bx)(b^2 - y)$

Example 2:

$$\frac{ax + 2y + 2x + ay}{ax + ay + 2y + 2x}$$

$$\frac{2axy + 4xy^2}{\cancel{2axy}} = \frac{\cancel{4}xy}{2axy}$$

$$= \frac{2}{a} = 2a \text{ Answer}$$

$$\frac{x^2 + 2bx + b^2 - y^2}{x^2 + 2bx + b^2 - y^2} = \frac{x^2y^2}{2b^3x}$$

$$\frac{x^2 + 2b^3x - y^2}{2b^3x - y^2 - x^2} = \frac{y^2}{2b^3} \text{ Answer}$$

$$2b^3x - x^2y^2$$

Question 3a:

Simplify the fractional expression $\frac{3}{x-3} - \frac{2}{x-2} - \frac{1}{x}$ completely.

In *better responses,* candidates took the LCM and correctly applied the rules to simplify an algebraic expression along with correct use of signs in writing different terms and able to fulfil the requirement of the question. Hence, they got the simplified form of the given expression.

Example :

a) $\frac{3}{x-3} - \frac{2}{x-2} - \frac{1}{x}$

$\Rightarrow \frac{3(x-2)(x) - 2(x-3)(x) - 1(x-2)(x-3)}{(x-3)(x-2)(x)}$

$\Rightarrow \frac{3(x^2-2x) - 2(x^2-3x) - 1(x^2-5x+6)}{(x-3)(x-2)(x)}$

$\Rightarrow \frac{\cancel{3x^2} - \cancel{6x} - \cancel{2x^2} + \cancel{6x} - \cancel{x^2} + 5x - 6}{(x-3)(x-2)(x)}$

$\Rightarrow \frac{5x-6}{(x-3)(x-2)(x)}$. Ans.

Weaker responses showed that candidates failed to take LCM or after taking LCM they were unable to write the terms in the numerator correctly. This is due to lack of understanding of algebraic operations of multiplication, division, addition and subtraction. The weaker responses also showed that candidates have confusions in writing correct signs of algebraic terms.

Example 1:

$$\frac{3}{x-3} - \frac{2}{x-2} - \frac{1}{x}$$

$$(3x^2-6)-(2x-6)$$

$$x^2-5x+6$$

$$\frac{x^2-12}{x^2-2x-3x+6}$$

$$\frac{x^2-12}{x(x-2)-3(x-2)}$$

$$\frac{x^2-12}{(x-2)(x-3)} - \frac{1}{x}$$

$$\frac{(x^2-12)x}{x^3-5x^2+6} - \ x^2-2x-3x+6 \text{ Ans}$$

Example 2:

$$\frac{3(x-2) - 2(x-3) - 1(x)(x-2)(x-3)}{(x-3)(x-2)(x)}$$

$$\frac{3x-6-2x+6-x^3+5x^2\pm 6x}{x^3-5x^2+6x}$$

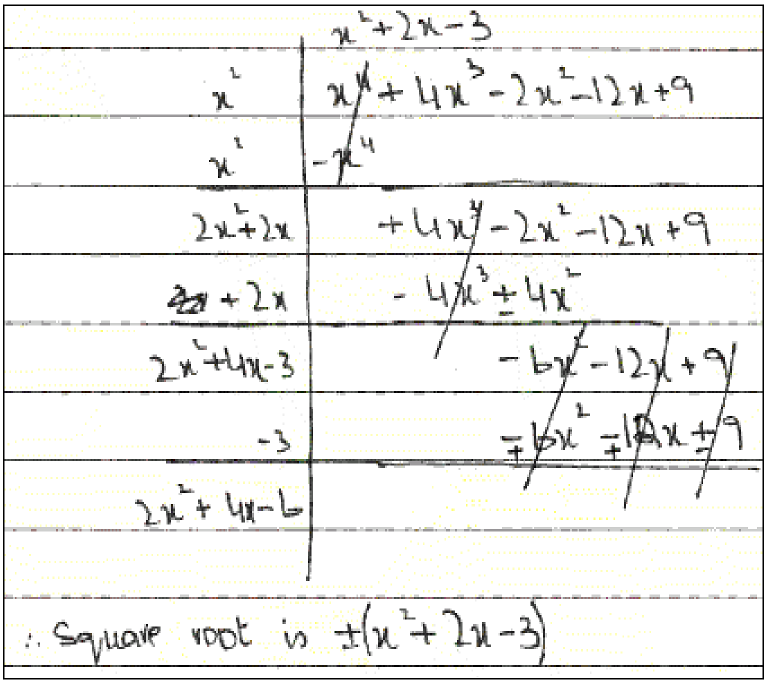
$$\frac{-x^3+3x-2x\mp 6x+5x^2}{x^3-5x^2+6x}$$

$$\frac{-x^3+5x^2-5x}{x^3-5x^2+6x}$$

Question 3b: Find the square root of $x^4+4x^3-2x^2-12x+9$.

Better responses displayed that candidates comprehended the question well and applied the correct process of division method to find the square root of the given algebraic expression.

