



NSEJS (IJSO Stage-1) | 18.11.2018 | Paper Code: JS511



Ques.	Ans.	Ques.	Ans.
1	b	41	c
2	a	42	d
3	d	43	d
4	c	44	c,d
5	a	45	a
6	c	46	c,d
7	b	47	Bonus
8	b	48	b
9	c	49	b
10	a	50	b
11	b	51	a
12	b	52	c
13	b	53	c
14	a	54	a
15	c	55	b
16	b*	56	b
17	b	57	Bonus
18	b	58	a
19	b	59	d
20	c	60	d
21	d	61	a
22	b	62	b
23	c	63	b
24	a	64	a
25	c	65	d
26	d	66	d
27	c	67	c
28	d	68	d
29	b	69	c
30	b	70	a or d
31	a	71	b
32	a	72	a
33	a	73	c
34	a	74	c
35	a	75	a
36	c	76	a or b
37	d	77	d
38	a	78	b
39	c	79	a
40	c	80	a

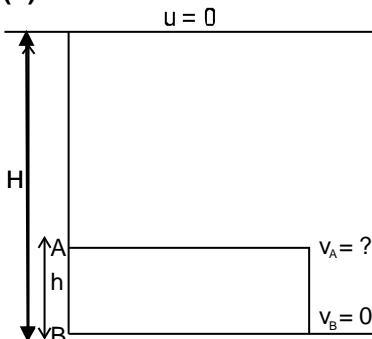
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HINTS & SOLUTIONS

1. (b)



Velocity at point A

$$V_A^2 = u^2 + 2as$$

Here $u = 0$

$$a = g$$

$$S = (H-h)$$

$$V_A^2 = 0 + 2g(H-h)$$

$$V_A = \sqrt{2g(H-h)}$$

Now for point A and point B

$$V_B^2 = V_A^2 = 2ah$$

$$0 = (\sqrt{2g(H-h)})^2 + 2ah \quad \text{Here } (V_B = 0 \text{ & } V_A = \sqrt{2g(H-h)})$$

$$2ah = 2g(H-h)$$

$$\text{So } a = g \left(\frac{H-h}{h} \right)$$

$$a = g \left(\frac{H}{h} - 1 \right)$$

2. (a)

Given $\lambda_1 - \lambda_2 = 2 \text{ m} \dots \dots \dots \text{(i)}$

$$\text{And } \frac{n_2}{n_1} = 1.4$$

$$n_1 = \frac{1000}{20} = 50 \text{ Hz.}$$

$$\text{So } n_2 = 1.4 \times 50 = 70 \text{ Hz}$$

Now from equation (i)

$$\lambda_1 - \lambda_2 = 2$$

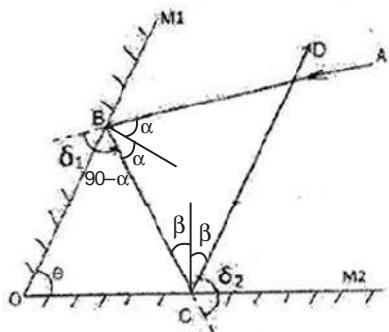
$$\frac{v}{n_1} - \frac{v}{n_2} = 2$$

$$\frac{v}{50} - \frac{v}{70} = 2$$

$$v \left[\frac{20}{3500} \right] = 2$$

$$v = 350 \text{ m/s}$$

3. (d)



Deviation through M_1

$$\delta_1 = 180 - 2\alpha \dots \dots \dots \text{(i)}$$

Deviation through M_2

$$\delta_2 = 180 - 2\beta \dots \dots \dots \text{(ii)}$$

so total deviation

$$\delta = \delta_1 + \delta_2 = 360 - 2(\alpha + \beta) \dots \dots \dots \text{(iii)}$$

Now from $\triangle BOC$

$$\theta + 90 - \alpha + 90 - \beta = 180$$

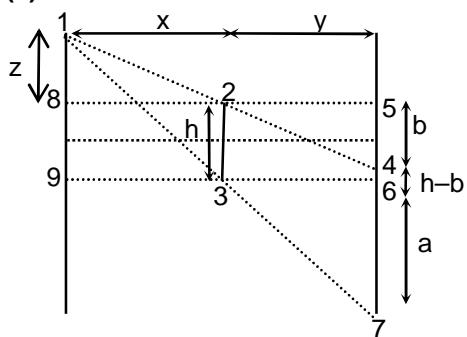
$$\theta = \alpha + \beta \dots \dots \dots \text{(iv)}$$

From equation (iii) and (iv)

$$\delta = 360 - 2\theta$$

4.

