28/12/2025

Set-1

Corporate Office : AESL, 3rd Floor, Incuspaze Campus-2, Plot No. 13, Sector-18, Udyog Vihar, Gurugram, Haryana - 122015, **Ph.**+91-1244168300

MM : 180

AIATS For One Year JEE(Advanced)-2026 (XII Studying)_Test-3A_Paper-1_ONLINE

Time : 180 Min.

MATHEMATICS

Section-I

1. (03.00)
2. (37.00)
3. (52.00)
4. (03.00)
5. (125.00)
6. (00.00)
7. (05.00)
8. (03.00)

Section-II

9. (A,B,C)
10. (A,C)
11. (A,C)
12. (A,C)
13. (A,B)
14. (A,D)

Section-III

15. (B)
16. (A)
17. (C)
18. (C)

PHYSICS

Section-I

19. (20.00)
20. (00.00)
21. (04.00)
22. (06.20)
23. (07.00)
24. (01.00)
25. (02.78)
26. (02.00)

Section-II

27. (B,C)
28. (C,D)
29. (A,C,D)
30. (A,D)
31. (B,C)
32. (A,B,C)

Section-III

33. (C)
34. (D)
35. (A)
36. (B)

CHEMISTRY

Section-I

37. (04.00)

38. (11.00)

39. (16.00)

40. (02.00)

41. (06.00)

42. (56.00)

43. (07.00)

44. (05.00)

Section-II

45. (A,B,C)

46. (A,B)

47. (A,C,D)

48. (A,B,C)

49. (A,B,C)

50. (C,D)

Section-III

51. (A)

52. (C)

53. (A)

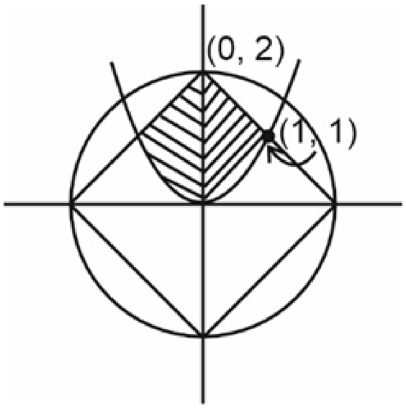
54. (C)

Hints and Solutions

MATHEMATICS

Section-I

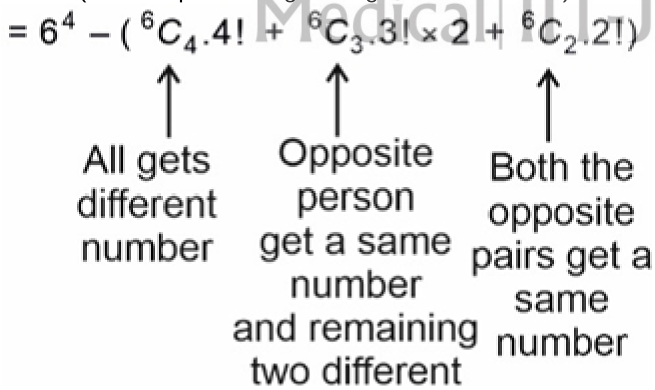
(1) **Answer :** 03.00
Hint:
Make the graph
Solution:



Required area $\frac{1}{2}\times 2\times 2 - \left[\int_0^1 x^2 dx + \frac{1}{2}\right]$

$= \frac{7}{3}$

(2) **Answer :** 37.00
Hint:
Total – (Number pair of neighbour get same outcome)
Solution:
Total – (Number pair of neighbour get same outcome)

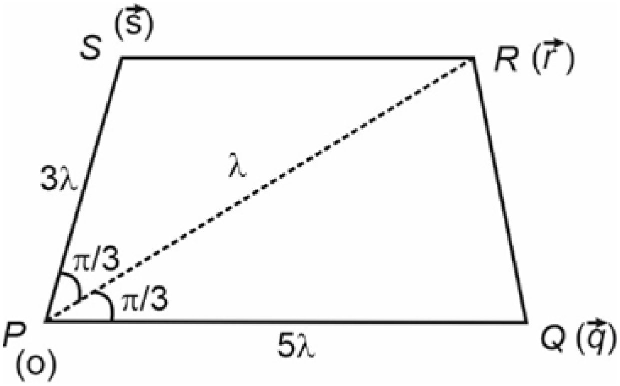


Probability $= 1 - \frac{630}{6^4} = \frac{37}{72}$

(3) **Answer :** 52.00
Hint:

$\cos\theta = \frac{\overrightarrow{QP}\cdot\overrightarrow{RS}}{\left|\overrightarrow{QP}\right|\cdot\left|\overrightarrow{RS}\right|}$

Solution:



$\cos\theta = \dfrac{\overrightarrow{QP}.\overrightarrow{RS}}{\left|\overrightarrow{QP}\right|.\left|\overrightarrow{RS}\right|}$

$= \dfrac{-\vec{q}.(\vec{s}-\vec{r})}{\left|\vec{q}\right|.\left|\vec{s}-\vec{r}\right|}$

$= \dfrac{5\lambda\cdot\lambda\cdot\frac{1}{2} - 5\lambda\cdot 3\lambda\cdot\left(-\frac{1}{2}\right)}{5\lambda\sqrt{9\lambda^2+\lambda^2-2\cdot 3\lambda\cdot\lambda\cdot\frac{1}{2}}}$