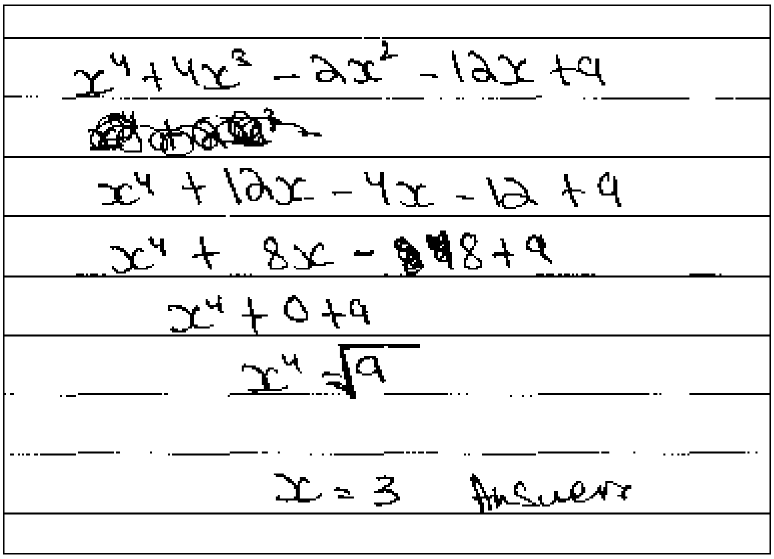
Example:



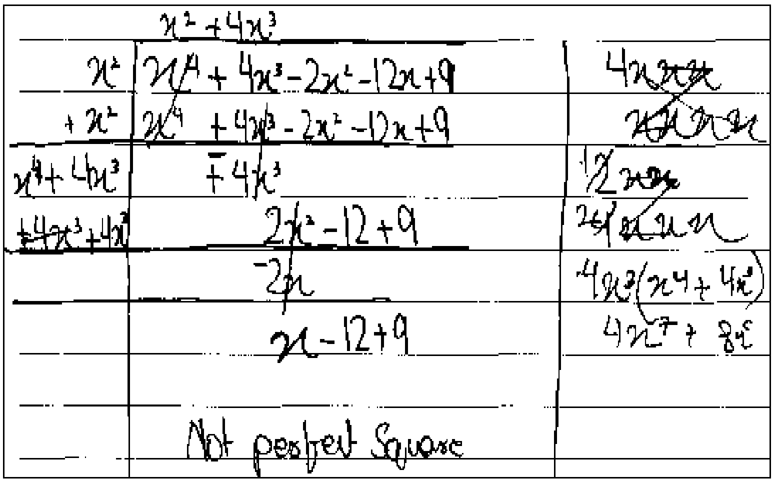
Weaker responses reflected that candidates made mistakes in the division process. They failed to follow the steps needed to find the square root of the given algebraic expression. The mistakes are noted in writing divisor, quotient and sign in the process of addition and subtraction of algebraic terms.

To highlight further mistakes, three examples are cited below.

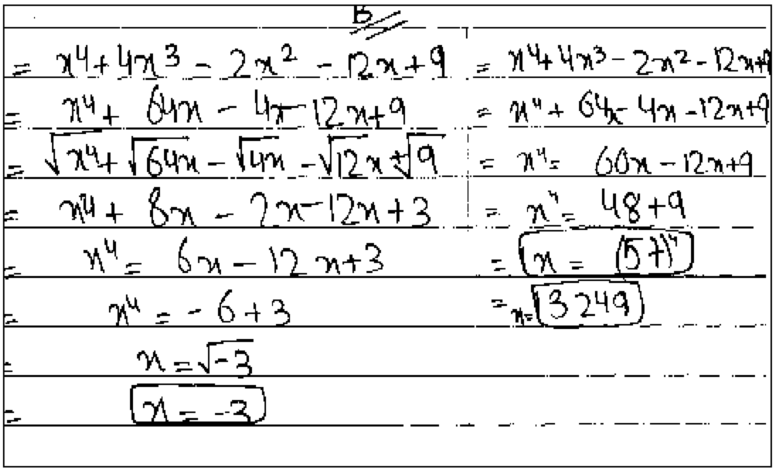
Example 1:



Example 2:



Example 3:



Question 4a:

Find the value of x for the equation $2x+\frac{x}{3}=-7$.

This was generally a well attempted question and candidates were able to find the value of *x.*

In *better responses*, many candidates took LCM and multiplied both sides of the equation $2x+\frac{x}{3}=-7$ by the LCM. Consequently, they were able to successfully find the value of *x*.

Example 1:

$2x + \frac{x}{3} = -7$	$7x = -21$
$LCM = 3.$	$x = -\frac{\cancel{21}\,3}{\cancel{7}}$
$3\times(2x) + \cancel{3}\times\frac{x}{\cancel{3}} = 3\times(-7)$	$x = -3$
$6x + x = -21$	$S.S = \{-3\}$

Example 2:

$$3\times 2x + \frac{x}{\cancel{3}}\times\cancel{3} = -7\times 3$$

$$6x + x = -21$$

$$7x = -21$$

$$x = -\cancel{21}^{3}/\cancel{7}$$

$$x = -3.$$

Weaker responses showed that candidates had various misconceptions about solution of linear equation; therefore, they were failed to find the values of *x*. Some mistakes noted are finding wrong LCM, wrong multiplication with the LCM and application of inapt hierarchy of arithmetical operations.

Example 1:

$$2x + \frac{x}{3} = -7$$

$$2x + x = -7(3)$$

$$2x + x = -21$$

$$3x = -21$$

$$x = \frac{-21}{3}$$

$$x = -7$$

Example 2:

$2x + \frac{x}{3} = -7$

$x + 3 = -7$

$2x = -7 - 3$

$x = -10$

Question 4b:

Find the value(s) of x for the equation $|x - 18| = 18$.

Better responses exhibited that candidates correctly solved the equation involving absolute value in one variable. They removed the modulus sign and wrote $x - 18 = \pm 18$ and correctly got the values of *x*.