(c)



From $\Delta 182$ & $\Delta 254$

$$\frac{x}{y} = \frac{z}{b} \dots \dots \text{(1)}$$

From $\Delta 193$ & $\Delta 367$

$$\frac{x}{y} = \frac{z+h}{a} \dots \dots \text{(2)}$$

$$\text{From Equ. (1) \& (2)} b = \frac{zy}{x}, a = \frac{(z+h)y}{x}$$

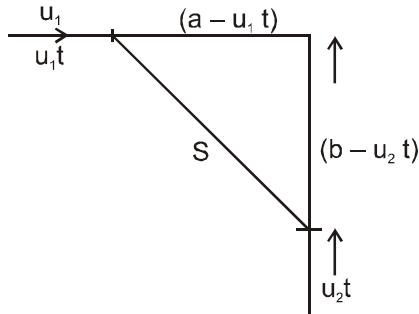
$$\begin{aligned}
 \text{Height of image} &= a + h - b \\
 &= h + \frac{(z+h)y}{x} - \frac{zy}{x} = h + \left[\frac{y}{x}(z+h-z) \right] \\
 &= h + \frac{yh}{x} = h \left[1 + \frac{y}{x} \right]
 \end{aligned}$$

Since h , y & x are constant so height of image will always be same.

5.

(a)

Let instant is t then distance travel by particle P_1 is $u_1 t$ and distance travel by particle P_2 is $u_2 t$



So, relative separation

$$\begin{aligned}
 S &= \sqrt{(a - u_1 t)^2 + (b - u_2 t)^2} \\
 S &= \sqrt{a^2 + u_1^2 t^2 - 2a u_1 t + b^2 + u_2^2 t^2 - 2b u_2 t} \\
 S &= \left(a^2 + b^2 + (u_1^2 + u_2^2) t^2 - 2(a u_1 + b u_2) t \right)^{\frac{1}{2}}
 \end{aligned}$$

So option (a) is correct

6.

(c)

Let x kg mass of fuel burn per hour there for $\frac{x}{3600}$ kg/sec.

Now efficiency = $\frac{\text{output}}{\text{input}}$

$$0.25 = \frac{25 \times 10^3 \text{ W}}{\frac{x}{3600} \times 17200 \times 10^3 \times 4.2}$$

$x \approx 5$ kg per hour

Now electric energy generated per tonne of fuel burnt

$$= \frac{17200 \times 10^6 \times 0.25 \times 4.2}{3.6 \times 10^6} = 5000 \text{ Kwh}$$

7.

(b)

$$m = \frac{f}{f - u}$$

For first case when object is at 25 cm

$$m = \frac{f}{f - (-25)} \quad \dots (1)$$

Now for second case when object is at 40 cm

$$m' = \frac{f}{f - (-40)} \quad \dots (2)$$

$$m = 4m'$$

$$4m' = \frac{f}{f - (-25)} \quad \dots (3)$$

(3) \div (2)

$$4 = \frac{f}{f + 25} \times \frac{f + 40}{f}$$

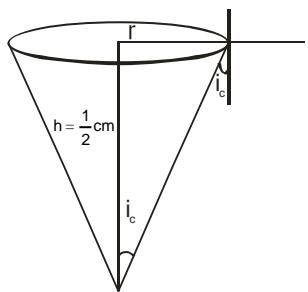
$$4f + 100 = f + 40$$

$$3f = 60$$

$$f = 20 \text{ cm}$$

8. (b)

We know for TIR $\sin i_c = \frac{1}{\mu}$



$$\text{From figure TIR } \sin i_c = \frac{r}{\sqrt{r^2 + h^2}}$$

$$\text{So } \frac{r}{\sqrt{r^2 + h^2}} = \frac{1}{\mu}$$

$$r^2 \mu^2 = r^2 + h^2$$

$$r^2 (\mu^2 - 1) = h^2$$

$$r = \frac{h}{\sqrt{\mu^2 - 1}} = \frac{\frac{1}{2}}{\sqrt{(1.5)^2 - 1}} = 0.447 \text{ cm}$$

9. (c)

$$\alpha = \frac{L' - L}{L(T' - T)}$$

So unit of α is K^{-1} So option (C) is correct

10. (a)

Since time period is 2 sec

So time taken in 60 oscillation is 2 min

Now soldier complete 110 beats in 2 min. therefore 55 beats per min which is less than 60 so it is bradycardia

$$\text{Now } T = 2\pi \sqrt{\frac{\ell}{g}}$$

$$2 = 2\pi \sqrt{\frac{\ell}{g}}$$

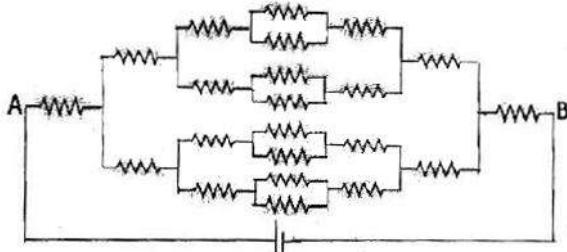
$$4 = 4\pi^2 \frac{\ell}{g}$$

$$\ell = 1 \text{ m}$$

That means length is 1 m and symptom is brady-cardia

So option (a) incorrect

11. (b)



R_{eq} between A and B

$$= \frac{29R}{8}$$

So minimum value of R, for integral value for equivalent resistance between A and B must be 8Ω

12. (b)

In water

$$\frac{\rho_0}{\rho_w} = \frac{V_i}{V} \Rightarrow \frac{\rho_0}{1} = \frac{5/8V}{V} \Rightarrow \rho_0 = \frac{5}{8}$$

For salt solution .