$= \frac{10}{5\times\sqrt{7}} = \frac{2}{\sqrt{7}} \;\Rightarrow\; \sin^2\theta = 1-\frac{4}{7} = \frac{3}{7}$

$a + b^2 = 3 + 49 = 52$

(4) **Answer :** 03.00

Hint:

$\left|\vec{a}-\hat{i}\right|^2 = \left|\vec{a}\right|.\left|\vec{a}-2\hat{i}\right|$

Solution:

$\left|\vec{a}-\hat{i}\right|^2 = \left|\vec{a}\right|.\left|\vec{a}-2\hat{i}\right|$

$\Rightarrow (a^2+1-a)^2 = a^2(a^2+4-2a)$

$\Rightarrow a^4+a^2+1+2a^2-2a-2a^3 \quad = a^4+4a^2-2a^3$

$= a^2+2a-1=0$

$a=\sqrt{2}-1$

(5) **Answer :** 125.00

Hint:

Total solution = ${}^{15+3-1}C_2 = 136$

Solution:

$x+y+2=15, \quad x\ge 0,\ y\ge 0,\ z\ge 0$

Total solution = ${}^{15+3-1}C_2 = 136$

Case-I : Let $x=y\ne z$ (exclude the unwanted cases)

$2x + z = 15$

$\Rightarrow\ z=15-2x$

$x\in\{0,\ 1,\ 2,...7\}-\{5\}$

$\Rightarrow$ 7 solutions

∴ Total solution 7 × 3 = 21

Case-II : $x = y = z$

case I : (5, 5, 5)

∴ Probability = $\frac{136-1-21}{136} = \frac{114}{136} = \frac{57}{68}$

(6) **Answer :** 00.00

Hint:

$\displaystyle\int\frac{dy}{y^3} = \int\frac{e^{1/x}}{x^2}dx$

Solution:

$\displaystyle\int\frac{dy}{y^3} = \int\frac{e^{1/x}}{x^2}dx$

$= \frac{y^{-2}}{-2} = -e^{1/x} + c$
$= \frac{1}{y^2} = 2e^{1/x} + c'$
$2 = 2 + c'$
$\Rightarrow\ c' = 0$
$\therefore\ \frac{1}{y^2} = 2e^{1/x}$
$\Rightarrow\ y^2 = \frac{1}{2}e^{-1/x}$
$\Rightarrow\ y = \frac{1}{\sqrt{2}}e^{-1/2x}$
$\lim\limits_{x\to 0^+} y = \frac{1}{\sqrt{2}} \cdot e^{-\infty} = 0$

(7) **Answer :** 05.00
Hint:

$$d = \left|\frac{(\vec{a}-\vec{b})\cdot\left(\vec{n}_1\times\vec{n}_2\right)}{\left|\vec{n}_1\times\vec{n}_2\right|}\right|$$

Solution:

$$d = \left|\frac{(\vec{a}-\vec{b})\cdot(\vec{n}_1\times\vec{n}_2)}{\left|\vec{n}_1\times\vec{n}_2\right|}\right|$$

$$b = \left|\frac{\left[(-\sqrt{6}-\alpha)\hat{i}-\left(\sqrt{6}\hat{j}\right)+\left(3\sqrt{6}\hat{k}\right)\right].(\vec{n}_1\times\vec{n}_2)}{\left|\vec{n}_1\times\vec{n}_2\right|}\right|$$

$$\vec{n}_1\times\vec{n}_2 = \begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & 3 & 4\\ 3 & 4 & 5\end{vmatrix} = \hat{i}(-1)-\hat{j}(-2)+\hat{k}(-1)$$

$= -\hat{i}+2\hat{j}-\hat{k}$
$6 = \left|\frac{(\sqrt{6}+\alpha)-2\sqrt{6}-3\sqrt{6}}{\sqrt{6}}\right|$
$\Rightarrow\ 6\sqrt{6} = |4\sqrt{6}-\alpha|$
$\alpha = 10\sqrt{6},\ -2\sqrt{6}$
$\left|\frac{\alpha_1}{\alpha_2}\right| = 5$

(8) **Answer :** 03.00
Solution:

$$\left|\int_0^1 (xe^x - e^x)dx\right| = xe^x|_0^1 - e^x|_0^1 - e^x|_0^1$$

$= |((e)-(e-1)-(e-1))|$
$= |(2-e)|$ = e – 2

Section-II

(9) **Answer :** (A,B,C)
Hint:

$$D = \begin{vmatrix}\alpha & 1 & 1\\ 1 & \alpha & 1\\ 1 & 1 & \alpha\end{vmatrix}$$

Solution:

$$D = \begin{vmatrix}\alpha & 1 & 1\\ 1 & \alpha & 1\\ 1 & 1 & \alpha\end{vmatrix}$$

$= \alpha^3 - 3x + 2 = (\alpha+2)(\alpha-1)^2$
If α = 1
$P_1 : x + y + z = 1$
$P_2 : x + y + z = 1$
$P_3 : x + y + z = \beta$
If α = –2, β = – 1, planes do not passes through a single common point.
If α = – 2, β = 2, planes passes through a single line.