Example:

$\Rightarrow |x - 18| = 18$

$\Rightarrow x - 18 = \pm 18$

if $x - 18 = +18$ then,

$\Rightarrow x - 18 = 18$

$\Rightarrow x = 18 + 18$

$\Rightarrow x = 36$ Ans.

if $x - 18 = -18$ then

$\Rightarrow x - 18 = -18$

$\Rightarrow x = -18 + 18$

$\Rightarrow x = 0$ Ans

Weaker responses displayed different misconceptions in solving equation involving modulus and consequently, failed to find the values of the given equation. Few misconceptions are cited in the following examples.

Example 1:

$|x - 18| = 18$

$18 + 18$

$36x$ Ans.

Example 2:

$|x - 18| = 18$

$x = 18 + 18$

$x = 36$

Example 3:

$$|x - 18| = 18$$
$$x = 18 - 18$$
$$x = 0 \quad \text{ans}$$

Question 5a:
Find the solution set of the quadratic equation $(x-2)(3x-1)=2$.

The question offered choice a between part **a** and part **b**. Most of the candidates attempted part **a.**

Better responses indicated that candidates had command over the solution of quadratic equation. They first multiplied the brackets $(x-2)$ and $(3x-1)$ and then converted the given equation in standard quadratic form. Finally they applied quadratic formula or factorisation method to solve the question. Although, it was very simple quadratic equation but some of the candidates used the method of completing square to solve the given quadratic equation as well.

Example 1:

$$(x-2)(3x-1) = 2$$
$$3x^2 - x - 6x + 2 = 2$$
$$3x^2 - x - 6x = 2 - 2$$
$$3x^2 - x - 6x = 0$$
$$3x^2 - 7x = 0$$
$$x(3x - 7) = 0$$
$$x = 0 \qquad 3x - 7 = 0$$
$$3x = 7$$
$$x = 7/3$$
$$S.S = \left\{0, \frac{7}{3}\right\}$$

Example 2:

$(x-2)(3x-1) = 2.$

$x(3x-1)-2(3x-1) = 2.$

$3x^2-x-6x+2 = 2.$

$3x^2-7x+2-2 = 0.$

$\boxed{3x^2-7x+0=0.}$

$\dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$

$\dfrac{-(-7) \pm \sqrt{(-7)^2-4(3)(0)}}{2(3)}$

$\dfrac{7 \pm \sqrt{49-0}}{6}$

$\dfrac{7 \pm 7}{6}$

$= \dfrac{7+7}{6}$ $\quad$ $= \dfrac{7-7}{6}$

$= \dfrac{\cancel{14}\,7}{\cancel{6}\,3}$ $\quad$ $= \dfrac{0}{6}$

$\boxed{= \dfrac{7}{3}}$ $\quad$ $\boxed{= 0.}$

$\{7/3, 0\}$ Ans

Weaker responses indicated that candidates were failed to convert the given equation into the standard quadratic equation. They also wrote wrong quadratic formula or failed to identify value of *a*, *b* and *c* correctly. In few other responses, it was noted that candidates correctly identified *a*, *b* and *c* but failed to apply quadratic formula correctly. It is also noted that candidates wrote $(x-2)=2$ or $(3x-1)=2$ which is a clear indication of a misconception.

Some candidates used trial and error method to solve the equation but failed to find the solution set of the given quadratic equation. Incorrect use of algebraic operations was evident in many responses.

Example 1:

$(x-2)(3x-1)=2$

$\Rightarrow 4x - x - 6x - 2 = 2$

$\Rightarrow 3x - 6x - 2 - 2$

$\Rightarrow 3x - 6x - 4$

$a \quad b \quad c$

$\dfrac{-b \pm \sqrt{b^2 4ac}}{2a}$

$= \dfrac{-6 \pm \sqrt{(6)^2 4(3)(-4)}}{2(3)}$ $\quad$ $= -6 \pm \dfrac{-\cancel{12}\,2}{\cancel{6}\,1}$

$= \dfrac{-6 \pm \sqrt{36 - 48}}{6}$ $\quad$ $\Rightarrow -6+2=4, \; -6-2=-8$

Example 2:

(ii) $(x-2)(3x-1)=2$

$= 3x^2 - x - 6x - 2 = 2$

$= 2x^2 - 6x - 2 = 2$

$= 2x^2 - 6x - \cancel{2} + \cancel{2} = 2$

$= 2x^2 - 6x = 2$

$\dfrac{6 \pm \sqrt{(6)^2 - 4(2)(2)}}{2(2)}$

$\dfrac{6 \pm \sqrt{36+16}}{4}$

$\dfrac{6 \pm \sqrt{52}}{4} \quad \dfrac{6 \pm 26}{2} = \dfrac{6 \pm 13}{2} = 6 - \dfrac{13}{2}$

S.S. $\left\{6 - \dfrac{13}{2}\right\}$

Question 5b:

The product of two consecutive positive odd integers is 1443. Find the smaller of the two integers.

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 the candidates translated the given question into the quadratic equation successfully and found the smaller number by solving the quadratic equation using method of their choice, i.e. factorisation or quadratic formula method.

Example 1:

Let the first number be x, second number $= x+2$

$(x)(x+2) = 1443$

$x^2 + 2x = 1443 \qquad \dfrac{-2 \pm 76}{2}$

$x^2 + 2x - 1443 = 0$

$a=1,\ b=2,\ c=-1443$

$\therefore \dfrac{-b \pm \sqrt{(b)^2 - 4ac}}{2a} \qquad \dfrac{-2+76}{2} \qquad \dfrac{-2-76}{2}$

$\dfrac{-2 - \sqrt{(2)^2 - 4(1)(-1443)}}{2(1)} \qquad \dfrac{74}{2} = \boxed{37} \qquad \dfrac{-78}{2} = -39$

$\dfrac{-2 - \sqrt{5776}}{2} \qquad x \leftarrow x$

37 is the smaller integer.