$$\frac{5/8}{1.12} = \frac{V_i}{V}$$

$$\text{so } \frac{V_o}{V} = 1 - \frac{V_i}{V}$$

$$\frac{V_o}{V} = 1 - \frac{5/8}{1.12} = 0.44$$

13. (b)

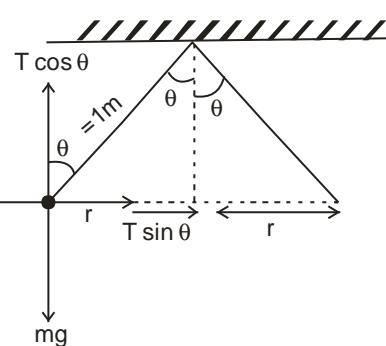
$$F = kg \frac{M}{sec^2}$$

$$\text{Unit of mass} = \frac{F sec^2}{m} = \frac{F}{V} sec$$

$$= \frac{10}{100} \times \frac{1}{100}$$

$$= 10^{-3} \text{ kg}$$

14. (a)



$$F = \frac{KQ^2}{4r^2}$$

$$T \sin \theta = \frac{KQ^2}{4r^2}$$

$$\text{and } T \cos \theta = mg$$

$$\tan \theta = \frac{KQ^2}{4r^2 mg}$$

$$\text{So } \tan \theta = \frac{KQ^2}{4 \sin^2 \theta gm} \quad \therefore \sin \theta = \frac{r}{1}$$

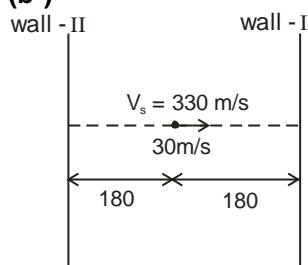
$$\tan \theta \sin^2 \theta = \frac{KQ^2}{4 gm} \quad r = \sin \theta$$

θ is maximum . so g is minimum

15. (c)

According to fraunhaffer good absorbers are good radiators and bad absorbers are bad radiators so black body is good absorber and good radiator.

16. (b*)



reflection from wall - I

$$360 - 30t_1 = 330 t_1$$

$$t_1 = 1 \text{ sec}$$

$$720 + 30 t_2 = 330 t_2$$

$$t_2 = 2.4 \text{ sec}$$

$$1080 - 30 t_3 = 330 t_3$$

$$t_3 = \frac{1080}{360} = 3 \text{ sec}$$

Answer May be (b)

reflection from wall - II

$$360 + 30 t_1 = 330 t_1$$

$$t_1 = 1.2 \text{ sec}$$

$$720 - 30 t_2 = 330 t_2$$

$$t_2 = 2 \text{ sec}$$

$$1080 + 30 t_3 = 330 t_3$$

$$t_3 = 3.6 \text{ sec}$$

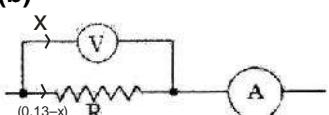
17. (b)

(i) Since potential at surface of solid and hollow sphere are $\frac{Kq}{r}$ so option I is incorrect .

(ii) A charged body can attract another uncharged body so it is correct.

(iii) Two electric line of force never intersect each other so this is incorrect.

18. (b)



Let current through V be 'x'

So current through R is $(0.13 - x)$

Now potential difference in parallel combination must be same.

So $117 = R (0.13 - x)$ (i)

And $V = IR$

$$117 = 9000 x$$

$$\text{so } x = \frac{117}{9000}$$

using this value in equation (i)

$$117 = R \left(0.13 - \frac{117}{9000} \right)$$

$$\text{or } R = 1000 \Omega$$

19. (b)

20. (c)

Because volume is minimum at 4°C so volume will increase at temperature greater than or less than 4°C .

21. (d)

Because number of protons are same in both, but number of electrons are more in p^{3-} , so there will be greater repulsion between electrons in p^{3-}

22. (b)

Given

Molarity = 0.5 molar

M = 0.5 M

Volume = 4 litre

Mass of substance (x) = 240 gm

$$\text{Molarity (M)} = \frac{\text{given Mass of substance}}{\text{Molecular mass of substance} \times \text{volume}}$$

$$M = \frac{x}{\text{MW} \times V}$$

$$0.5 = \frac{240}{\text{MW} \times 4}$$

$$\text{MW} = \frac{240}{0.5 \times 4}$$

$$= \frac{600}{5} = 120 \text{ gm/mole}$$

23. (c)

$$\text{Density (d)} = 1.28 \text{ g/cc} = \frac{m}{1\text{ml}} \quad m = 1.28 \times 10^3$$

$$M = 4.2 = \frac{w}{98 \times 1000} \times 1000$$

$$\text{H}_2\text{SO}_4 (w) = 4.2 \times 98 \text{ g of } 1000 \text{ cm}^3$$

$$\left(\frac{m}{wl} \right) \% = \frac{4.2 \times 98 \times 10}{1.28 \times 10^3} \times 100 = 32 \%$$

24. (a)

Element	% composition	Atomic mass	Relative no. od after	Simple atomic ratio	Simplets whole No. Atomic ratio
X	60	10	$\frac{60}{10} = 6$	$\frac{6}{2} = 3$	3
Y	40	20	$\frac{40}{20} = 2$	$\frac{2}{2} = 1$	1

Simplet formula of this compound = $\text{X}_3 \text{Y}$



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30. (b) Bobby added Na_3PO_4 which is basic in nature, remaining all salts are either neutral or acidic. So, Na_3PO_4 will increase the pH of soil which is suitable for growing the daffodil

31. (a) Because ionic compound has high melting point then co-valent compounds.

