

Basic Mathematics (241)
Marking Scheme
2023-24

Section A

1) (b) xy^2	1
2) (c) 20	1
3) (b) $\frac{1}{2}$	1
4) (d) No Solution	1
5) (d) 0,8	1
6) (c) 5 Unit	1
7) (a) $\Delta PQR \sim \Delta CAB$	1
8) (d) RHS	1
9) (b) 70°	1
10) (b) $\frac{3}{4}$	1
11) (b) 45°	1
12) (a) $\sin^2 A$	1
13) (c) $\pi : 2$	1
14) (a) 7 cm	1
15) (d) $\frac{1}{6}$	1
16) (a) 15	1
17) (a) 3.5 CM	1
18) (b) 12-18	1
19) (a) Both assertion and reason are true and reason is the correct explanation of assertion.	1
20) (d) Assertion (A) is false but reason(R) is true.	1

SECTION B

21) $3x+2y = 8$

$6x-4y = 9$

$a_1=3, \quad b_1=2, \quad c_1 = 8$

$a_2=6, \quad b_2=-4, \quad c_2 = 9$

1

$\frac{a_1}{a_2} = \frac{3}{6} = \frac{1}{2} \quad \frac{b_1}{b_2} = \frac{2}{-4} = \frac{-1}{2} \quad \frac{c_1}{c_2} = \frac{8}{9}$

1/2

$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

The given pair of linear equations are consistent.

1/2

22) Given:- $AB \parallel CD \parallel EF$

To prove:- $\frac{AE}{ED} = \frac{BF}{FC}$

Construction:- Join BD to intersect EF at G.

Proof:- in $\triangle ABD$

$EG \parallel AB$ ($EF \parallel AB$)

$\frac{AE}{ED} = \frac{BG}{GD}$ (by BPT) _____ (1)

In $\triangle DBC$

$GF \parallel CD$ ($EF \parallel CD$)

$\frac{BF}{FC} = \frac{BG}{GD}$ (by BPT) _____ (2)

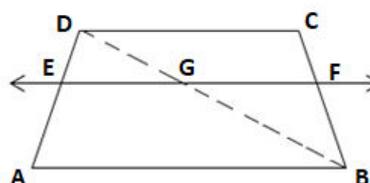
from (1) & (2)

$\frac{AE}{ED} = \frac{BF}{FC}$

1/2

1/2

1/2



OR

Given $AD=6\text{cm}, DB=9\text{cm}$

$AE=8\text{cm}, EC=12\text{cm}, \angle ADE=48^\circ$

To find:- $\angle ABC=?$

Proof:

In $\triangle ABC$

$\frac{AD}{DB} = \frac{6}{9} = \frac{2}{3}$ (1)

$\frac{AE}{EC} = \frac{8}{12} = \frac{2}{3}$ (2)

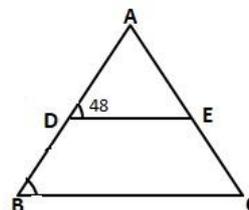
From (1) & (2)

$\frac{AD}{DB} = \frac{AE}{EC}$

$DE \parallel BC$ (Converse of BPT)

$\angle ADE = \angle ABC$ (Corresponding angles)

$\Rightarrow \angle ABC = 48^\circ$



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23) In ΔOTA , $\angle OTA = 90^\circ$

By Pythagoras theorem

$$OA^2 = OT^2 + AT^2$$

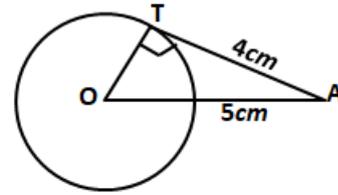
$$(5)^2 = OT^2 + (4)^2$$

$$25 - 16 = OT^2$$

$$9 = OT^2$$

$$OT = 3\text{cm}$$

radius of circle = 3cm.