Example 2:

First consecutive positive odd number is = x

second consecutive positive odd number = $x+2$

$(x)(x+2) = 1443$

$x^2+2x = 1443$

$x^2+2x-1443 = 0$

using quadratic formula

$a = 1,\ b = 2,\ c = -1443$

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

$\frac{-2 \pm \sqrt{(2)^2-4(1)(-1443)}}{2(1)}$

$\frac{-2 \pm \sqrt{4+5772}}{2}$

$\frac{-2 \pm \sqrt{5776}}{2}$

$\frac{-2 \pm 76}{2}$

$\frac{-2+76}{2}, \frac{-2-76}{2}$

$74/2,\ -78/2$

$37,\ -39$

$x = 37$

$x+2 = 37+2$

$x+2 = 39$

37 is the smaller of the two integers.

Weaker responses indicated that candidates failed to form the correct quadratic equation. They assumed *x* and *x*+1 as two consecutive odd numbers or they failed to translate product as multiplication of the two numbers. In solving equation, they also made mistakes as depicted in the following examples:

Example 1:

b. Let x = 1st odd integer

$x+1$ = consecutive odd integer

$\cancel{x \cdot (x+1)} = x(x+1) = 1443$

$x^2 + x - 1443 = 0$

$2x^2 - 1443 = 0$

$2x^2 = 1443$

$x^2 = \frac{1443}{2}$

$x^2 = 721.5$

$\sqrt{x^2} = \sqrt{721.5}$

$x = 26.86 \approx 27$, s.s $\{27\}$

$\therefore$ Smallest integer is 27

Example 2:

a. $x+2$ Data: 1. Integer $= x$ Total $= 1443$.

Solution: 2. Integer $= x+2$.

b. $x + (x+2) = 1443$. $(x+2)$

$x + x + 2 = 1443$ $= 720.5 + 2$

$2x + 2 = 1443$ $= 722.5$

$2x = 1443 - 2$

$2x = 1441$ ∴ The smallest of the two

$x = \frac{1441}{2}$ integers is the value of

x that is 720.5.

$x = 720.5$.

Question 6a:

Find the matrix *X* from the following equation.

$$\frac{1}{3}X + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix} + \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix}$$

This question was based on the concept of operations on matrices, i.e. multiplication, subtraction and addition of matrices.

Better responses showed that candidates had good understanding of the concepts of multiplication and addition of matrices; therefore, they were able to find the matrix *X* from the given matrix equation.

Example 1:

a) $1/3\ X + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix} + \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix}$

$1/3\ X + \begin{bmatrix} 0+4 & 1+6 \\ 0+8 & 3+12 \end{bmatrix} = \begin{bmatrix} 10+10 & 8+8 \\ 6+6 & 4+4 \end{bmatrix}$

$1/3\ X + \begin{bmatrix} 4 & 7 \\ 8 & 15 \end{bmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}$

$1/3\ X = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix} - \begin{bmatrix} 4 & 7 \\ 8 & 15 \end{bmatrix}$

$1/3\ X = \begin{bmatrix} 20-4 & 16-7 \\ 12-8 & 8-15 \end{bmatrix}$

$1/3\ X = \begin{bmatrix} 16 & 9 \\ 4 & -7 \end{bmatrix}$

$X = \begin{bmatrix} 16\times3 & 9\times3 \\ 4\times3 & -7\times3 \end{bmatrix} = \begin{bmatrix} 48 & 27 \\ 12 & -21 \end{bmatrix}$

Example 2:

$$\frac{1}{3}x + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix} + \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix}$$

$$= \frac{1}{3}x + \begin{bmatrix} 1\times 0+2\times 2 & 1\times 1+2\times 3 \\ 3\times 0+4\times 2 & 3\times 1+4\times 3 \end{bmatrix} = \begin{bmatrix} 10+10 & 8+8 \\ 6+6 & 4+4 \end{bmatrix}$$

$$= \frac{1}{3}x + \begin{bmatrix} 0+4 & 1+6 \\ 0+8 & 3+12 \end{bmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}$$

$$= \frac{1}{3}x + \begin{bmatrix} 4 & 7 \\ 8 & 15 \end{bmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}.$$

$$= \frac{1}{3}x = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix} - \begin{bmatrix} 4 & 7 \\ 8 & 15 \end{bmatrix}$$

$$= \frac{1}{3}x = \begin{bmatrix} 20-4 & 16-7 \\ 12-8 & 8-15 \end{bmatrix} = \begin{bmatrix} 16 & 9 \\ 4 & -7 \end{bmatrix}$$

$$x = \begin{bmatrix} 16\times 3 & 9\times 3 \\ 4\times 3 & -7\times 3 \end{bmatrix}$$

$$x = \begin{bmatrix} 48 & 27 \\ 12 & -21 \end{bmatrix}$$

Weaker responses exhibited lack of understanding of the concepts of multiplication and addition of matrices and made different types of mistakes. One common mistake noted in the multiplication was as follows:

$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 1\times 0 & 2\times 1 \\ 3\times 2 & 4\times 3 \end{bmatrix}$$

The weaker candidates have no idea of conformability of matrices for addition, subtraction and multiplication of matrices. The following examples depict few more mistakes observed in the weaker responses.