If α = 2, β = 1, planes passes through $\left(\frac{1}{4}, \frac{1}{4}, \frac{1}{4}\right)$

(10) **Answer :** (A,C)
Hint:
Find x_0, y_0 using equation of tangent.
Solution:

$3x^2-4y^2=36 \Rightarrow \frac{x^2}{12}-\frac{y^2}{9}=1$

Equation of tangent : $y=mx\pm\sqrt{a^2m^2-b^2}$

$\Rightarrow y=-\frac{3x}{2}\pm\sqrt{12.\left(\frac{9}{4}\right)-9}$

$\Rightarrow y=-\frac{3x}{2}\pm3\sqrt{2}$

$=2y+3x=\pm6\sqrt{2}$

$3xx_0-4yy_0=36$

$\frac{x_0}{1}=\frac{-4y_0}{2}=\frac{36}{\pm6\sqrt{2}}$

$\Rightarrow x_0=\frac{6}{\sqrt{2}},\ y_0=\frac{-3}{\sqrt{2}}$ Or $x_0=\frac{-6}{\sqrt{2}},\ y_0=\frac{3}{\sqrt{2}}$

$\left(\frac{6}{\sqrt{2}}, \frac{-3}{\sqrt{2}}\right)$ is nearest to the line.

∴ tangent at $P: 2y+3x=6\sqrt{2}$

$$A=\int_{y_0}^{0}\left(\sqrt{\frac{36+4y^2}{3}}-\left(\frac{6\sqrt{2}-2y}{3}\right)\right)dy$$

(11) **Answer :** (A,C)
Hint:
$\frac{dy}{dx}=\frac{-ye^{-x}}{1-e^{-x}}$
Solution:
$\frac{dy}{dx}=\frac{-ye^{-x}}{1-e^{-x}}$

$\Rightarrow \int\frac{dy}{y}=-\int\frac{e^{-x}}{1-e^{-x}}dx$

$=\ln|y|=-\ln|1-e^{-x}|+\ln\ c$

$\Rightarrow\ |y|=\frac{c}{|1-e^{-x}|}$

$f\left(\frac{1}{2}\right)\ =\frac{\sqrt{e}}{\sqrt{e}-1}=\frac{c.\sqrt{e}}{\sqrt{e}-1}\Rightarrow c=1$

$\because\ f\left(\frac{1}{2}\right)=\frac{\sqrt{e}}{\sqrt{e}-1}$

$\Rightarrow\ f(x)=\frac{e^x}{e^x-1}$

$f(-x)=\frac{e^{-x}}{e^{-x}-1}=\frac{1}{1-e^x}$

$g(x)=f(-x)-f(x)$

$g(x)=\frac{1}{1-e^x}+\frac{e^x}{1-e^x}$

$g(x)=\frac{1+e^x}{1-e^x}=\frac{e^{-x}+1}{e^{-x}-1}$

Area = $\int_2^4\frac{e^x}{e^x-1}dx$

$=\ln|e^x-1|\,_2^4$

$\ln|e^4-1|-\ln|e^2-1|$

$=\ln|e^2+1|$

(12) **Answer :** (A,C)
Hint:
$\vec{b}\,\|\,\vec{c}\ \Rightarrow\ \vec{b}=\vec{c}$

Solution:

$\vec{b}\,\|\,\vec{c}\ \Rightarrow\ \vec{b}=\vec{c}$

$\vec{b} \cdot \vec{c} = 4$

$\vec{a} + \lambda \vec{b} = 4\vec{c}$

$\Rightarrow \vec{a} = 4\vec{c} - \lambda \vec{b}$

$\Rightarrow 64 = 16(4) + \lambda^2(4) - 8\lambda(4)$

$\Rightarrow 8\lambda = \lambda^2$

$\lambda = 0,\ 8$

$\lambda = 0, \quad \vec{a} \cdot \vec{c} = 4 \cdot 4 = 16,\ \vec{a} = 4\vec{c} = 4\vec{b}$

$\Rightarrow \vec{a} \times \vec{b} = \vec{0}$

$\lambda = 8 \quad \vec{a} \cdot \vec{c} = -16,\ \vec{a} = -4\vec{b} = -4\vec{c}$

$\Rightarrow \vec{a} \times \vec{b} = \vec{0}$

$\Rightarrow \left|\vec{c} \times \left(\vec{a} \times \vec{b}\right)\right| = 0$

(13) **Answer :** (A,B)
Hint:

DR of L is parallel to $\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ 2 & 0 & -2 \end{vmatrix}$

Solution:

$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & 3 \\ 2 & 0 & -2 \end{vmatrix}$

$= \hat{i}(-4) - \hat{j}(-2-6) + \hat{k}(-4)$

$= -4\hat{i} + 8\hat{j} - 4\hat{k}$

Mid-point of *AB* : (2, 2, 2)

$\therefore\ L : \frac{x-2}{1} = \frac{y-2}{-2} = \frac{z-2}{1}$

$\cos\alpha = \frac{1}{\sqrt{6}},\ \cos\beta = \frac{-2}{\sqrt{6}},\ \cos\gamma = \frac{1}{\sqrt{6}}$