32. (a) When CO_2 is KOH then reaction is

$$2\text{KOH}_{(\text{aq})} + \text{H}_2\text{CO}_3 \rightarrow \text{K}_2\text{CO}_3 + 2\text{H}_2\text{O}$$
1 mole of H_2CO_3 is required for 2 mol of KOH
Given data
 \Rightarrow 1000 ml solution contain 0.1 mol KOH
1 ml solution contain $\frac{0.1}{1000}$
then 5 ml contain $= \frac{0.1}{1000} \times 5 = 5 \times 10^{-4}$ mol
If 2 mole KOH dissolve \rightarrow 1 mol H_2CO_3
then 1 mol KOH dissolve $\rightarrow \frac{1}{2}$ mol H_2CO_3
 5×10^{-4} mol KOH dissolve $\rightarrow \frac{1}{2} 5 \times 10^{-4}$ mol
 2×10^{-4} mol H_2CO_3
 $\text{C} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3$
1 mole C gives 1 mol CO_2 and 1 mol CO_2 gives 1 mol H_2CO_3
So requirement of C is $2.5 \times 10^{-4} \times 12 = 30 \times 10^{-4}$ g
In mg $= 30 \times 10^{-4} \times 10^3$ mg
 $= 3 \times 10^{-3} \times 10^3$
 $= 3$ mg

33. (a) Given both contain equal number molecule
So in (a) option

$$\text{mole of } \text{SO}_2 = \frac{1120}{22400} = \frac{1}{20} = 0.05 \text{ mole}$$

$$\text{Mole of } \text{NH}_3 = \frac{0.85}{17} = 0.05 \text{ mole}$$

Equal moles or equal volume of all gases at NTP contains equal number of molecules.

34. (a) $\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$
7g + 21 gm 8.6 g
Acc. to Law of conservation of mass. $28 - 8.6 = 19.40$ gm

35. (a) If solutions are same in nature
 $\text{N}_1\text{V}_1 + \text{N}_2\text{V}_2 = \text{N}_R\text{V}_R$
 $\text{V}_R = 2 \text{ Ltr} (\text{V}_1 + \text{V}_2 = 2 \text{ Ltr})$
If $\text{V}_1 = x$
 $\text{V}_2 = (2 - x)$
 $\Rightarrow 0.5 \times x + 0.1 (2 - x) = 2 \times 0.2$
 $\Rightarrow 0.5 x + 0.2 - 0.1 x = 0.4$
 $\Rightarrow 0.4 x = 0.2$
 $x = \frac{0.2}{0.4} = 0.5$
 $x = 0.5 = \text{V}_1 = 0.5 \text{ Ltr}$
 $\text{V}_2 = 2 - 0.5 = 1.5 \text{ Ltr}$

36.

(c)

Oxalic acid – 6.39 g

 $(\text{COOH})_2 \cdot 2\text{H}_2\text{O} \rightarrow$ gram molecular mass = 126 gm

$$\text{Mole of oxalic acid} = \frac{6.3}{126} = \frac{1}{20} = 0.05 \text{ mol}$$

In 100 ml water = 0.05 mol of oxalic acid present

Now In 25 ml of water, amount of oxalic acid

$$\text{will be} = \frac{0.05}{100} \times 25 = \frac{0.05}{4} \text{ mol}$$

250 ml solution contains = 0.0125 mol of oxalic acid

$$\text{then 10 ml contains} = \frac{0.0125}{250} \times 10 = \frac{0.0125}{25} = 0.0005 \text{ mol}$$

So, mole of NaOH will be required = 0.0005 × 2

Mass of NaOH = 0.001 × 40 = 0.04 gm

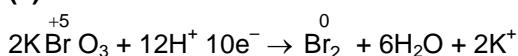
Weight of NaOH in ppm = 0.04 × 1000 = 40

37.

(d)

Iso-octane improve the quality of petrol because it has more branches.

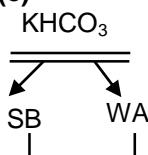
38.

(a)Total change in oxidation number of KBrO_3 = valency factor = 5

$$\text{Eq. Wt. of KBrO}_3 = \frac{\text{Molecular wt. of KBrO}_3}{\text{Valency factor}}$$

$$\text{Eq. Wt. KBrO}_3 = \frac{M}{5}$$

39.

(c)

For basic salt solution colour would be blue

Universal indicator colour for different pH range

pH	Type of solution	Colour
< 3	Strong acid	Red
3–6	Weak acid	Orange or yellow
7	Neutral	Green
8–11	Weak basic	Blue
> 11	Strong base	Violet of indigo

40.