1/2

1/2

1

24) $\sin^2 60^\circ + 2 \tan 45^\circ - \cos^2 30^\circ$

$$= \left(\frac{\sqrt{3}}{2}\right)^2 + 2(1) - \left(\frac{\sqrt{3}}{2}\right)^2$$

$$= \frac{3}{4} + 2 - \frac{3}{4}$$

$$= 2$$

1

1

25) Area of the circle = sum of areas of 2 circles

$$\pi R^2 = \pi(40)^2 + \pi(9)^2$$

$$\pi R^2 = \pi \times (40^2 + 9^2)$$

$$R^2 = 1600 + 81$$

$$R^2 = 1681$$

$$R = 41 \text{ cm.}$$

$$\text{Diameter of given circle} = 41 \times 2 = 82 \text{ cm}$$

1/2

1/2

1/2

1/2

OR

radius of circle = 10cm, $\theta = 90^\circ$

$$\text{Area of minor segment} = \frac{\theta}{360^\circ} \pi r^2 - \text{Area of } \Delta$$

$$= \frac{\theta}{360^\circ} \times \pi r^2 - \frac{1}{2} \times b \times h$$

$$= \frac{90^\circ}{360^\circ} \times 3.14 \times 10 \times 10 - \frac{1}{2} \times 10 \times 10$$

$$= \frac{314}{4} - 50$$

$$= 78.5 - 50 = 28.5 \text{ cm}^2$$

$$\text{Area of minor segment} = 28.5 \text{ cm}^2$$

1/2

1/2

1/2

1/2

Section C

26) Let us assume that $\sqrt{3}$ be a rational number

$$\sqrt{3} = \frac{a}{b} \quad \text{where } a \text{ and } b \text{ are co-prime.} \quad 1$$

squaring both the sides

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

$$3 = \frac{a^2}{b^2} \Rightarrow a^2 = 3b^2$$

a^2 is divisible by 3 so a is also divisible by 3 _____(1)

let $a=3c$ for any integer c .

$$(3c)^2 = 3b^2 \quad 1/2$$

$$9c^2 = 3b^2$$

$$b^2 = 3c^2$$

since b^2 is divisible by 3 so, b is also divisible by 3 _____(2)

From (1) & (2) we can say that 3 is a factor of a and b 1/2

which is contradicting the fact that a and b are co-prime.

Thus, our assumption that $\sqrt{3}$ is a rational number is wrong.

Hence, $\sqrt{3}$ is an irrational number. 1/2

27) $P(S) = 4S^2 - 4S + 1$

$$4S^2 - 2S - 2S + 1 = 0$$

$$2S(2S-1) - 1(2S-1) = 0$$

$$(2S-1)(2S-1) = 0$$

$$S = \frac{1}{2} \quad S = \frac{1}{2} \quad 1$$

$$a = 4 \quad b = -4 \quad c = 1 \quad \alpha = \frac{1}{2} \quad \beta = \frac{1}{2}$$

$$\alpha + \beta = \frac{-b}{a}$$

$$LHS = \alpha + \beta = \frac{1}{2} + \frac{1}{2} = 1, \quad RHS = \frac{-b}{a} = \frac{-(-4)}{4} = 1, \quad \text{hence proved} \quad 1$$

$$\alpha \beta = \frac{c}{a}$$

$$LHS = \alpha \beta = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}, \quad RHS = \frac{c}{a} = \frac{1}{4}, \quad \text{hence proved} \quad 1$$

28) Let cost of one bat be Rs x

Let cost of one ball be Rs y 1/2

ATQ

$$4x + 1y = 2050 \quad \text{_____ (1)}$$

$$3x + 2y = 1600 \quad \text{_____ (2)} \quad 1/2$$

from (1) $4x + 1y = 2050$

$$y = 2050 - 4x \quad 1/2$$

Substitute value of y in (2)

$$3x + 2(2050 - 4x) = 1600$$

$$3x + 4100 - 8x = 1600$$

$$-5x = -2500$$

$$x = 500$$

1/2

Substitute value of x in (1)

$$4x + 1y = 2050$$

$$4(500) + y = 2050$$

$$2000 + y = 2050$$

$$y = 50$$

1/2

Hence

Cost of one bat = Rs. 500
 Cost of one ball = Rs. 50

1/2

OR

Let the fixed charge for first 3 days = Rs. x
 And additional charge after 3 days = Rs. y