(14) **Answer :** (A,D)
Hint:
Put *y* = *vx*
Solution:
y = *vx*

$y' = v + x\frac{dv}{dx}$

$(x^2 + 3v^2x^2) + 2x.\,vx\left(v + x\frac{dv}{dx}\right) = 0$

$\Rightarrow 1 + 3v^2 + 2v\left(v + x\frac{dv}{dx}\right) = 0$

$\Rightarrow 1 + 5v^2 + 2xv\frac{dv}{dx} = 0$

$\Rightarrow -2xv\frac{dv}{dx} = 1 + 5v^2$

$\Rightarrow \frac{-2vdv}{1+5v^2} = \frac{dx}{x}$

$= \frac{-\ln|1+5v^2|}{5} = \ln x + \ln c$

$= \frac{1}{1+5v^2} = cx^5$

$= \frac{x^2}{x^2+5y^2} = cx^5$

$\Rightarrow x^2 + 5y^2 = \frac{c'}{x^3}$

$\Rightarrow x^5 + 5y^2x^3 = c'$

f(1)=1

$\therefore\ x^5 + 5y^2x^3 = 6$

$x^3(x^2 + 5y^2) = 6$

$5y^2 = \frac{6}{x^3} - x^2 \geq 0$

$6 \geq x^5$

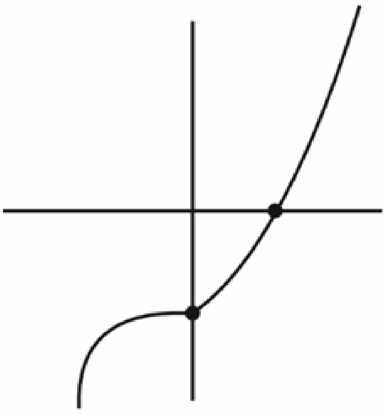
Section-III

(15) **Answer :** (B)

Hint:

Make the curve

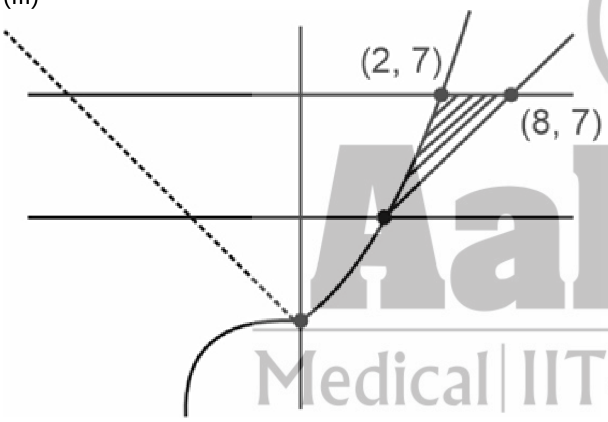
Solution:



(I) $\frac{1}{2} \times 1 \times 1 = \frac{1}{2}$

(II) $\int\limits_0^1 \left((x-1)-(x^3-1)\right)dx = \frac{1}{4}$

(III)



Area = $\int\limits_0^7 \left((1+y)-(y+1)^{1/3}\right)dy$

$= \frac{81}{4}$

(IV) $\frac{1}{4}$

(16) **Answer :** (A)

Hint:

$d(y^2x)+2dyx = 0$

Solution:

(I) $(x^2y^2+2y)dx+(2x^3y-2x)dy = 0$

$= y^2dx+2xydy+2\left(\frac{ydx-xdy}{x^2}\right) = 0$

$= d(y^2x)-2d\left(\frac{y}{x}\right) = 0$

$= xy^2 - \frac{2y}{x} = c$

$= x^2y^2-2y = cx$

(I)→ T

(II) $\frac{2y}{x^2}+1+\frac{2y'}{x} = 0$

$\Rightarrow\ 2ydx+x^2dx+2xdy = 0$

$= 2(xdy + ydx) + x^2dx = 0$

$= 2d(xy) + \frac{1}{3}d(x^3) = 0$

$= 2xy + \frac{x^3}{3} = c$

$= 6xy + x^3 = c$

(II) → P

(III) $\frac{dx}{dy} = \frac{2yx^2}{x^2 - 2xy^2}$

$\Rightarrow\ dx(x^2 - 2xy^2) - dy(2yx^2) = 0$

$\Rightarrow\ \frac{x^3}{3} - x^2y^2 = c$

$\Rightarrow x^3 - 3x^2y^2 = c$

$\Rightarrow x^2(x - 3y^2) = c$

(III) → Q

(IV) $y - x\frac{dy}{dx} = x^2 + y^2$

$\Rightarrow ydx - xdy - (x^2 + y^2)dx = 0$

$\Rightarrow \frac{ydx - xdy}{x^2 + y^2} - dx = 0$

$-\tan^{-1}\left(\frac{y}{x}\right) - x = c$

$\Rightarrow \tan^{-1}\left(\frac{y}{x}\right) = c - x$

$\Rightarrow\ \frac{y}{x} = \tan(c - x)$

$\Rightarrow\ y = x\tan(c - x)$

(IV) → R

(17) Answer : (C)

Hint:

Find the point of intersection of L_1 and L_2.

