FIITJEE

ALL INDIA TEST SERIES

JEE (Advanced)-2025

FULL TEST – III

PAPER –2

TEST DATE: 18-02-2025

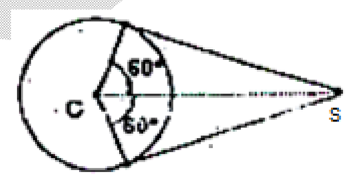
ANSWERS, HINTS & SOLUTIONS

Physics

PART – I

SECTION – A

1. B



Sol. $\frac{v + v_0}{v - v_0} = \frac{11}{9}$

$v = 10v_0$

$\Rightarrow v_0 = 34\ \text{m/s}$

$\therefore \Delta t = \frac{\frac{2\pi}{3} \times R}{v_0} = \frac{2\pi \times 17}{3 \times 34} = \frac{\pi}{3}$

2. C

Sol. $\beta = \frac{\Delta I_C}{\Delta I_B} = \frac{0.98}{0.02} = 49$

$\therefore \Delta V(\text{across } R_L) = \beta \Delta I_B R_L = 49 \times 50 \times 10^{-6} \times 10^4 = 24.5V$

3. D

Sol. $I_1 = \frac{\varepsilon_1}{R_1} e^{\frac{1}{R_1C_1}} \Rightarrow \ln I_1 = \frac{\varepsilon_1}{R_1} - \frac{t}{R_1C_1}$

Similarly, $\ln I_2 = \frac{\varepsilon_2}{R_2} - \frac{t}{R_2C_2}$

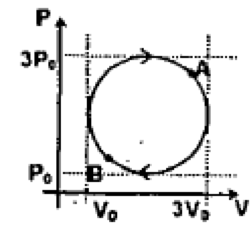
From figure 3, it is clear that

$\frac{\varepsilon_1}{R_1} = \frac{\varepsilon_2}{R_2}$ .....(1)

and $\frac{1}{R_1C_1} > \frac{1}{R_2C_2}$ .....(2)

4. D

Sol. The maximum temperature will occur at point A and minimum temperature will accurate point B of the cycle, so



At point A

$$\frac{P_A}{P_0} = \frac{V_A}{V_0} = 2 + \cos 45^\circ = \frac{2\sqrt{2}+1}{\sqrt{2}} = \frac{4+\sqrt{2}}{2}$$

$$nRT_A = P_A V_A = \left(\frac{4+\sqrt{2}}{2}\right)^2 P_0 V_0$$

Similarly at point B

$$\frac{P_B}{P_0} = \frac{V_B}{V_0} = 2 - \cos 45^\circ = \frac{4-\sqrt{2}}{2}$$

$$nRT_B = P_B V_B = \left(\frac{4-\sqrt{2}}{2}\right)^2 P_0 V_0$$

$$\Rightarrow \Rightarrow \quad \frac{T_A}{T_B} = \left(\frac{4+\sqrt{2}}{4-\sqrt{2}}\right)^2$$

5. B, C

Sol. $$R_{x-y} = \frac{m^2 r + 2r}{2m}$$

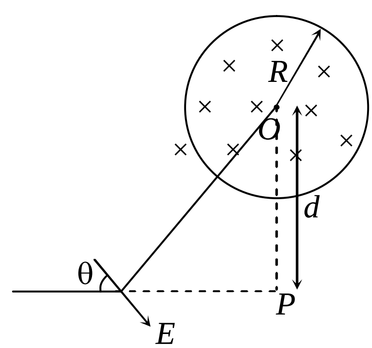
$$\therefore \quad \frac{R_{x-y}}{dm} = 0$$