1/2

ATQ

$$x + 4y = 27 \text{-----(1)}$$

$$x + 2y = 21 \text{-----(2)}$$

1/2

Subtract eqⁿ (2) from (1)

$$2y = 6$$

$$y = 3$$

1

Substitute value of y in (2)

$$x + 2(3) = 21$$

$$x = 21 - 6$$

$$x = 15$$

1

Fixed charge = Rs. 15

Additional charge per day = Rs. 3

29) Given circle touching sides of ABCD at P, Q, R and S

To prove- $AB + CD = AD + BC$

Proof-

$$AP = AS \text{-----(1) tangents from an external point}$$

$$PB = BQ \text{-----(2) to a circle are equal in length}$$

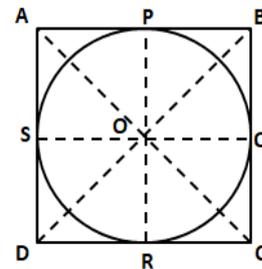
$$DR = DS \text{-----(3)}$$

$$CR = CQ \text{-----(4)}$$

Adding eqⁿ (1),(2),(3) & (4)

$$AP + BP + DR + CR = AS + DS + BQ + CQ$$

$$AB + DC = AD + BC$$



1

1

1

30) $(\operatorname{cosec} \theta - \cot \theta)^2 = \frac{1 - \cos \theta}{1 + \cos \theta}$

$$\text{LHS} = (\operatorname{cosec} \theta - \cot \theta)^2$$

$$= \left(\frac{1}{\sin \theta} - \frac{\cos \theta}{\sin \theta} \right)^2$$

1/2

$$= \left(\frac{1 - \cos \theta}{\sin \theta} \right)^2$$

1/2

$$= \frac{(1 - \cos \theta)^2}{\sin^2 \theta}$$

$$= \frac{(1-\cos\theta)^2}{1-\cos^2\theta} \quad 1$$

$$= \frac{(1-\cos\theta)^2}{(1-\cos\theta)(1+\cos\theta)}$$

$$= \frac{1-\cos\theta}{1+\cos\theta} = \text{RHS} \quad 1$$

LHS = RHS, Hence Proved

OR

$$\sec A (1 - \sin A)(\sec A + \tan A) = 1$$

$$\text{LHS} = \frac{1}{\cos A} (1 - \sin A) \left(\frac{1}{\cos A} + \frac{\sin A}{\cos A} \right) \quad 1$$

$$= \frac{(1-\sin A)(1+\sin A)}{\cos A \cos A}$$

$$= \frac{(1-\sin A)(1+\sin A)}{\cos^2 A}$$

$$= \frac{1-\sin^2 A}{\cos^2 A} \quad (1-\sin^2 A = \cos^2 A) \quad 1$$

$$= \frac{\cos^2 A}{\cos^2 A}$$

$$= 1 = \text{RHS} \quad 1$$

LHS=RHS. Hence Proved

31) (i) Red balls = 6, Black balls = 4, White balls = x

$$P(\text{white ball}) = \frac{x}{10+x} = \frac{1}{3} \quad 1$$

$$\Rightarrow 3x = 10 + x \Rightarrow x = 5 \text{ white balls} \quad 1/2$$

(ii) Let y red balls be removed, black balls = 4, white balls = 5

$$P(\text{white balls}) = \frac{5}{(6-y)+4+5} = \frac{1}{2} \quad 1$$

$$\Rightarrow \frac{5}{15-y} = \frac{1}{2} \Rightarrow 10 = 15 - y \Rightarrow y = 5 \quad 1/2$$

So 5 balls should be removed.