Solution:

$L_1:\ \frac{x-2}{1} = \frac{y-2}{2} = \frac{z-2}{1} = \lambda$

$L_2:\ \frac{x-3}{1} = \frac{y-2}{4} = \frac{z-2}{2} = \mu$

Point of intersection of L_1 and L_2 is $P(4, 6, 4)$

$\overrightarrow{PQ} = \lambda\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 1 & 2 & 1\\ 1 & 4 & 2\end{vmatrix} = \lambda\left(\hat{i}(0) - \hat{j}(1 + \hat{k}(2)\right)$

$= \lambda(-\hat{j} + 2\hat{k})$

$4\sqrt{5} = |\lambda(\sqrt{5})|$

$\therefore\ \lambda = \pm 4$

$\overrightarrow{PQ} = -4\hat{j} + 8\hat{k}$ or $4\hat{j} - 8\hat{k}$

$(x-4)\hat{i} + (y-6)\hat{j} + (z-4)\hat{k} = \overrightarrow{PQ}$

$\therefore Q_1$ (4, 2, 12) and Q_2 (4, 10, – 4)

$|Q_1Q_2| = 8\sqrt{5}\ \ |OQ_2| = 2\sqrt{33}$

$|OQ_1| = 2\sqrt{41}\ \ |OP| = 2\sqrt{17}$

(18) Answer : (C)

Hint:

$\frac{13}{14} = \frac{ab}{ab + \frac{1}{1001}\times(1-a)(1-b)}$

Solution:

$\frac{13}{14} = \frac{ab}{ab + \frac{1}{1001}\times(1-a)(1-b)}$

$\Rightarrow\ 13ab + \frac{13}{1001}(1 - a - b + ab) = 14ab$

$\Rightarrow \frac{13}{1001}\left(1 - \frac{5}{24} + ab\right) = ab$

$\Rightarrow 13(19 + 24ab) = 24 \times 1001ab$

$\Rightarrow 19 + 24ab = 24 \times 77ab$

$\Rightarrow 19 = 24 \times 76ab$

$\Rightarrow ab = \frac{1}{96}$

$\therefore\ a = \frac{1}{8},\ b = \frac{1}{12}$

$a-b=\frac{1}{8}-\frac{1}{12}=\frac{3-2}{24}=\frac{1}{24}$

(I) The probability of both getting the same answer is

$1\cdot\frac{1}{12}\cdot\frac{1}{8}+\frac{1}{1001}\cdot\left(1-\frac{1}{12}\right)\left(1-\frac{1}{8}\right)=\frac{7}{624}$

(II) The probability of both getting the correct answer is $\frac{1}{12}\cdot\frac{1}{8}=\frac{1}{96}$

(III) The probability of both getting the wrong answer is $\left(1-\frac{1}{12}\right)\left(1-\frac{1}{8}\right)=\frac{77}{96}$

(IV) $a-b=\frac{1}{24}$

PHYSICS

Section-I

(19) Answer : 20.00

Hint:

Minimum number represents the S. D.

Solution:

$=\frac{26.62\times10^{-3}}{1.3331\times10^{-3}}=20$

(20) Answer : 00.00

Hint:

$\sin^{-1}\frac{1}{\mu}+\tan^{-1}\mu=\theta$

Solution:

$\sin^{-1}\frac{1}{\mu}+\tan^{-1}\mu=\theta$

$\sin^{-1}\left\{\frac{1}{\mu}\frac{1}{\sqrt{\mu^2+1}}+\frac{\sqrt{\mu^2-1}}{\sqrt{\mu^2-1}}\right\}$

(21) Answer : 04.00

Hint:

$E\propto(\omega+\omega_0)$

Solution:

Given wave equation : Superposition of $w_0,\ w+w_0,\ w-w_0$

$w_{\max}=w+w_0$

$E_{\max}=hv_{\max}=\frac{h(w_0+w)}{2\pi}=KE+\ \phi$

$\Rightarrow\ \phi=4eV$

(22) Answer : 06.20

Hint:

$E=\phi_0+KE$

Solution:

Least energetic photon

⇒ n = 2 to n = 1

⇒ p = 2

$\lambda=\frac{1500\times4}{4-1}=1500\times\frac{4}{3}=2000\,\text{Å}$

$\varepsilon=\frac{1240}{200}=6.2\,eV$

(23) Answer : 07.00

Hint:

$E=\phi_0+KE$

Solution:

$E=\phi_0+KE$

$KE=eVs$

$h\nu=\phi+eVs$

= 2 + 5 = 7 eV

$I_s=10^{-5}A\left(\frac{N}{t}e\right)\eta$

$\eta=10^{-3}\%=10^{-5}$

$P=\frac{N}{t}(h\nu)$

$\Rightarrow\ \frac{P}{h\nu}e=\frac{N}{t}e=\frac{I}{\eta}$

$\Rightarrow\ P\frac{10^{-5}}{10^{-5}}\times=\frac{7eV}{e}=7\,W$

(24) **Answer :** 01.00
Hint:
Dimensional analysis
Solution:
$T=2\pi\sqrt{\frac{\ell}{g}}$

(25) **Answer :** 02.78
Hint:
$N=N_0e^{-\lambda t}$
Solution:
$\frac{dN}{dt}=\lambda N_0$
$\ell n\left(\frac{dN}{dt}\right)=\ell n\Big(\lambda N\Big)$
Slope $=-\lambda=\frac{-1}{5}$
$\lambda=\frac{1}{5}hrs.$
$N=N_0e^{-1}$
$N=\frac{N_0}{e}$