$$2m(2mr) - 2(m^2 r + 2r) = 0$$

$$m = \sqrt{2}$$

6. A, C, D

Sol. $$\int \vec{E} \cdot d\vec{l} = A\frac{dB}{dt}$$



$$E 2\pi\sqrt{x^2 + d^2} = \pi R^2 k$$

$$E = \frac{\pi R^2 k}{2\sqrt{x^2 + d^2}}$$

$$W_{ext} = \int_0^\infty q\vec{E} \cdot dx = \frac{q\pi R^2}{4} k$$

7. A, C, D

Sol. $\lambda_B = 2\lambda_A \quad \Rightarrow \quad 2T_B = T_A$

$T_B = T_A - 1.5$

$T_B = 1.5$ eV

$T_A = 3$ eV

$\therefore \phi_A = 1.25$ eV and $\phi_B = 3.2$ eV

SECTION – B

8. 5

Sol. $F = 2rA(v_0 - u)^2$

$v_0 \rightarrow$ speed of jet, u = speed of cart

$$\Rightarrow m\frac{du}{dt} = 2\rho A(v_0 - u)^2$$

$$\Rightarrow \int_0^u \frac{du}{(v_0 - u)^2} = \int_0^t \frac{2\rho A}{m} dt$$

$$\Rightarrow \frac{1}{(v_0 - u)} - \frac{1}{v_0} = \frac{2\rho At}{m} \qquad \left[\frac{2\rho A}{m} = \frac{4}{100}\right]$$

$$\Rightarrow \frac{1}{(v_0 - u)} - \frac{1}{v_0} = \frac{4t}{100}$$

at t = 10 sec

$v_0 - u = 2$

u = 5.50 m/s.

9. 2

Sol. Velocity after collision $\vec{v} = 6\hat{i} + 8\left(\frac{1}{2}\right)\hat{j}$

$$|v| = \sqrt{36 + 16} = \sqrt{52}$$

10. 1

Sol. The tension T in the string at a distance x from its free end is given as

$$T = \frac{F}{l}x$$

Hence, $p = \frac{T}{A} = \frac{F}{Al}x$

Substituting (p) in the formula $U = \frac{1}{2Y}\int p^2 dV$

We have, $U = \frac{1}{2Y}\int_0^1 \frac{F^2}{A^2 l^2} x^2 dV$

Where $dV = Adx$

This gives $U = \frac{F^2 l}{6AY}$

11. 500

Sol. Intensity of the source at the cross-section *A*

12. 9

Sol. COLM

$$2mv_0 - mv_0 = 2mv$$

$$v = \frac{v_0}{2}$$

COME

$$-\frac{Gm^2}{a}+\frac{mv_0^2}{2}+\frac{m(2v_0)^2}{2}=-\frac{Gm^2}{r}+\frac{2m}{2}\left(\frac{v_0}{2}\right)^2$$

$$-\frac{Gm^2}{a}+\frac{mv_0^2}{2}\left[1+4-\frac{1}{2}\right]=-\frac{Gm^2}{r}$$

$$-\frac{Gm^2}{a}+\frac{mv_0^2}{2}\left[\frac{9}{2}\right]=-\frac{Gm^2}{r}$$

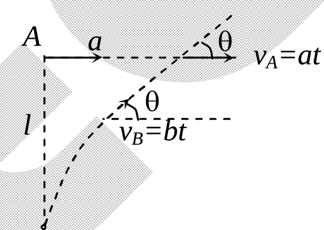
$$\frac{Gm^2}{a}-\frac{9}{4}mv_0^2=\frac{Gm^2}{r}$$

$$r=\frac{4Gma}{(4Gm-9v_0^2a)}$$

k = 9

13. 9

Sol. Let after time t, the velocity B is directed at angle θ with the horizontal.



$$-\frac{ds}{dt}=bt-at\cos\theta$$

$$\Rightarrow -\int_l^0 ds=b\int_0^t t\,dt-a\int_0^t t\cos\theta\,dt$$

$$\frac{1}{2}at^2=b\int_0^t t\cos\theta\,dt$$

$$\therefore\ l=\frac{bt^2}{2}-\frac{a^2t^2}{2b}$$

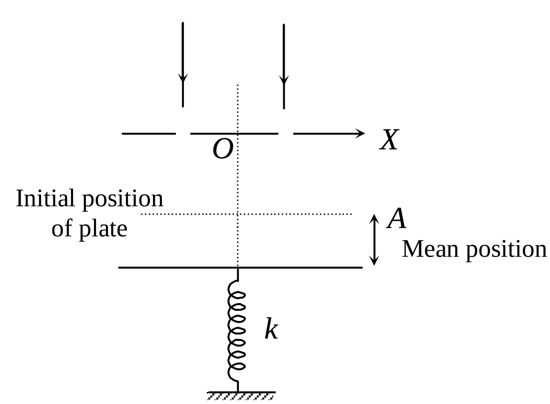
$$t=\sqrt{\frac{2bl}{b^2-a^2}}$$

$$S=\frac{1}{2}bt^2=\frac{1}{2}b\frac{2bl}{b^2-a^2}=\frac{b^2l}{b^2-a^2}=9\text{ m}$$