Section D

32) Let the speed of train be x km/hr 1/2

distance = 360 km

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{Time} = \frac{360}{x} \quad 1/2$$

New speed = $(x + 5)$ km/hr

$$\text{Time} = \frac{D}{S}$$

$$x + 5 = \frac{360}{\left(\frac{360}{x} - 1\right)} \quad 1$$

$$(x + 5) \left(\frac{360}{x} - 1 \right) = 360$$

$$(x + 5)(360 - x) = 360x$$

$$-x^2 - 5x + 1800 = 0$$

$$x^2 + 5x - 1800 = 0 \quad 1$$

$$x^2 + 45x - 40x - 1800 = 0$$

$$x(x + 45) - 40(x + 45) = 0$$

$$(x + 45)(x - 40) = 0 \quad 1$$

$$x + 45 = 0 \quad , \quad x - 40 = 0$$

$$x = -45 \quad , \quad x = 40$$

Speed cannot be negative

Speed of train = 40 km/hr 1

OR

Let the speed of the stream = x km/hr 1/2

Speed of boat = 18 km/hr

Upstream speed = $(18 - x)$ km/hr

Downstream speed = $(18 + x)$ km/hr 1/2

Time taken (upstream) = $\frac{24}{(18-x)}$

Time taken (downstream) = $\frac{24}{(18+x)}$

ATQ

$$\frac{24}{(18-x)} = \frac{24}{(18+x)} + 1 \quad 1$$

$$\frac{24}{(18-x)} - \frac{24}{(18+x)} = 1$$

$$24(18 + x) - 24(18 - x) = (18 - x)(18 + x)$$

$$24(18 + x - 18 + x) = (18)^2 - x^2$$

$$24(2x) = 324 - x^2$$

$$48x - 324 + x^2 = 0$$

$$x^2 + 48x - 324 = 0 \quad 1$$

$$x^2 - 6x + 54x - 324 = 0$$

$$x(x - 6) + 54(x - 6) = 0$$

$$(x - 6)(x + 54) = 0 \quad 1$$

$$x - 6 = 0 \quad , \quad x + 54 = 0$$

$$x = 6 \quad , \quad x = -54$$

Speed cannot be negative 1

Speed of stream = 6 km/hr

33) Given $\triangle ABC$, $DE \parallel BC$

To prove $\frac{AD}{DB} = \frac{AE}{EC}$

Construction: join BE and CD 1/2

Draw $DM \perp AC$ and $EN \perp AB$

Proof: Area of $\triangle ADE = \frac{1}{2} \times b \times h$

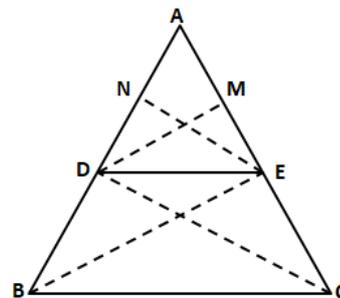
$$= \frac{1}{2} \times AD \times EN \text{-----(1)}$$

$$\text{Area } (\triangle DBE) = \frac{1}{2} \times DB \times EN \text{-----(2)}$$

Divide eqⁿ (1) by (2)

$$\frac{\text{ar } \triangle ADE}{\text{ar } \triangle DBE} = \frac{\frac{1}{2} \times AD \times EN}{\frac{1}{2} \times DB \times EN} = \frac{AD}{DB} \text{-----(3)}$$

$$\text{area } \triangle ADE = \frac{1}{2} \times AE \times DM \text{-----(4)}$$



1

$$\text{area } \triangle DEC = \frac{1}{2} \times EC \times DM \text{ -----(5)}$$

Divide eqⁿ (4) by (5)

$$\frac{\text{ar } \triangle ADE}{\text{ar } \triangle DEC} = \frac{\frac{1}{2} \times AE \times DM}{\frac{1}{2} \times EC \times DM} = \frac{AE}{EC} \text{ -----(6)}$$

$\triangle BDE$ and $\triangle DEC$ are on the same base DE and between same parallel lines BC and DE

$$\therefore \text{area } (\triangle DBE) = \text{ar } (DEC)$$

hence

$$\frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle DBE)} = \frac{\text{ar}(\triangle ADE)}{\text{ar}(\triangle DEC)} \quad [\text{LHS of (3) = RHS of (6)}]$$

$$\frac{AD}{DB} = \frac{AE}{EC} \quad [\text{RHS of (3) = RHS of (6)}]$$

Since $\frac{PS}{SQ} = \frac{PT}{TR} \therefore ST \parallel QR$ (by converse of BPT)

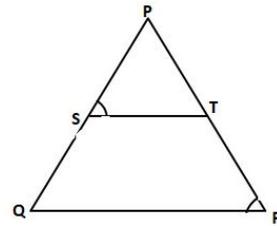
$\angle PST = \angle PQR$ (Corresponding angles)

But $\angle PST = \angle PRQ$ (given)

$$\angle PQR = \angle PRQ$$

$PR = PQ$ (sides opposite to equal angles are equal

Hence $\triangle PQR$ is isosceles.