(26) **Answer :** 02.00
Hint:
$A=\lambda_1N_1e^{-\lambda_1 t}$
Solution:
$A=\lambda_1N_1e^{-\lambda_1 t}$
$R=\lambda_1^2N_1e^{-\lambda_1 t}$
t = 0
$\frac{R_P}{R_Q}=\left(\frac{\lambda_1}{\lambda_2}\right)^2\frac{N_1(1)}{N_2(1)}=1$
$\tau=\frac{1}{\lambda_1}$
$\frac{\tau}{2}=\frac{\lambda}{\lambda_2}=\frac{1}{2\lambda_1}$
$\Rightarrow\ N_1=4N_2$
$\Rightarrow\ (\lambda_2=2\lambda_1)$
t = τ
$\frac{A_P}{A_Q}=\frac{\lambda_1N_1}{\lambda_2\lambda_2}e^{-\lambda_1 t+\lambda_2 t}=2e$
α = 2

Section-II

(27) **Answer :** (B,C)
Hint:
Cut-off wavelength $\lambda=\frac{hc}{E}$
Solution:
Cut-off wavelength $\lambda=\frac{hc}{E}$
E = *eV*
de-broglie wavelength $(\lambda_D)=\frac{h}{p}=\frac{h}{\sqrt{2meV}}$

(28) **Answer :** (C,D)
Hint:
$\Delta d=-d(\cot\theta)(\pm\Delta\theta)$
Solution:
$2d\sin\theta=\lambda$
$\Rightarrow\Delta d\sin\theta=-d\cos\theta(\Delta\theta)$
$\Delta d=-d(\cot\theta)(\pm\Delta\theta)$
$\theta\uparrow\ \ \cot\theta\downarrow\quad\Rightarrow\Delta d\downarrow$
$\Rightarrow\frac{\Delta d}{d}=-\cot\theta\ \Delta Q\quad Q\uparrow\quad\cot\theta\downarrow$

(29) **Answer :** (A,C,D)
Hint:

$\frac{1}{\lambda_L} \propto \frac{1}{(n-1)^2} - \frac{1}{n^2} = \frac{2n-1}{(n(n-1))^2}$

Solution:

$\frac{1}{\lambda_L} \propto \frac{1}{(n-1)^2} - \frac{1}{n^2} = \frac{2n-1}{(n(n-1))^2}$

$\Delta p_L = p = \frac{E}{c} = \frac{h}{\lambda_L} \propto \frac{2n-1}{(n(n-1))^2}$

$\frac{hc}{\lambda_m} = \frac{E_0}{(n-1)^2} \Rightarrow \lambda_m \propto (n-1)^2$

(30) **Answer :** (A,D)

Hint:

K_α depends on target material

Solution:

K_α depends on target material Cut-off wavelength depends of energy of e$^-$

(31) **Answer :** (B,C)

Hint:

$\frac{dy}{D} = \lambda$

Solution:

$\frac{d(OP)}{\Delta} = 7 \times 10^{-7} = \lambda$

→ constructive interference

$\Delta x = d\alpha + \frac{d(OP)}{\Delta} = 2\lambda$

→ constructive interference

$\alpha = \left(\frac{1.26}{\pi}\right)^o$

(32) **Answer :** (A,B,C)

Hint:

$mvr = \frac{nh}{2\pi}$

Solution:

$F = \frac{-\partial u}{\partial r} = \frac{-B}{r}$

$\Rightarrow \frac{B}{r} = \frac{mv^2}{r}$ ...(1) $mvr = \frac{nh}{2\pi}$

$mv = \sqrt{mB}$ $r = \frac{nh}{2\pi\sqrt{mB}}$

$r_{\text{min}} \Rightarrow n = 1$

$r = \frac{h}{2\pi\sqrt{mB}}$

Section-III

(33) **Answer :** (C)

Hint:

Intensity $\propto$ saturation current

Solution:

Intensity $\propto$ saturation current

Stopping potential and KE related to incident energy

ϕ (Work function) not dependent of incident light.

(34) **Answer :** (D)

Hint:

$y = \frac{(\mu-1)tD}{d} = 1.25\ mm$ → position of central maximas.

$I_{\text{min}} = \left(\sqrt{I} - \sqrt{0.64\,I}\right)^2 = 0.04\,I$

$I_{\text{min}} = (1.8)^2 \times I = 3.24\,I$

$\beta = \frac{\lambda D}{d} = 05\ mm$

Solution:

(A) d = 1mm $\beta = \frac{\lambda D}{d} = 0.5\,mm$

(B) $y = \frac{(\mu-1)tD}{d} = 1.25\ mm$

→ position of central maximas.

$I_{\text{min}} = \left(\sqrt{I} - \sqrt{0.64\,I}\right)^2 = 0.04\,I$

$I_{\text{min}} = (1.8)^2 \times I = 3.24\,I$

$\beta = \frac{\lambda D}{d} = 05\ mm$

(C) $\Delta x = d\alpha + \frac{yd}{D} - (\mu - 1)t \Rightarrow y = 0$

or $d\alpha + \frac{yd}{D} + (\mu - 1)t \Rightarrow y = 2.5\ mm$

(D) $\Delta x + \frac{yd}{D} - \left(\frac{\mu_g}{\mu_l} - 1\right)t \Rightarrow 0$

y = 1.25 mm

(35) **Answer :** (A)

Hint:

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

Solution:

ℓ = 0.4 mm Δx = 8000 Å maximum for 4000 Å / maximum 8000 Å

ℓ = 0 Δx = 0 maximum of all λ.