Example 1:

$$\frac{1}{3}X + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix} + \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} (1\times 0)-(2\times 2) & (1\times 1)-(2\times 3) \\ (3\times 0)-(4\times 2) & (3\times 1)-(4\times 3) \end{bmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} 1-4 & 1-6 \\ 3-8 & 3-12 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} -3+(-5) \\ -5+(-9) \end{bmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} -3-5 \\ -5-9 \end{bmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} -8 \\ -14 \end{bmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}$$

$$\frac{1}{3}X = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix} - \begin{bmatrix} -8 \\ -14 \end{bmatrix}$$

$$\frac{1}{3}X = \begin{bmatrix} (-8+20)-(-14+16) \\ (-8+12)-(-14+8) \end{bmatrix}$$

$$\frac{1}{3}X = \begin{bmatrix} 12-2 \\ 4-(-6) \end{bmatrix}$$

$$\frac{1}{3}X = \begin{bmatrix} 10 \\ 10 \end{bmatrix}$$

$$X = \begin{bmatrix} 10\times \frac{1}{3} \\ 10\times \frac{1}{3} \end{bmatrix}$$

$$X = \begin{bmatrix} 10/3 \\ 10/3 \end{bmatrix}$$

Example 2:

$$\frac{1}{3}X + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \times \begin{bmatrix} 0 & 1 \\ 2 & 3 \end{bmatrix} = \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix} + \begin{bmatrix} 10 & 8 \\ 6 & 4 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} (1\times0)+(2\times2) & (1\times1)+(2\times3) \\ (3\times0)+(3\times2) & (3\times1)+(3\times3) \end{bmatrix} = \begin{bmatrix} (10+10)+(8+6) & (10+8)+(8+4) \\ (6+10)+(6+6) & (6+8)+(6+4) \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} 0+4 & 1+6 \\ 0+6 & 3+9 \end{bmatrix} = \begin{bmatrix} 20+14 & 18+12 \\ 16+12 & 14+10 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} 4 & 7 \\ 6 & 12 \end{bmatrix} = \begin{bmatrix} 34 & 30 \\ 28 & 24 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} 34 & 30 \\ 28 & 24 \end{bmatrix} - \begin{bmatrix} 4 & 7 \\ 6 & 12 \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} (34-4)+(30-6) & (34-7)+(30-12) \\ (28-4)+(24-6) & (28-7)+(24-12) \end{bmatrix}$$

$$\frac{1}{3}X + \begin{bmatrix} 30+24 & 27+18 \\ 24+18 & 21+12 \end{bmatrix}.$$

$$\frac{1}{3}X + \begin{bmatrix} 54 & 45 \\ 42 & 33 \end{bmatrix}$$

$$X = \begin{bmatrix} \frac{\cancel{54}^{18}}{\cancel{3}_1} & \frac{\cancel{45}^{15}}{\cancel{3}_1} \\ \frac{\cancel{42}^{14}}{\cancel{3}_1} & \frac{\cancel{33}^{11}}{\cancel{3}_1} \end{bmatrix} \Rightarrow X = \begin{bmatrix} 18 & 15 \\ 14 & 11 \end{bmatrix} \text{ Answer}$$

Example 3:

$$\frac{1}{3}x + \begin{pmatrix} 0+2 & 2+6 \\ 0+3 & 4+12 \end{pmatrix} = \begin{bmatrix} 20 & 16 \\ 12 & 8 \end{bmatrix}$$

$$\frac{1}{3}x = \begin{pmatrix} 20 & 16 \\ 12 & 8 \end{pmatrix} - \begin{pmatrix} 2 & 12 \\ 3 & 16 \end{pmatrix}$$

$$\frac{1}{3}x = \begin{bmatrix} 20-2 & 16-12 \\ 12-3 & 8-16 \end{bmatrix}$$

$$x = \begin{pmatrix} \frac{\cancel{18}^{6}}{\cancel{3}_1} & \frac{4}{3} \\ \frac{\cancel{9}^{3}}{\cancel{3}_1} & -\frac{8}{3} \end{pmatrix}$$

$$x = \begin{pmatrix} 6 & \frac{4}{3} \\ 3 & -\frac{8}{3} \end{pmatrix} \text{ Ans.}$$

Question 6b:

For the matrices $A=\begin{bmatrix}3 & 2\\ 1 & 4\end{bmatrix}$ and $B=\begin{bmatrix}4 & 2\\ 6 & 4\end{bmatrix}$, find $A\times B^{-1}$.

Better responses informed that candidates found the multiplicative inverse of the matrix B systematically and followed all the necessary steps. After finding B^{-1} they found the product $A\times B^{-1}$ correctly.

Example 1:

$B^{-1} = \dfrac{\text{Adjoint}}{\text{det}}$ $\qquad$ $\text{Adj} = \begin{bmatrix}4 & -2\\ -6 & 4\end{bmatrix}$

$\text{det} = ad - bc$

$= 4\times 4 - 2\times 6$

$= 16 - 12 \Rightarrow 4$

$B^{-1} = \begin{bmatrix}4/4 & -2/4\\ -6/4 & 4/4\end{bmatrix} = \begin{bmatrix}1 & -1/2\\ -3/2 & 1\end{bmatrix}$

$A\times B^{-1} = \begin{bmatrix}3 & 2\\ 1 & 4\end{bmatrix}\times\begin{bmatrix}1 & -1/2\\ -3/2 & 1\end{bmatrix}$

$= \begin{bmatrix}3\times 1 + 2\times -3/2 & 3\times -1/2 + 2\times 1\\ 1\times 1 + 4\times -3/2 & 1\times -1/2 + 4\times 1\end{bmatrix}$

