CLASS IX – MATHEMATICS

Chapter Test: Introduction to Linear Polynomials

Step-by-Step Solutions and Marking Scheme | M. M.: 40

Results used

A linear polynomial has degree 1 ($ax + b$, $a \neq 0$). A linear relationship is $y = ax + b$: a is the slope and b is the y-intercept (the line cuts the y-axis at $(0, b)$).

Positive slope: linear growth. Negative slope: linear decay. Lines with equal slopes and different intercepts are parallel.

To find a and b from two points, substitute both into $y = ax + b$ and solve the two equations.

Section A (1 mark each)

Q	Ans	Reason
1	(B)	$3 - 4y$ has degree 1. $x^2 + 1$ has degree 2, $5y^3$ has degree 3 and 7 has degree 0. So **$3 - 4y$**.
2	(C)	The term in x^2 is $8x^2$, so the coefficient is **8**.
3	(A)	$4(-2) - 7 = -8 - 7 =$ **-15**.
4	(D)	$2(3)^2 - 3(3) + 5 = 18 - 9 + 5 =$ **14**.
5	(B)	In $y = ax + b$ the y-intercept is b, so here it is **-8**.
6	(C)	The slope -3 is negative, so the quantity decreases by a fixed amount: **linear decay**.
7	(A)	Parallel lines have the same slope 3 and a different intercept: **$y = 3x - 7$**.
8	(C)	The y-intercept is 3, so $b = 3$. Slope $= (-1 - 3)/(2 - 0) = -2$. So **$y = -2x + 3$**. Check: $x = 2$ gives $-4 + 3 = -1$ (verified).
9	(B)	Stages 1, 2, 3 need 4, 7, 10 matchsticks: 3 more per stage, so Stage n needs $3n + 1$. Stage 10: $3(10) + 1 =$ **31**.
10	(D)	The common difference is 4 and the first term is 7, so the nth term is $4n + 3$ ($n = 1$: 7; $n = 4$: 19). **$4n + 3$**.
11	(D)	A is false: for $y = 4x - 5$, $x = 0$ gives $y = -5$, not 0. R is true. → **(D)**.
12	(A)	Both lines have slope 3 and different y-intercepts (2 and -5), so they are parallel: A is true. R is true and states exactly why. → **(A)**.

Section B (2 marks each)

Q.13 (2 marks)

Substitute $t = -3$ in $2t^2 - 3t + 7$: **[1]**

$2(-3)^2 - 3(-3) + 7 = 2(9) + 9 + 7 = 18 + 9 + 7 =$

Ans. 34. [1]

Q.14 (2 marks)

(A) Let the smaller number be x. The other is $x + 13$.

$x + (x + 13) = 91 \Rightarrow 2x + 13 = 91 \Rightarrow 2x = 78 \Rightarrow x = 39$. **[1]**

The numbers are **39 and 52**. [1]

OR (B) Let the width be w cm; the length is $(w + 5)$ cm.

Perimeter = 2(length + width): $2(2w + 5) = 46 \Rightarrow 2w + 5 = 23 \Rightarrow w = 9$. **[1]**

Width = **9 cm**, length = **14 cm**. [1]

Q.15 (2 marks)

The first 2 km cost ₹30. The remaining distance is $9 - 2 = 7$ km at ₹12 per km = ₹84. **[1]**

Ans. Fare = $30 + 12 \times 7 =$ ₹114. [1] ***(In general, the fare for n km ($n \geq 2$) is $30 + 12(n - 2) = 12n + 6$.)***

Q.16 (2 marks)

(A) Divide by 3: y = 3x − 5, which is of the form y = ax + b.

Slope = **3**. **[1]**

y-intercept = **−5**. **[1]**

OR (B) The line cuts the y-axis at (0, 4), so b = 4.