SECTION – C

14. 1.00

Sol. $\beta=\dfrac{(D+y)\lambda}{d}$



$$\frac{d\beta}{dt}=\frac{\lambda}{d}\frac{dy}{dt}=\frac{\lambda}{d}v$$

At mean position $v=A\omega=\dfrac{mg}{k}\sqrt{\dfrac{k}{m}}=g\sqrt{\dfrac{m}{k}}$

$$\frac{d\beta}{dt}=\frac{\lambda g}{d}\sqrt{\frac{m}{k}}$$

15. 2.00

Sol. $\beta_1 = \frac{(D+2A)\lambda}{d}$

$\beta_2 = \frac{D\lambda}{d}$

$\beta_1 - \beta_2 = \frac{2\lambda}{d}\frac{mg}{k}$

16. 0.50

Sol. The emission of photoelectron will stop when $\frac{hc}{\lambda_{\text{violet}}} = \phi + \text{eV}$, where V is the potential of sphere.

$\frac{12408}{4136} = 2.5 + \text{eV}$

$V = 0.5\,\text{V}$

17. 1.39

Sol. Number of electrons emitted to raise the potential of sphere to 0.5V is

$n = \frac{Q}{e} = \frac{4\pi\varepsilon_0 rV}{e}$ = 3.47×10^6 electrons

Time taken = $\frac{3.44\times10^{-6}}{2.5\times10^{9}} = 1.39\times10^{-3}$ s

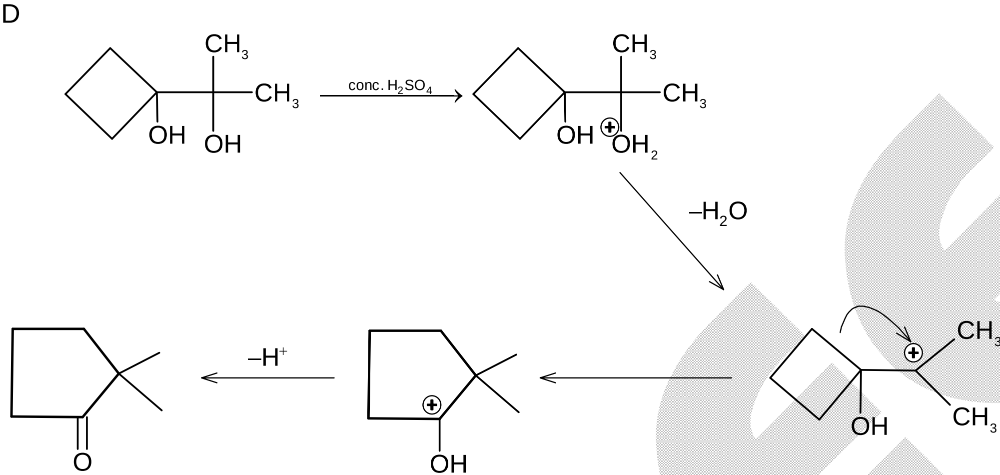
Chemistry

PART – II

SECTION – A

18. D

Sol.



19. D

Sol. Factual

20. B

Sol. Factual

21. A

Sol. Factual

22. A,B,C,D

Sol. $\Delta H = nC_P\Delta T$

$= 1\times(5+2)\times 100 = 500\,\text{cal}$

$\Delta U = nC_V\Delta T$

$= 1\times 5\times 100 = 500\,\text{cal}$

$\Delta S = n_R \ln\frac{V_2}{V_1} + nC_V \ln\frac{T_2}{T_1}$

$= 2\ln 10 + 5\ln\frac{4}{3}$

23. A, C

Sol. $\frac{760-740}{740} = \frac{1}{n_{H_2O}}$

$\Rightarrow \quad n_{H_2O} = 37$

$\Rightarrow \quad n_{ice} = 200 - 37 = 163$

$\Rightarrow \quad \Delta T_f = 2\times\frac{1}{37\times 18}\times 1000\,\text{K}$