$= \begin{bmatrix}3+(-3) & -3/2+2\\ 1+(-6) & -1/2+4\end{bmatrix} = \begin{bmatrix}0 & 1/2\\ -5 & 7/2\end{bmatrix}$ Ans

Example 2:

b. $A\times B^{-1}$ $\quad$ Adjoint $B = \begin{bmatrix}4 & -2\\ -6 & 4\end{bmatrix}$

$B^{-1} = \dfrac{\text{Adjoint } B}{|B|}$

$|B| = ad - bc$

$= (4)(4) - (2)(6)$

$= 16 - 12$

$= 4$

$B^{-1} = \dfrac{\begin{bmatrix}4 & -2\\ -6 & 4\end{bmatrix}}{4}$

$B^{-1} = \begin{bmatrix}1 & -1/2\\ -3/2 & 1\end{bmatrix}$

$A\times B^{-1}$

$\begin{bmatrix}3 & 2\\ 1 & 4\end{bmatrix}\cdot\begin{bmatrix}1 & -1/2\\ -3/2 & 1\end{bmatrix}$

$\begin{bmatrix}(3)(1)+(2)(-\frac{3}{2}) & (3)(-\frac{1}{2})+(2)(1)\\ (1)(1)+(4)(-\frac{3}{2}) & (1)(-\frac{1}{2})+(4)(1)\end{bmatrix}$

$\begin{bmatrix}\frac{3}{1}+\frac{-6}{2} & \frac{-3}{2}+\frac{2}{1}\\ \frac{1}{1}+\frac{-12}{2} & \frac{-1}{2}+\frac{4}{1}\end{bmatrix} \Rightarrow \begin{bmatrix}\frac{6-6}{2} & \frac{-3+4}{2}\\ \frac{2-12}{2} & \frac{-1+8}{2}\end{bmatrix} \Rightarrow \begin{bmatrix}0/2 & 1/2\\ -10/2 & 7/2\end{bmatrix} \Rightarrow \begin{bmatrix}0 & 1/2\\ -5 & 7/2\end{bmatrix}$ Ans

Weaker responses showed that candidates made following mistakes:

- Wrong calculation of the determinant of B
- Failed to calculate adjoint of B and hence were unable to calculate B^{-1} correctly
- Instead of calculating $A \times B^{-1}$, they calculated $(A \times B)^{-1}$
- They made mistakes in the multiplication of the matrices

Example 1:

$$A \times b = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 4 & 2 \\ 6 & 4 \end{bmatrix}$$

$$A \times b = \begin{bmatrix} 12 + 18 & 4 + 8 \\ 4 + 6 & 8 + 16 \end{bmatrix}$$

$$A \times b = \begin{bmatrix} 30 & 12 \\ 10 & 24 \end{bmatrix}$$

$$A \times b^{-1} = \begin{bmatrix} 30 - 1 & 12 - 1 \\ 10 - 1 & 24 - 1 \end{bmatrix}$$

$$A \times b^{-1} = \begin{bmatrix} 29 & 11 \\ 9 & 23 \end{bmatrix}$$

Example 2:

$$A = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix} \text{ and } B = \begin{bmatrix} 4 & 2 \\ 6 & 4 \end{bmatrix}$$

$$A \times B^{-1} = ??$$

$$A \times B^{-1} \begin{bmatrix} (3 \times 4) + (2 \times 6) & (3 \times 2) + (2 \times 4) \\ (1 \times 4) + (4 \times 6) & (1 \times 2) + (4 \times 4) \end{bmatrix}$$

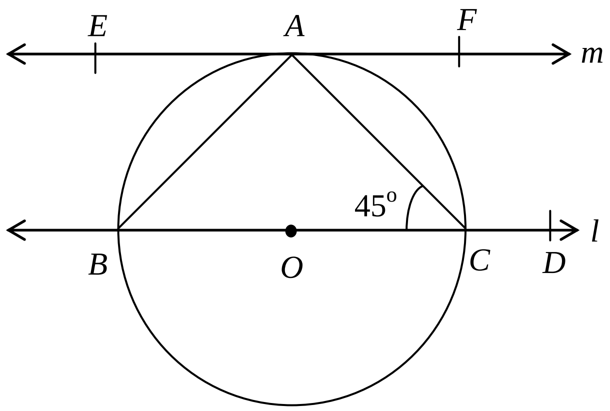
$$= \begin{bmatrix} 12 + 12 & 6 + 8 \\ 4 + 24 & 2 + 16 \end{bmatrix}$$

$$= \begin{bmatrix} 24 & 16 \\ 28 & 18 \end{bmatrix}$$

$$A \times B^{-1} \begin{bmatrix} 28 & -16 \\ -28 & 24 \end{bmatrix} \text{ and}$$

Question 7:

The given diagram shows a circle having centre *O*. *l* and *m* are two lines parallel to each other and *m* is tangent to the circle.



NOT TO SCALE

Find the measurements of the following angles.

i. $\angle BAC$

ii. $\angle ABC$

iii. $\angle ACD$

iv. $\angle BAE$

v. $\angle BAF$

Better responses displayed that candidates were able to comprehend the diagram and applied the related theorems to find required angles correctly. Justification was not required but few of the candidates also wrote the justification.