(c)(a) Chalcocite = Cu_2S (c) Calamine = ZnCO_3

Option (c) is correct

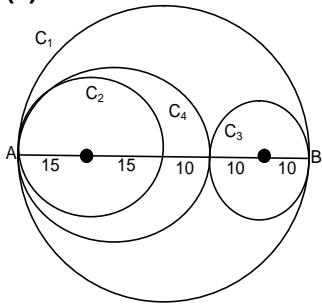
calamine is a ore of zinc

(b) Magnetite = Fe_3O_4 (d) Galena = PbS 

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41. (c)

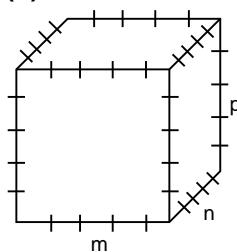


$$\text{Diameter of } C_4 = 15 + 15 + 10 = 40$$

Radius = 20 cm

42.

(d)



$$\frac{m(m+1)}{2} \times \frac{n(n+1)}{2} \times \frac{p(p+1)}{2}$$

$$\frac{5 \times 6}{2} \times \frac{5 \times 6}{2} \times \frac{5 \times 6}{2}$$

$$15 \times 15 \times 15$$

$$= 3375$$

43.

(d)

$$n^2(n^2 - 1)(n^2 - n - 2)$$

$$n^2(n^2 - 1)(n^2 - 2n + n - 2)$$

$$n^2(n^2 - 1)(n - 2)(n + 1)$$

$$n^2(n - 1)(n + 1)(n - 2)(n + 1)$$

$$(n - 2)(n - 1)n^2(n + 1)^2 \text{ (after factorization)}$$

$\Rightarrow (n - 2)(n - 1)(n)(n + 1)$ is the product of four consecutive numbers which is always divisible by $4! = 24$.

\Rightarrow Now in this product of $(n - 2)(n - 1)n^2(n + 1)^2$ there are two perfect squares of n and $n + 1$ in which one of them should be even so it should be a multiple of 2. and square of 2 is 4.

\Rightarrow So $(n - 2)(n - 1)(n)(n + 1)$ is divisible by 24 and $(n - 2)(n - 1)(n)^2(n + 1)^2$ should be divisible by 48.

44.

(c, d)

12 through

one number (3 times) 4 number (2 times) one number (1 time)

1, 2, 3, 4, 5, 6

each number constant at least one time

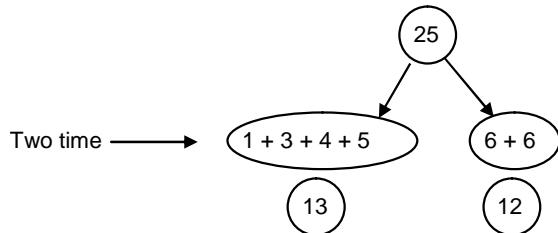
$$\frac{6 \times 7}{2} = 21$$

$$\text{Required sum} = 46 - 41 = 25$$



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6 – three times

1, 3, 4, 5 → two times

2 → one time

at least number is 2.

One more case is possible

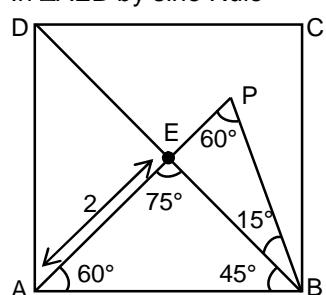
$$2 + 3 + 4 + 6 + 5 + 5 = 25$$

so at least number is 1.

45.

(a)

In $\triangle AEB$ by sine Rule



$$\frac{\sin 45}{AE} = \frac{\sin 75}{AB}$$

$$\frac{1}{\sqrt{2}} = \frac{\sqrt{3} + 1}{2AB}$$

$$AB = \sqrt{3} + 1$$

$$\text{Area of square } ABCD = AB^2 = (\sqrt{3} + 1)^2$$

$$= 3 + 1 + 2\sqrt{3} = 4 + 2\sqrt{3}.$$

46.

(c, d)