ℓ = 0.1 mm Δx = 2000 Å minimum for 4000 Å

ℓ = 0.2 mm Δx = 4000 Å maximum for 4000 Å/min 8000 Å

(36) **Answer :** (B)

Hint:

Use differential calculus

Solution:

$\frac{a\Delta P}{P} + \frac{a\Delta Q}{Q} + \frac{a\Delta R}{R} = \frac{\Delta X}{X}$

CHEMISTRY

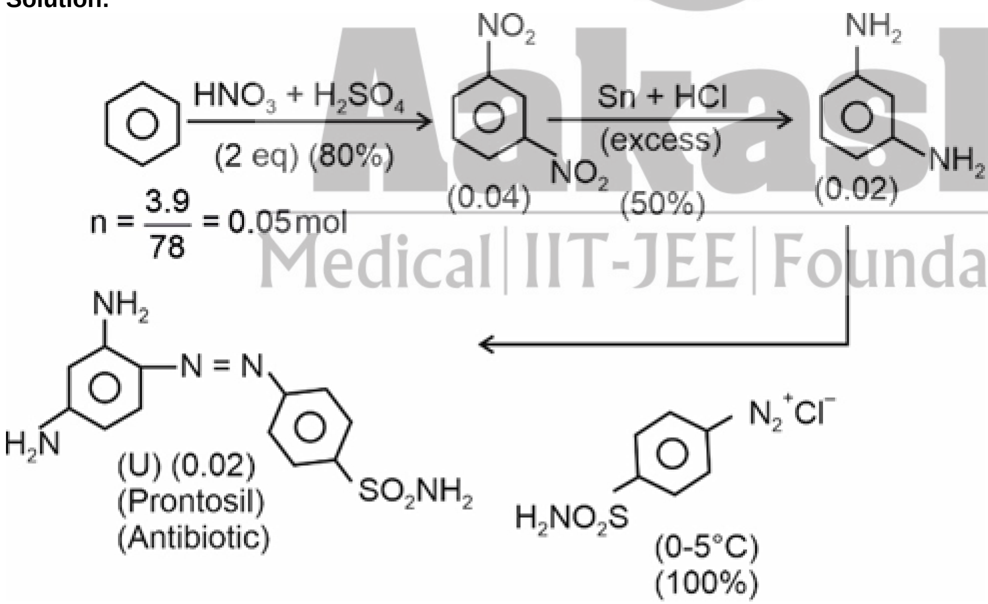
Section-I

(37) **Answer :** 04.00

Hint:

Prontosil is an antibacterial.

Solution:



∴ DU = 11

∴ Number of moles of N = 0.02 × 5 = 0.1 mol

∴ Number of moles of π electrons

= 0.02 × 9 × 2 = 0.36 mol

∴ 2, 3, 5 are correct statements.

(38) **Answer :** 11.00

Hint:

Nylons are condensation polymers.

Solution:

Number of condensation polymer = x = 5

(Nylon-6; Nylon-6, 6; Mylar, Resol, PHBV)

Number of homopolymers = y = 6

(Nylon-6, PVC, PTFE, Polystyrene, Neoprene orlon)

∴ x + y = 11

(39) **Answer :** 16.00

Hint:

$\frac{x}{m} = KP^{1/n}$

Solution:

$\log \frac{x}{m} = \log K + \frac{1}{n} \log P$

log K= 0.6020

K = 4

$\tan 45^{\circ} = 1 = \frac{1}{n}$

$\therefore\ \frac{x}{m} = KP^{1/n}$

= 4 × (0.4)