34) Diameter of cylinder and hemisphere = 5mm radius, $(r) = \frac{5}{2}$

Total length = 14mm

Height of cylinder = 14 - 5 = 9mm

CSA of cylinder = $2\pi rh$

$$= 2 \times \frac{22}{7} \times \frac{5}{2} \times 9$$

$$= \frac{990}{7} \text{ mm}^2$$

CSA of hemispheres = $2\pi r^2$

$$= 2 \times \frac{22}{7} \times \left(\frac{5}{2}\right)^2$$

$$= \frac{275}{7} \text{ mm}^2$$

CSA of 2 hemispheres = $2 \times \frac{275}{7}$

$$= \frac{550}{7} \text{ mm}^2$$

Total area of capsule = $\frac{990}{7} + \frac{550}{7}$

$$= \frac{1540}{7}$$

$$= 220 \text{ mm}^2$$

OR

Diameter of cylinder = 2.8 cm

$$\text{radius of cylinder} = \frac{2.8}{2} = 1.4 \text{ cm}$$

radius of cylinder = radius of hemisphere = 1.4 cm

Height of cylinder = 5-2.8

$$= 2.2 \text{ cm}$$

Volume of 1 Gulab jamun = vol. of cylinder + 2 x vol. of hemisphere

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

$$\frac{22}{7} \times (1.4)^2 \times 2.2 + 2 \times \frac{2}{3} \times \frac{22}{7} \times (1.4)^3$$

$$= 13.55 + 11.50$$

$$= 25.05 \text{ cm}^3$$

volume of 45 Gulab jamun = 45 x 25.05

syrup in 45 Gulab jamun = 30% x 45 x 25.05

$$= \frac{30}{100} \times 45 \times 25.05$$

$$= 338.175 \text{ cm}^3$$

$$\approx 338 \text{ cm}^3$$

1

1

1

1

35)

Life time (in hours)	Number of lamps(f)	Mid x	d	fd
1500-2000	14	1750	-1500	-21000
2000-2500	56	2250	-1000	-56000
2500-3000	60	2750	-500	-30000
3000-3500	86	3250	0	0
3500-4000	74	3750	500	37000
4000-4500	62	4250	1000	62000
4500-5000	48	4750	1500	72000
	400			64000

2

$$\text{Mean} = a + \frac{\sum fd}{\sum f}$$

1/2

$$a = 3250$$

1/2

$$\text{Mean} = 3250 + \frac{64000}{400}$$

1

$$= 3250 + 160$$

$$= 3410$$

Average life of lamp is 3410 hr

1

Section E

36) $a_6 = 16000$ $a_9 = 22600$

$$a + 5d = 16000 \text{-----(1)}$$

$$a + 8d = 22600 \text{-----(2)}$$

substitute $a = 1600 - 5d$ from (1)