Let $n = 2^5$

$$\therefore 9 \times n = 2^5 \times 3^2$$

$$\text{Number of divisor} = (5 + 1)(2 + 1)$$

$$= 6 \times 3 = 18$$

Let $n = 75 = 3 \times 5^2$

$$\therefore 9 \times n = 3^3 \times 5^2$$

$$\text{Number of divisor} = (3 + 1)(2 + 1)$$

$$= 4 \times 3 = 12$$

47. **(Bonus)**

$$\begin{aligned}
 x &= \frac{2ab}{b^2 + 1} \\
 &= \frac{\sqrt{a+x} - \sqrt{a-x}}{\sqrt{a+x} + \sqrt{a-x}} \\
 &\Rightarrow \frac{(\sqrt{a+x})^2 + (\sqrt{a-x})^2 - 2\sqrt{(a+x)(a-x)}}{(a+x) - (a-x)} \\
 &\Rightarrow \frac{a+x + a-x - 2\sqrt{a^2 - x^2}}{2x} \\
 &\Rightarrow \frac{2a - 2\sqrt{a^2 - x^2}}{2x} \\
 &\Rightarrow \frac{a - \sqrt{a^2 - \left(\frac{2ab}{b^2 + 1}\right)^2}}{\frac{2ab}{b^2 + 1}} \\
 &\Rightarrow \left(a - \sqrt{a^2 - \frac{4a^2b^2}{b^2 + 1}}\right) \times \frac{b^2 + 1}{2ab} \\
 &\Rightarrow a \left[\frac{b^2 + 1 - \sqrt{(b^2 + 1)^2 - 4b^2}}{b^2 + 1} \right] \times \frac{b^2 + 1}{2ab} \\
 &\Rightarrow \frac{b^2 + 1 - \sqrt{b^4 + 1 + 2b^2 - 4b^2}}{2b} \\
 &\Rightarrow \frac{b^2 + 1 - \sqrt{(1-b^2)^2}}{2b} \Rightarrow \frac{b^2 + 1 - 1 + b^2}{2b} = b
 \end{aligned}$$

48. **(b)**

Let n_1 and n_2 are number of sides of polygon them

$$n_1 + \frac{n_2(n_2 - 3)}{2} = 103$$

$$2n_1 + n_2^2 - 3n_2 = 206 \quad \dots \dots \dots \text{(i)}$$

$$\frac{n_1(n_1 - 3)}{2} + n_2 = 80$$

$$n_1^2 - 3n_1 + 2n_2 = 160 \quad \dots \dots \dots \text{(ii)}$$

multiply equation (i) by (ii) by and equation (ii) by 3 and add.

$$4n_1 + 2n_2^2 - 6n_2 + 3n_1^2 - 9n_1 + 6n_2 = 412 + 480$$

$$2n_2^2 + 3n_1^2 - 5n_1 = 892 \quad \dots \dots \dots \text{(iii)}$$

and again multiply (i) by (iii) and equation (ii) by 2 and add.

$$2n_1^2 + 3n_2^2 - 5n_2 = 938 \quad \dots \dots \dots \text{(iv)}$$

subtract equation (iii) from (iv)

$$-n_1^2 + n_2^2 - 5n_2 + 5n_1 = 46$$

$$(n_2^2 - n_1^2) - 5(n_2 - n_1) = 46$$

$$(n_2 - n_1)(n_2 + n_1 - 5) = 46$$

Factors of 46 are

$$1 \times 46$$

$$2 \times 23$$

$$23 \times 2$$

$$46 \times 1$$



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In case – 1

$$(n_2 - n_1) \text{ and } n_2 + n_1 - 5 = 46 \Rightarrow n_2 + n_1 = 5$$

After solving

$$n_2 = 26 \text{ and } n_1 = 25$$

But given condition of diagonals are not satisfy.

In case – 2

$$n_2 - n_1 = 2$$

$$n_1 + n_2 - 5 = 23 \Rightarrow n_1 + n_2 = 28$$

After solving

$$n_1 = 13, n_2 = 15$$

In case - 3

$$n_2 - n_1 = 23$$

$$n_1 + n_2 - 5 = 2, n_1 + n_2 = 7$$

$$n_2 = 15 \text{ and } n_1 = -8$$

not possible.

In case - 4

$$n_2 - n_1 = 46 \text{ and } n_1 + n_2 - 5 = 1$$

$$\Rightarrow n_1 + n_2 = 6.$$

$$n_1 = -20, n_2 = 26.$$

not possible

Hence answer is 28.

49. (b)

Let number of Red & Yellow balls are respectively.

ATQ

$$r - 1 = \frac{1}{7} (r - 1 + y) \Rightarrow 7r - 7 = r - 1 + y$$

$$6r - y = 6 \dots(1)$$

$$r = \frac{1}{6} (r + y - 1)$$

$$\Rightarrow 6r = r + y - 1$$

$$5r - y = -1 \dots(2)$$

$$(1) - (2)$$

$$6r - y = 6$$

$$5r - y = -1$$

$$\underline{- + +}$$

$$r = 7$$

$$\therefore y = 36$$

$$\text{Number of balls} = r + y = 7 + 36 = 43$$

$$\text{Sum of digit} = 4 + 3 = 7$$

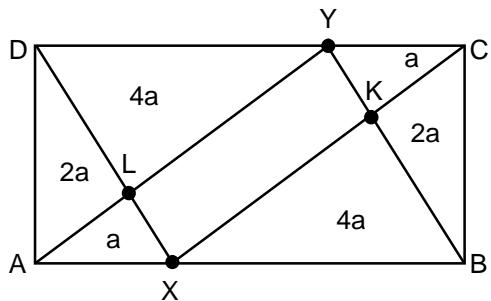


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50.