$T_f = -\left(\frac{2000}{37\times 18}\right)^{o}\text{C}$

(C) $T_f\left(\text{original solution}\right) = 2\times\frac{1}{200\times 18}\times 1000$

$= \frac{-10}{18}\,^{o}C$

(D) R.L of final solution = $\frac{760-740}{760} = \frac{1}{38}$

24. A,B.D

SECTION – B

25. 9

Sol. $K = \frac{2.303}{t}\log\frac{a_0}{a},\ a = \frac{a_0}{8}$ at $t_{1/8}$

$t_{1/8} = \frac{2.303}{K}\log\frac{a_0}{\frac{a_0}{8}} = \frac{2.303}{K}\log 8$ .... (i)

When $t = t_{1/10},\ a = \frac{a_0}{10}$

$t_{1/10}\ \frac{2.303}{K}\log\frac{a_0}{\frac{a_0}{10}} = \frac{2.303}{K}\log 10$ ... (ii)

From equation (i) and (ii)

$\frac{[t_{1/8}]}{[t_{1/10}]}\times 10 = \frac{2.303}{K}\log 8\times\frac{K}{2.303\log 10}\times 10$

$= \frac{\log 8}{\log 10}\times 10$

$= \frac{3\log 2}{\log 10}\times 10 = \frac{3\times 0.3\times 10}{1} = 9$

26. 3

27. 4

Sol. Volume of unit cell

$= 3\times\frac{\sqrt{3}}{4}a^2 + c$

$= 131.6\times 10^{-24}\,cm^3$

$d = \frac{Z\times M_{H_2O}}{N_A\times V}$

$= \frac{0.92\times 13.16\times 6.023}{18} = 4$

28. 4

29. 5

Sol. Milli equivalent of $RNO_2 = 300\times 0.01\times 4 = 12$

$\therefore$ Milli equivalent of $\left[H^+\right]$ consumed = 12

or Milli equivalent of $\left[OH^-\right]$ generated = 12

Let a mole of weak acid and b mole of its conjugate base are present, then

$$a + b = 0.50$$

Also, $pH = -\log K_a + \log\frac{[Salt]}{[Acid]}$

$5.0 = +4.7442 + \log\frac{b}{a} \quad \therefore \frac{b}{a} = 1.8$

$\therefore \quad a = 0.1786$

$b = 0.3214$

OH^- generate will increase the concentration of A^- ion

	OH^-	$HA \longrightarrow$	$H_2O + A^-$
Meq. after reaction	0	$(178.6 - 12)$	$(321.4 + 12)$
	0	166.6	333.4

$\therefore \quad pH = 4.7442 + \log\frac{333.4}{166.3} = 4.7442 + 0.3013 = 5.0455$

30. 8

Sol. $2^3 = 8$

SECTION – C

31. 5.45

Sol. $pI = \frac{1.8 + 9.1}{2} = 5.45$

32. 9.75

Sol. $pI = \frac{9 + 10.5}{2} = 9.75$

33. 1200.00

Sol. $V_1 = 320\,mL$

$V_2 = 10\,mL$

$P_1 = 1\,atm$

$T_1 = 300K$

$T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$

$T_2 = 300 \times \left(\frac{320}{10}\right)^{7/5-1} = 1200k$

34. 243.00

Sol. $P_2 = P_1\left(\frac{320}{10}\right)^{7/5}$

$P_2 = 128\ atm$

$|W| = \frac{P_2V_2 - P_1V_1}{\gamma - 1}$

$|W| = \left(\frac{128 \times 10 \times 10^{-3} - 1 \times 320 \times 10^{-3}}{7/5 - 1}\right) \times \frac{8.314}{0.0821} = 243J$

Mathematics

PART – III

SECTION – A

35. C

Sol. $T_{r+1} = {}^{25}C_r\,(ab)^{h-1}(x)^{\frac{h-r}{2}}c^r(x)^{-r/3}$

h = 25 ⇒ r = 15

$\Rightarrow\ {}^{25}C_{15}a^{10}b^{10}c^{15}$

10a + 10b + 15c = 1

Use AM ≥ GM inequality

Required value = ${}^{25}C_{15}\left(\frac{1}{35}\right)^{35}$

36. B

Sol. Put $\sqrt{x} = \tan^2\theta \quad \Rightarrow x = \tan^4\theta$

$dx = 4\tan^2\theta.\sec^2\theta d\theta$

$I = \int \tan\theta.4\tan^3\theta.\sec^2\theta.d\theta = \left(\frac{4}{5}\right)x^{5/4} + c$