Example 1:

$\angle BAC = 90^\circ$ ⇒ triangle in the semi-circle is a right angled triangle.

ii. $\angle ABC$

$A + B + C = 180$

$B + 90 + 45 = 180 \Rightarrow B\ 180 - 135 \Rightarrow B = 45^\circ$

iii. $\angle ACD$

$\angle ACO + \angle ACD = 180^\circ$

$45 + x = 180^\circ \Rightarrow x = 180 - 45 \Rightarrow \boxed{x = 135^\circ}$

iv. $\angle BAE$

$\angle BAE = 180^\circ - (90 + 45) \Rightarrow 180^\circ - 135^\circ$

$= 45^\circ$

v. $\angle BAF$

$\angle BAE + BAF = 180^\circ$

$45^\circ + \angle BAF = 180^\circ \Rightarrow BAF = 180 - 45 \Rightarrow \boxed{BAF = 135^\circ}$

Example 2:

$\angle BAC$ 90° Angle in a semi-circle

$\angle ABC$ 90 + 45 = 135, 180 - 135 = 45°

$\angle ACD$ 180 - 45 = 135°

$\angle BAE$ 45°

$\angle BAF$ 135°

Weaker responses indicated candidates' lack of understanding of the theorems to find the required angles. Hence, they were unable to find the angles correctly.

Example 1:

i. $\angle BAC$ ∠BAC = Supplementry Angle

ii. $\angle ABC$ ∠ABC = Alternative Angle

iii. $\angle ACD$ ∠ACD = Complementry Angle

iv. $\angle BAE$ ∠BAE = Adjoint Angle

v. $\angle BAF$ ∠BAE = Adjoint Angle.

Example 2:

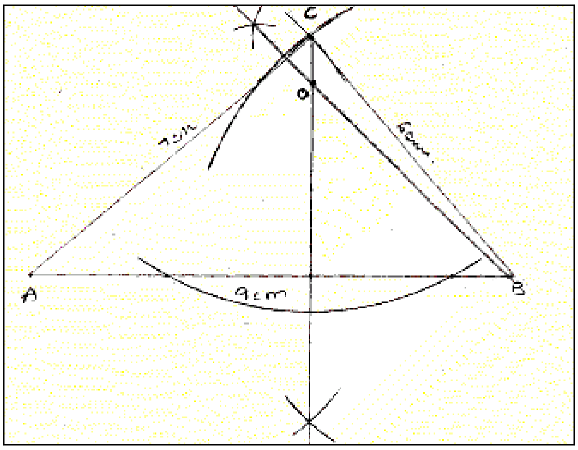
$\angle BAC$	180° = (triangle is of 180°) (Alternative angle.)
$\angle ABC$	90° or 60° (Right angle)
$\angle ACD$	∠ACD = More than 90° (obtuse angle) less than 180°
$\angle BAE$	less than 90° (Acute angle)
$\angle BAF$	More than 90° (Obtuse Angle) less than 180°

Question 8:

Draw a triangle whose sides are of measurements 9 cm, 6 cm and 7 cm. Also construct any two of its altitudes.

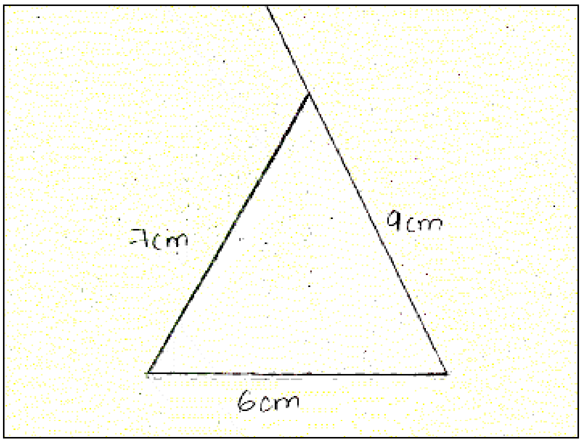
Better responses exhibited that candidates have good understanding of the construction of geometrical figures with the given measurements. They also constructed the required altitude correctly.

Example:

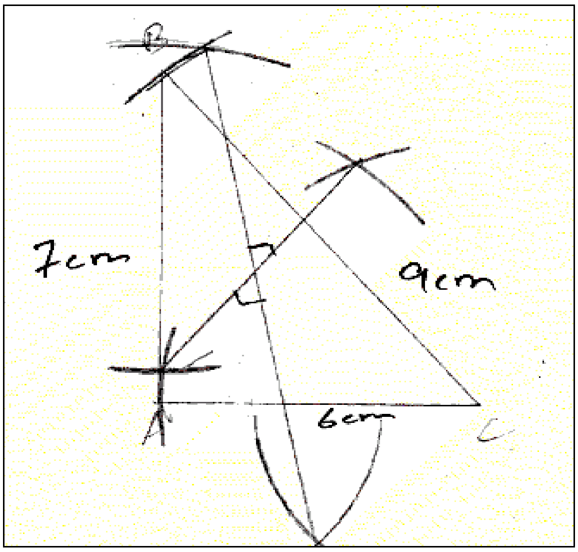


Weaker responses displayed that candidates were unable to draw the triangle with given measurements and also failed to draw the altitudes of the triangle.

Example1:



Example2:



Question 9: Find the area of a square that has a diagonal of length 10 cm.

Better response reported that candidates understood the question and very rightly applied the Pythagorean Theorem to find the sides and the area of the square. In few other responses, candidates applied the formula $Area\ of\ Square = \frac{1}{2}(diagonal)^2$

Example 1:

$(H)^2 = (B)^2 + (A)^2$

$(10)^2 = a^2 + a^2$

$100 = 2a^2$

$\frac{^{50}\cancel{100}}{\cancel{2}_1} = a^2$

$50 = a^2$

The area of the square is $50 cm^2$

Example 2:

Area of Square = ?