Slope a = (10 − 4)/(2 − 0) = 3. [1]

Equation: **y = 3x + 4**. Check: x = 2 gives 6 + 4 = 10 (verified). [1]

Section C (3 marks each)

Q.17 (3 marks)

(A) Substituting x = 8, y = 1100 and x = 14, y = 1700 in y = ax + b:

1100 = 8a + b ... (1) and 1700 = 14a + b ... (2). [1]

Subtracting (1) from (2): 600 = 6a ⇒ **a = 100**. [1]

From (1): b = 1100 − 800 = **300**. [1] *(So y = 100x + 300: fixed fee ₹300, ₹100 per class.)*

OR (B) Substituting x = 120, y = 1500 and x = 200, y = 2300:

1500 = 120a + b ... (1) and 2300 = 200a + b ... (2). [1]

Subtracting: 800 = 80a ⇒ **a = 10**. [1]

From (1): b = 1500 − 1200 = **300**. [1] *(So y = 10x + 300.)*

Q.18 (3 marks)

(A)

(i) Value = initial value − yearly loss × years: **v = 60000 − 4000t**. [1]

(ii) At t = 5: v = 60000 − 20000 = **₹40,000**. [1]

(iii) 60000 − 4000t = 12000 ⇒ 4000t = 48000 ⇒ t = **12 years**. [1]

OR (B)

(i) **h = 2.5 + 0.75t**. [1]

(ii) At t = 8: h = 2.5 + 6 = **8.5 ft**. [1]

(iii) 2.5 + 0.75t = 10 ⇒ 0.75t = 7.5 ⇒ t = **10 months**. [1]

Section D (5 marks each)

Q.19 (5 marks)

(A) Let p(x) = ax + b.

(i) p(1) = −4 ⇒ a + b = −4 ... (1); p(4) = 2 ⇒ 4a + b = 2 ... (2). [1]

Subtracting (1) from (2): 3a = 6 ⇒ a = 2, and b = −4 − 2 = −6. So **p(x) = 2x − 6**. [1]

(ii) y-axis: put x = 0, y = −6, so the graph cuts the y-axis at **(0, −6)**. [1]

x-axis: put y = 0: 2x − 6 = 0 ⇒ x = 3, so it cuts the x-axis at **(3, 0)**. [1]

(iii) The slope of p(x) is 2 and the slope of y = 2x + 5 is 2, with different y-intercepts (−6 and 5). So the lines are **parallel**. [1]

OR (B)

p(0) = b = 4. [1]

p(x) + q(x) = (a + c)x + (b + d) = 7x + 10 for all x ⇒ a + c = 7 and b + d = 10 ⇒ d = 6. [1]

p(x) − q(x) = (a − c)x + (b − d) = (a − c)x − 2. It is 0 at x = 2: 2(a − c) − 2 = 0 ⇒ a − c = 1. [1]

Adding a + c = 7 and a − c = 1: 2a = 8 ⇒ a = 4 and c = 3. [1]

Ans. p(x) = 4x + 4 and q(x) = 3x + 6. [1] ***(Check: sum = 7x + 10; p − q = x − 2 is zero at x = 2 (verified))***

Q.20 (5 marks)

(A) The numbers 5, 8, 11, 14 increase by 3 each time, so it is a linear pattern.

(i) The tile count is 3n + 2 (check: n = 1 gives 5, n = 4 gives 14). [2]

(ii) Stage 20: 3(20) + 2 = **62 tiles**. [1]

(iii) 3n + 2 = 80 ⇒ 3n = 78 ⇒ n = **26**. [1]

(iv) 3n + 2 = 100 ⇒ n = 98/3, which is not a whole number. So **no stage has exactly 100 tiles**. [1]

OR (B)

(i) Company A: **40 + 12d**. Company B: **100 + 6d**. [2]

(ii) 40 + 12d = 100 + 6d ⇒ 6d = 60 ⇒ **d = 10 km** (both charge ₹160). [2]

(iii) For 15 km: A = 40 + 180 = ₹220 and B = 100 + 90 = ₹190, so **Company B** is cheaper. [1]

Section E (4 marks)

Q.21 (4 marks)

(i) V = 120 − 8(5) = 120 − 40 = **80 litres**. **[1]**

(ii) The tank is empty when V = 0: 120 − 8t = 0 ⇒ t = **15 minutes** (the graph meets the t-axis at (15, 0)). **[1]**

(iii) (A) Writing V = −8t + 120: the slope is **−8**. It means the volume falls by 8 litres every minute (the draining rate). [1]

The V-intercept is **120**: the volume at t = 0, i.e. the initial amount of water (the graph cuts the V-axis at (0, 120)). [1]

OR (iii) (B)

120 − 8t = 40 ⇒ 8t = 80 ⇒ t = **10 minutes**. [1]

The volume decreases by a fixed amount (8 litres) every minute, and the slope is negative, so it is **linear decay**. [1]

— End of Solutions —