37. C

Sol. Vector which is orthogonal to $\vec{a}$ and caplanar to $\vec{b}$ and $\vec{c}$ is $\vec{a}\times\left(\vec{b}\times\vec{c}\right)$

$\therefore$ Required vector is $\frac{3\hat{j}-\hat{k}}{\sqrt{10}}$

38. A

Sol. Differential equation can be rewritten as

$$\left(\frac{xdy - ydx}{x^2}\right)\left(\frac{x^2}{y^2}\right) = (x\,dy + y\,dx)\sin xy$$

39. A, B, C, D

Sol. $4\sin x + 3\cos x + 6\sin y + 8\cos y = 15$

$\Rightarrow 5\{\sin(x+\alpha)\} + 10\{\sin(y+\beta)\} = 15$

Where $\alpha = \tan^{-1}\left(\frac{3}{4}\right)$ & $\beta = \tan^{-1}\left(\frac{4}{3}\right)$

$\therefore \sin(x+\alpha) = 1$ and $\sin(y+\beta) = 1$

$\therefore\ x + \alpha = m\pi + (-1)^n\frac{\pi}{2}$ where $m \in I$ and $y + \beta = k\pi + (-1)^k\frac{\pi}{2}$, where $k \in I$

Similarly, $\cos(x-\alpha) = 1$ and $\cos(y-\beta) = 1$

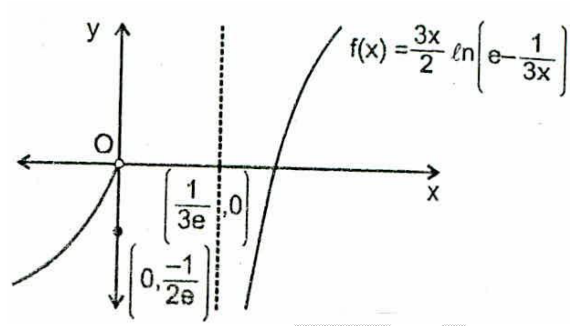
Where, $\therefore x = 2m\pi + \alpha$, where $\alpha = \tan^{-1}\left(\frac{4}{3}\right)$ $m \in I$ and $y = k\pi + \beta$, where $\beta = \tan^{-1}\left(\frac{3}{4}\right)$ $k \in I$

40. B, C

Sol. $$\sum_{r=0}^{n}(-2)^r.2.\frac{{}^{n+2}C_{r+2}}{(n+1)(n+2)} = \frac{\sum_{r=0}^{n}(-2)^{r+2}.\,{}^{n+2}C_{r+2}}{2(n+1)(n+2)} = \frac{(-1)^{n+2} - {}^{n+2}C_0 + 2.\,{}^{n+2}C_1}{2(n+1)(n+2)}$$

41. A, B, D

Sol. $f(x)=\frac{3x}{2}\ell n\left(e-\frac{1}{3x}\right)$



$D_f=(-\infty,0)\cup\left(\frac{1}{3e},\infty\right)$

$\lim_{x\to\left(\frac{1}{3e}\right)^+} f(x)\to(-\infty)$

$\lim_{x\to0^-} f(x)=0^{-1}$

$\lim_{x\to(-\infty)} f(x)=-\infty$

$\lim_{x\to\infty} f(x)=\infty$

$$f'(x)=\frac{3x}{2}\frac{1}{\left(e-\frac{1}{3x}\right)}\times\left(\frac{1}{3x^2}\right)+\frac{3}{2}.\ell n\left(e-\frac{1}{3x}\right)$$

$$f'(x)=\frac{3}{2(3ex-1)}+\frac{3}{2}.\ell n\left(e-\frac{1}{3x}\right)\Rightarrow f'(x)>0\forall x\in D_f$$

SECTION – B

42. 4

Sol. Let $a=x+iy$,

$|a^2-2|=|4a+i|\ \Rightarrow\left|(x^2-y^2-2)+2xyi\right|^2=\left|4x+(4y+1)i\right|^2$

$\Rightarrow(x^2-y^2-2)^2+4x^2y^2=16x^2+(4y+1)^2\qquad\Rightarrow(x^2+y^2-10)^2=99-8\left(y-\frac{1}{2}\right)^2$