(b)


 $\triangle KYC \sim \triangle KBX$

$$\frac{KY}{KB} = \frac{KC}{KX} = \frac{YC}{XB} = \frac{1}{2}$$

 $\text{Let ar } \triangle KYC = a$

$$\frac{\text{ar } \triangle KYC}{\text{ar } \triangle KCB} = \frac{KY}{KB} = \frac{1}{2}$$

$$\frac{a}{\text{ar } \triangle KCB} = \frac{1}{2}$$

 $\text{ar } \triangle KCB = 2a$

$$\frac{\text{ar } \triangle KCB}{\text{ar } \triangle KBX} = \frac{CK}{KX} = \frac{1}{2}$$

$$\frac{2a}{\text{ar } \triangle KBX} = \frac{1}{2}$$

 $\text{ar } \triangle KBX = 4a$

$$\frac{\text{ar } \triangle XBC}{\text{ar } \triangle ABC} = \frac{BX}{AB} = \frac{2}{3}$$

$$\frac{6a}{\text{ar } \triangle ABC} = \frac{2}{3}$$

 $\Rightarrow \text{ar } \triangle ABC = 9a.$
 $\text{ar Rect } ABCD = 2 \text{ar } \triangle ABC = 2(9a) = 18a$

$$\text{ar } XKYL = \text{ar } ABCD - [a + 4a + 2a + a + 4a + 2a]$$

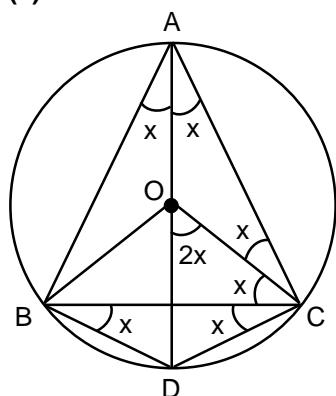
$$= 18a - [14a] = 4a$$

$$\frac{\text{ar } XKYL}{\text{ar } ABCD} = \frac{4a}{18a} = \frac{2}{9} = \frac{m}{n}$$

$$\therefore m + n = 2 + 9 = 11.$$

51.

(a)


 $\angle BAD = \angle DAC = x$ (AD is angle bisector)

$\angle BCD = \angle BAD = x$
 $\angle BAC = \angle ACB = 2x$ (equilateral triangle)
 $\angle DOC = 2 \times \angle DAC = 2x$
 In $\triangle DOC$ $\Rightarrow OD = DC$
 In $\triangle BDC$ $\Rightarrow BD = DC$

and $BD + DC = 4$
 $BD = DC = 2$
 $OD = DC = 2$

Diameter = $2 \times 2 = 4$ m.

52. (c)

$$T_m = \frac{1}{n}, T_n = \frac{1}{m}$$

$$T_{mn} = A + (mn - 1)D \quad . \quad \frac{1}{n} = A + (m - 1)D \quad \dots \dots (1)$$

$$\frac{1}{m} = A + (n - 1)D \quad \dots \dots (2)$$

equ. (1) - equ. (2)

$$\frac{1}{n} - \frac{1}{m} = (m - 1)D - (n - 1)D$$

$$\frac{m - n}{nm} \Rightarrow D(m - 1 - n + 1)$$

$$\frac{m - n}{nm} \Rightarrow D(m - n)$$

$$D = \frac{1}{nm}$$

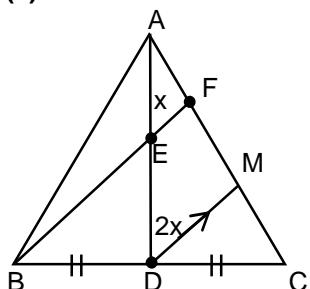
from equ. (1)

$$\frac{1}{n} = A + (m - 1) \times \frac{1}{nm}$$

$$A = \frac{1}{nm}$$

$$T_{nm} = \frac{1}{nm} + (mn - 1)1 - \frac{1}{nm} = 1$$

53. (c)



Construction draw $DM \parallel BF$

In $\triangle BCF$, D is mid point of BC & $DM \parallel BF$

$$FM = MC \Rightarrow \frac{FM}{MC} = \frac{1}{1}$$

In $\triangle ADM$

$$EF \parallel DM, \frac{AE}{ED} = \frac{1}{2}$$

therefore $\frac{AF}{FM} = \frac{1}{2}$

therefore $AF : FM : MC \Rightarrow 1 : 2 : 2$

$$\frac{AF}{FC} = \frac{1}{4}$$

54. (a)

$$px^2 + qx + r = 0$$

$$\sin^2\theta + \cos^2\theta = -\frac{q}{p}$$

$$\sin\theta \cos\theta = \frac{r}{p}$$

$$\sin^2\theta + \cos^2\theta + 2 \sin\theta \cos\theta = \frac{q^2}{p^2}$$

$$1 + 2 \frac{r}{p} = \frac{q^2}{p^2}$$

$$\frac{p+2r}{P} = \frac{q^2}{p^2}$$

$$p(p+2r) = q^2$$

$$p^2 + 2pr = q^2$$

$$p^2 - q^2 + 2pr = 0$$

55. (b)

$a(n-2), a(n), a(n+3)$ are in AP

$$\frac{(n-2-2) \times 180}{n-2}, \quad \frac{(n-2) \times 180}{n}, \quad \frac{(n+3-2) \times 180}{n+3}$$

$$\frac{(n-4) \times 180}{n-2}, \quad \frac{(n-2) \times 180}{n}, \quad \frac{(n+1) \times 180}{n+3}$$

from the property of A.P.