Diagonal = 10

Area of Square $= \frac{D^2}{2}$

$= \frac{(10)^2}{2}$

$= \frac{100}{2}$

$= 50$

Example 3:

$(x)^2 + (x)^2 = (10)^2$

$2x^2 = 100$

$x^2 = 100/2$

$\sqrt{x^2} = \sqrt{50}$

$x = 5\sqrt{2}$

Area of square = $l \times b$

$= 5\sqrt{2} \times 5\sqrt{2}$

$= (25)(\sqrt{2})^2$

$= 50 cm^2$ is the area.

Weaker responses showed that the candidates were unable to understand the question and applied wrong approach or formula to find the area of the square. The following examples cite different mistakes and misconceptions noted in the weaker responses.

Example 1:

Solution:

$2\pi r^2$

$2 \times \left(\frac{22}{7}\right)^2 =$

$2 \times \frac{44}{49} = 10$

$88 = 10 \times 49$

$88 = 490$

$490 - 88$

$= 412$ ans!

Example 2:

$\frac{\text{Diagonal}}{2} = \text{Side}$

$\frac{10}{2} = 5$ cm $\therefore$ Side $= 5$ cm.

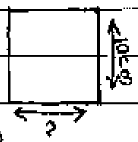
Area of square $= 5^2$

$= 5 \times 5$

Area of square $= 25$ cm^2. Ans.

Example 3:

~~length~~ length = 10cm



Square side are all equal to ?

each other so

$= 10 \times 4$ = length x all four sites

$= 40$

Sum of square $= 100 - 40$

$= 60°$ The area of square.

Example 4:

diagonal = 10 cm
rea of square = $\sqrt{2}\,a$
$= \sqrt{2} \times 10$
$= 14.142$ Ans

Question 10:
Prove that the points *A* (0, 0), *B* (3, 4) and *C* (6, 8) are collinear points.

Better responses reported that candidates used the distance formula between the given points and were able to establish the relation $AB + BC = AC$ to prove that the points *A* (0, 0), *B* (3, 4) and *C* (6, 8) are collinear points.

Example 1:

$|AB| = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} = \sqrt{(3-0)^2+(4-0)^2} = \sqrt{(3)^2+(4)^2} = \sqrt{9+16} = \sqrt{25} = 5$

$|BC| = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} = \sqrt{(6-3)^2+(8-4)^2} = \sqrt{(3)^2+(4)^2} = \sqrt{9+16} = \sqrt{25} = 5$

$|CA| = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2} = \sqrt{(6-0)^2+(8-0)^2} = \sqrt{(6)^2+(8)^2} = \sqrt{36+64} = \sqrt{100} = 10$

$|AB| + |BC| = |CA|$

$5 + 5 = 10$

Example 2:

$\lvert AB\rvert = \sqrt{(x_2-x_1)^2+(y_2-y_1)^2}$	$\lvert BC\rvert = \sqrt{(6-3)^2+(8-4)^2}$	$\lvert AC\rvert = \sqrt{(6-0)^2+(8-0)^2}$
$= \sqrt{(3-0)^2+(4-0)^2}$	$= \sqrt{(3)^2+(4)^2}$	$= \sqrt{(6)^2+(8)^2}$
$= \sqrt{(3)^2+(4)^2}$	$= \sqrt{9+16}$	$= \sqrt{36+64}$
$= \sqrt{9+16}$	$= \sqrt{25}$	$= \sqrt{100}$
$= \sqrt{25}$	$= 5$	$= 10$
$= 5$		

$|AB| + |BC| = 5 + 5 = 10$ proved that point A, B and C are collinear points.

Weaker responses showed different mistakes in writing or applying the distance formula and consequently, were failed to establish the relation $AB + BC = AC$.

- $d = \sqrt{(x_1 + y_1) + (x_2 + y_2)}$
- $d = \sqrt{(x_1 - y_1) + (x_2 - y_2)}$
- $d = \sqrt{(x_2 - x_1) + (y_2 - y_1)}$
- $d = \sqrt{(x_1 + y_1)^2 + (x_2 + y_2)^2}$
- $d = \sqrt{(x_2 - x_1)^2 - (y_2 - y_1)^2}$

The weaker responses also reported that candidates failed to identify the values of x_1, x_2, y_1 and y_2 correctly. Hence, they failed to fulfill the requirement of the question.

Example 1:

Distance of $\overline{AB} = \sqrt{(x^1-x^2)^2+(y^1-y^2)^2}$

$= \sqrt{(0-3)^2+(0-4)^2}$

$= \sqrt{9+16}$

$= \sqrt{28}$

Example 2:

$x = \frac{x_1 + x_2 + x_3}{2}$ $\quad y = \frac{y_1 + y_2 + y_3}{2}$

$x = \frac{0 + 3 + 6}{2}$ $\quad y = \frac{0 + 4 + 8}{2}$

$x = \frac{9}{2}$ $\quad y = \frac{12}{2}$

$x = 4.5$ $\quad y = 6$

Example 3:

$\overline{AB} = \sqrt{(x_1-y_1)^2+(x_2-y_2)^2}$ $\quad \overline{BC} = \sqrt{(x_1-y_1)^2+(x_2-y_2)^2}$

$\sqrt{(0-3)^2+(0-4)^2}$ $\quad = \sqrt{(3-6)^2+(4-8)^2}$

$\sqrt{(3)^2+(4)^2}$ $\quad = \sqrt{(-3)^2+(-4)^2}$

$\sqrt{9+16}$ $\quad = \sqrt{9+16}$

$\sqrt{25}$ $\quad = \sqrt{25}$

$\boxed{5}$ $\quad = \boxed{5}$