$\Rightarrow(|a|^2-10)^2=99-8\left(y-\frac{1}{2}\right)^2\qquad\because|a|^2=x^2+y^2$

$\therefore\ |a|_{maxi}=10+3\sqrt{11}$

43. 4

Sol. $$\lim_{x\to0}\int_0^x\frac{t^2dt}{(x-\sin x)\sqrt{a+t}}=\lim_{x\to0}\frac{\int_0^x\frac{t^2dt}{\sqrt{a+t}}}{(x-\sin x)}=\lim_{x\to0}\frac{x^2}{\sqrt{a+x}\,(1-\cos x)}$$

$$=\lim_{x\to0}\frac{x^2}{2\sin^2\frac{x}{2}.\sqrt{a+x}}=\frac{2}{\sqrt a}=1\text{ (given)}$$

$\Rightarrow\ a=4$.

44. 8

Sol. $\operatorname{cosec}^2\alpha=\operatorname{cosec}^2\beta=\operatorname{cosec}^2\gamma=1$

α,β,γ many be $\frac{\pi}{2},\frac{3\pi}{2}$

Hence no. of ordered pairs = $2\times2\times2$ =8

45. 8

Sol. $\lim_{x\to 0} I_1 = \dfrac{\lim_{x\to 0}\int_0^x \dfrac{t^2 dt}{\sqrt{\lambda^2 - 2\lambda t}}}{(x - \sin x)} = \lim_{x\to 0}\dfrac{x^2}{(1-\cos x)\sqrt{\lambda^2 + 2\lambda x}} = 1$

$\Rightarrow \dfrac{2}{|\lambda|} = 1 \qquad \Rightarrow |\lambda| = 2$

$\Rightarrow \lambda = \pm 2$

46. 12

Sol. $\sum \dfrac{a_i}{a_j}$, $i, j \in \{1, 2, 3, 4\}$, $i \neq j$ has a total of $4 \times 4 - 4 = 12$ terms i.e. 6 pairs, each pair of the type $\left(\dfrac{a_i}{a_j} + \dfrac{a_j}{a_i}\right)$.

Now $\left(\dfrac{a_i}{a_j} + \dfrac{a_j}{a_i}\right) \geq 2 \qquad$ (as $\dfrac{a_i}{a_j} > 0$)

$\Rightarrow \sum \dfrac{a_i}{a_j} \geq 2 \times 6 \Rightarrow \sum \dfrac{a_i}{a_j} \geq 12$.

47. 25

Sol. $\because {}^{30}C_r.{}^{20}C_0 + {}^{30}C_{r-1}.{}^{20}C_1 + ... + {}^{30}C_0.{}^{20}C_r$

= coefficient of x^r in $(1 + x)^{30}(1 + x)^{20}$

= coefficient of x^r in $(1+x)^{50} = {}^{50}C_r$

$\because {}^{50}C_r$ is maximum

$\therefore \; r = \dfrac{50}{2} = 25$

SECTION – C

48. 48.00

49. 48.00

Sol. (Q.48 to 49)

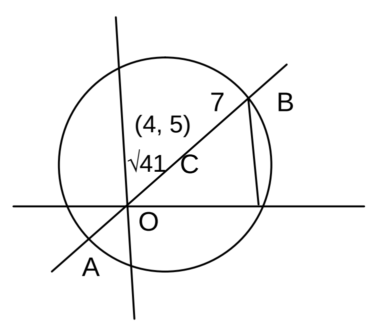
We have $\alpha + \beta = -z_1$ and $\alpha\beta = z_2 + m$, $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$

$= z_1^2 - 4z_2 - 4m$

$= 16 + 20i - 4m$

since $|\alpha - \beta| = 2\sqrt{7}$, we have $|4 + 5i - m| = 7$, m lies on a circle centre (4, 5) and radius = 7

$|m|_{max} = OB = 7 + \sqrt{41}$ and $|m|_{min} = OA = 7 - \sqrt{41}$.



50. 5.00

51. 13.00

Sol. L can take five values, $\dfrac{2}{5}, \dfrac{3}{4}, \dfrac{4}{3}, \dfrac{5}{2}, \dfrac{6}{1}$ respectively