$$\frac{(n-4) \times 180}{n-2} + \frac{(n+1) \times 180}{n+3} = \frac{(n-2) \times 180}{n}$$

$$\frac{(n-4) \times 180}{n-2} + \frac{(n+1) \times 180}{n+3} = \frac{2(n-2) \times 180}{n}$$

$$180 \left(\frac{n-4}{n-2} + \frac{n+1}{n+3} \right) = 180 \frac{(n-2) \times 2}{n}$$

$$\frac{(n-4)(n+3) + (n+1)(n-2)}{(n-2)(n+3)} = \frac{2n-4}{n}$$

$$\frac{n^2 + 3n - 4n - 12 + n^2 - 2n + n - 2}{n^2 + 3n - 2n - 6} = \frac{2n-4}{n}$$

$$\frac{2n^2 - 2n - 14}{n^2 + n - 6} = \frac{2n-4}{n}$$

$$2n^3 - 2n^2 - 14n = (2n-4)(n^2 + n - 6)$$

$$2n^3 - 2n^2 - 14n = 2n^3 + 2n^2 - 12n - 4n^2 - 4n + 24$$

$$2n = 24$$

$$n = 12$$

$$\text{Sum of the digits} = 1 + 2 = 3$$



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56.

(b)

Let numbers are

$$\frac{a}{d^2}, \frac{a}{d}, a, ad, ad^2$$

So, A.T.Q.

$$\frac{a}{d^2} + \frac{a}{d} + a + ad + ad^2 = 24$$

$$a \left\{ \frac{1+d+d^2+d^3+d^4}{d^2} \right\} = 24 \quad \text{and} \quad \frac{1+d+d^2+d^3+d^4}{d^2} = \frac{24}{a} \quad \dots \dots \dots \text{(i)}$$

$$\frac{d^2}{a} + \frac{d}{a} + \frac{1}{a} + \frac{1}{ad} + \frac{1}{ad^2} = 6$$

$$\frac{1+d+d^2+d^3+d^4}{ad^2} = 6$$

From equation (i)

$$\frac{24}{a \times a} = 6$$

$$a^2 = 4$$

$$a = \pm 2$$

$$\text{Product of the terms} = \frac{a}{d^2} \times \frac{a}{d} \times a \times ad \times ad^2 = a^5 = (\pm 2)^5 = \pm 32.$$

Answer is 32.

57.

(Bonus)

491 × 25b is divisible by 36 means divisible by 4 and 9.

⇒ 491 not a divisible by 4 in any case of a.

Hence 25b should be divisible by 4.

So possible values of b are 2 & 6.

Case-1 If b = 2, 252 is also divisible by 9.

Hence 252 is divisible by 36.

So possible value of a is 10 (from 0 to 9)

ordered pairs = 10

Case-2 If b = 6, 252 is not divisible by 9.

So 4a1 ⇒ divisible by 9.

Possible value of a is only 4.

Ordered pairs = 1.

Total ordered pairs of (a, b) are = 10 + 1 = 11

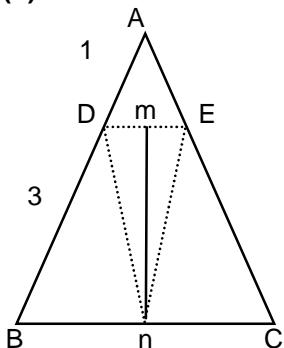
58.

(a)

$$\begin{aligned} & \sqrt{\underbrace{111\dots1}_{2018} - \underbrace{222\dots2}_{1009}} \\ &= \sqrt{\frac{1}{9} \times \underbrace{9999\dots9}_{2018} - \frac{2}{9} \times \underbrace{9999\dots9}_{1009}} \\ &= \sqrt{\frac{10^{2018} - 1}{9} - \frac{2}{9}(10^{1009} - 1)} \\ &= \sqrt{\frac{10^{2018} - 2 \times 10^{1009} + 1}{9}} \end{aligned}$$

$$= \sqrt{\left(\frac{10^{1009} - 1}{3}\right)^2} = \frac{10^{1009} - 1}{3}$$

59. (d)



$$\triangle ADE \sim \triangle ABC$$

$$\text{Hence } \frac{\text{Area}(ADE)}{\text{Area}(ABC)} = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$$

Let area of $\triangle ABC = 16x$, then area of $\triangle ADE = x$

Area of $BCFE = 16x - x = 15x$

Now in trapezium $BCFE$

Area ($\triangle DMN$) = Area ($\triangle MEN$)

& Area ($\triangle BDN$) = Area ($\triangle ENC$) $\quad \{ \because M \text{ & } N \text{ are mid points of } DE \text{ & } BC \text{ respectively} \}$

$$\text{Hence Area } (\triangle BDN) = \text{Area } (\triangle ENC) = \frac{15x}{2}$$

$$\text{So } \frac{\text{Area}(\triangle BDN)}{\text{Area}(ABC)} = \frac{\frac{15x}{2}}{16x} = \frac{15}{32}$$

60. (d)

$$\left[\frac{100}{1}\right], \left[\frac{100}{2}\right], \left[\frac{100}{3}\right], \dots, \left[\frac{100}{20}\right]$$

After solving values are

100, 50, 33, 25, 20, 16, 14, 12, 11, 10, 9, 8, 7, 7, 6, 6, 5, 5, 5, 5

Distinct integers are = 15.