$$16000 - 5d + 8d = 22600$$

$$3d = 22600 - 16000$$

$$3d = 6600$$

$$d = \frac{6600}{3} = 2200$$

$$a = 16000 - 5(2200)$$

$$a = 16000 - 11000$$

$$a = 5000$$

(i) $a_n = 29200$, $a = 5000$, $d = 2200$

$$a_n = a + (n-1)d$$

$$29200 = 5000 + (n-1)2200$$

$$29200 - 5000 = 2200n - 2200$$

$$24200 + 2200 = 2200n$$

$$26400 = 2200n$$

$$n = \frac{264}{22}$$

$$n = 12$$

in 12th year the production was Rs 29200

(ii) $n = 8$, $a = 5000$, $d = 2200$

$$a_n = a + (n-1)d$$

$$= 5000 + (8-1)2200$$

$$= 5000 + 7 \times 2200$$

$$= 5000 + 15400$$

$$= 20400$$

The production during 8th year is = 20400

OR

$$n = 3, \quad a = 5000, \quad d = 2200$$

$$s_n = \frac{n}{2} [2a + (n-1)d]$$

$$= \frac{3}{2} [2(5000) + (3-1)2200]$$

$$S_3 = \frac{3}{2} (10000 + 2 \times 2200)$$

1/2

1/2

1/2

1/2

1/2

1/2

1/2

1/2

$$= \frac{3}{2} (10000 + 4400) \quad 1/2$$

$$= 3 \times 7200$$

$$= 21600 \quad 1/2$$

The production during first 3 year is 21600

$$(iii) a_4 = a + 3d$$

$$= 5000 + 3 (2200)$$

$$= 5000 + 6600$$

$$= 11600 \quad 1/2$$

$$a_7 = a + 6d$$

$$= 5000 + 6 \times 2200$$

$$= 5000 + 13200$$

$$= 18200$$

$$a_7 - a_4 = 18200 - 11600 = 6600 \quad 1/2$$

37) coordinates of A (2, 3) Alia's house

coordinates of B (2, 1) Shagun's house

coordinates of C (4,1) Library

$$(i) AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \quad 1/2$$

$$= \sqrt{(2 - 2)^2 + (1 - 3)^2}$$

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

$$AB = \sqrt{0 + 4} = \sqrt{4} = 2 \text{ units} \quad 1/2$$

Alia's house from shagun's house is 2 units

(ii) C(4,1), B(2,1)

$$CB = \sqrt{(2 - 4)^2 + (1 - 1)^2} \quad 1/2$$

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

$$= \sqrt{4 + 0} = \sqrt{4} = 2 \text{ unit} \quad 1/2$$

(iii) O(0,0), B(2,1)

$$OB = \sqrt{(2 - 0)^2 + (1 - 0)^2} \quad 1$$

$$= \sqrt{2^2 + 1^2} = \sqrt{4 + 1} = \sqrt{5} \text{ units}$$

Distance between Alia's house and Shagun's house, AB = 2 units

Distance between Library and Shagun's house, CB = 2 units 1/2

OB is greater than AB and CB, 1/2

For shagun, school [O] is farther than Alia's house [A] and Library [C]

OR

C (4, 1), A(2, 3)

$$CA = \sqrt{(2 - 4)^2 + (3 - 1)^2}$$

$$= \sqrt{(-2)^2 + 2^2} = \sqrt{4 + 4} = \sqrt{8}$$

$$= 2\sqrt{2} \text{ units} \quad AC^2 = 8$$

Distance between Alia's house and Shagun's house, $AB = 2$ units

Distance between Library and Shagun's house, $CB = 2$ units

$$AB^2 + BC^2 = 2^2 + 2^2 = 4 + 4 = 8 = AC^2$$

Therefore A, B and C form an isosceles right triangle.

1

1/2

1/2

38)

(i) $XY \parallel PQ$ and AP is transversal.

$\angle APD = \angle PAX$ (alternative interior angles)

$$\angle APD = 30^\circ$$

(ii) $\angle YAQ = 30^\circ$

$$\angle AQD = 30^\circ$$

Because $XY \parallel PQ$ and AQ is a transversal
so alternate interior angles are equal

$$\angle YAQ = \angle AQD$$

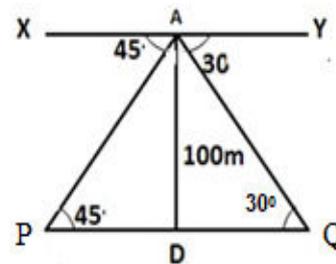
(iii) In $\triangle ADP$

$$\tan 45^\circ = \frac{100}{PD}$$

$$1 = \frac{100}{PD}$$

$$PD = 100 \text{ m}$$

Boat P is 100 m from the light house



1/2

1/2

1/2

1/2

1/2

1/2

1

OR

In $\triangle ADQ$

$$\tan 30^\circ = \frac{100}{DQ}$$

$$\frac{1}{\sqrt{3}} = \frac{100}{DQ}$$

$$DQ = 100\sqrt{3} \text{ m}$$

Boat Q is $100\sqrt{3}$ m from the light house

1/2

1/2

1