= 1.6

⇒ 16×10^{-1}

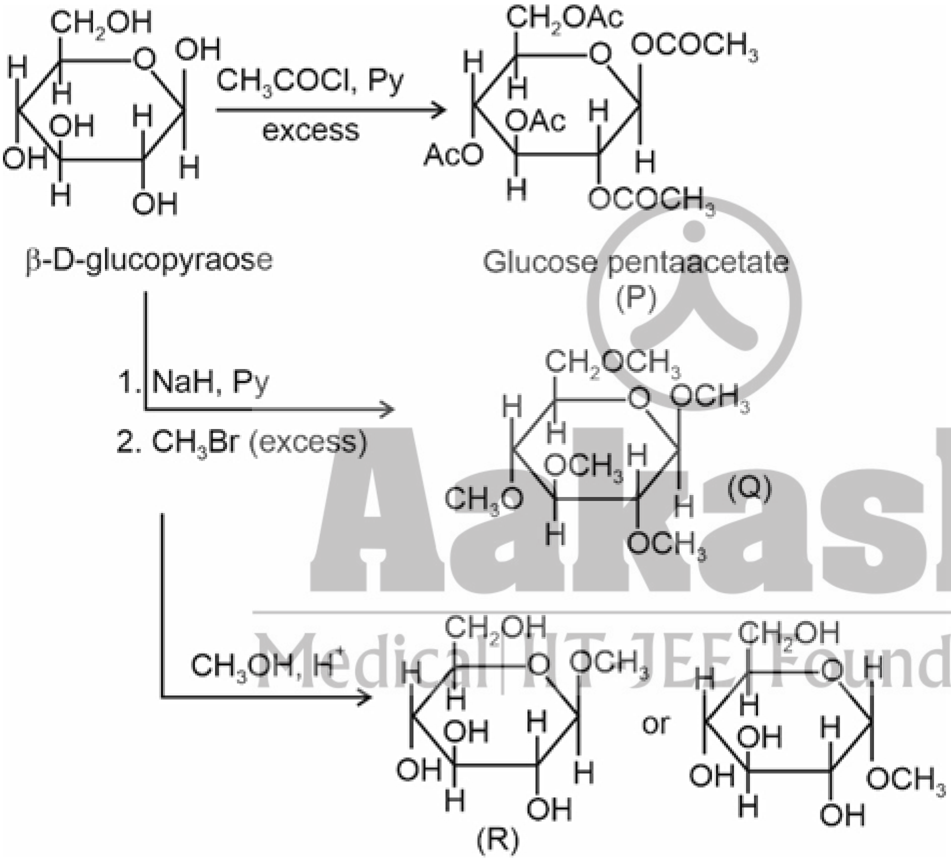
∴ P = 16.00

(40) **Answer :** 02.00

Hint:

CH_3COCl, Py causes acetylation of –OH group present in β-D-glucopyranose.

Solution:



∴ Difference in the molecular weight of P and Q is 28 × 5 = 140 units

∴ R is a non-reducing sugar.

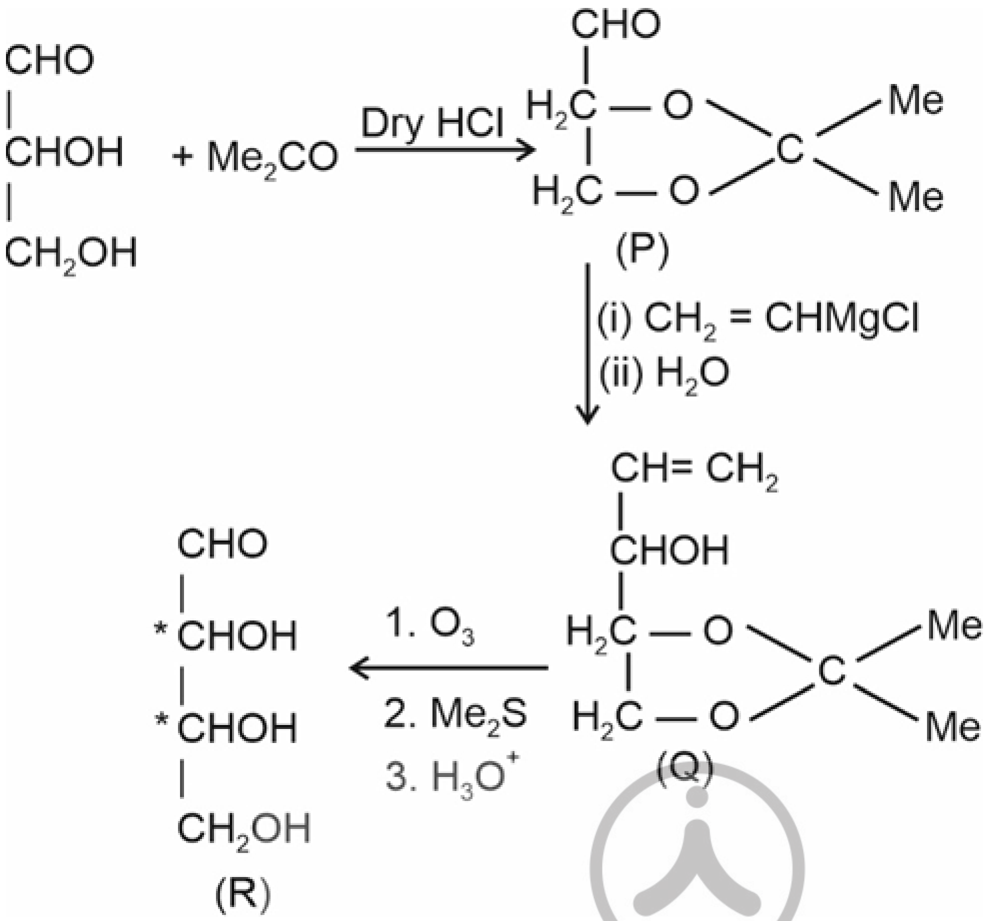
∴ P, Q and R all having same number of stereoisomers.

∴ Mo. wt. of P increases by (5 × 43 – 5) = 210 units

∴ R doesn’t show mutarotation.

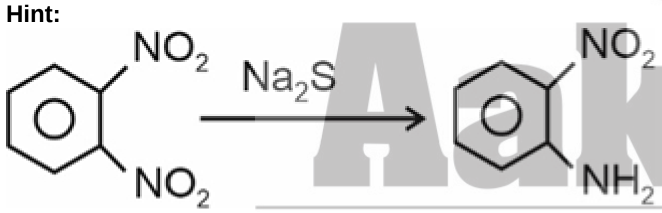
(41) **Answer :** 06.00

Solution:

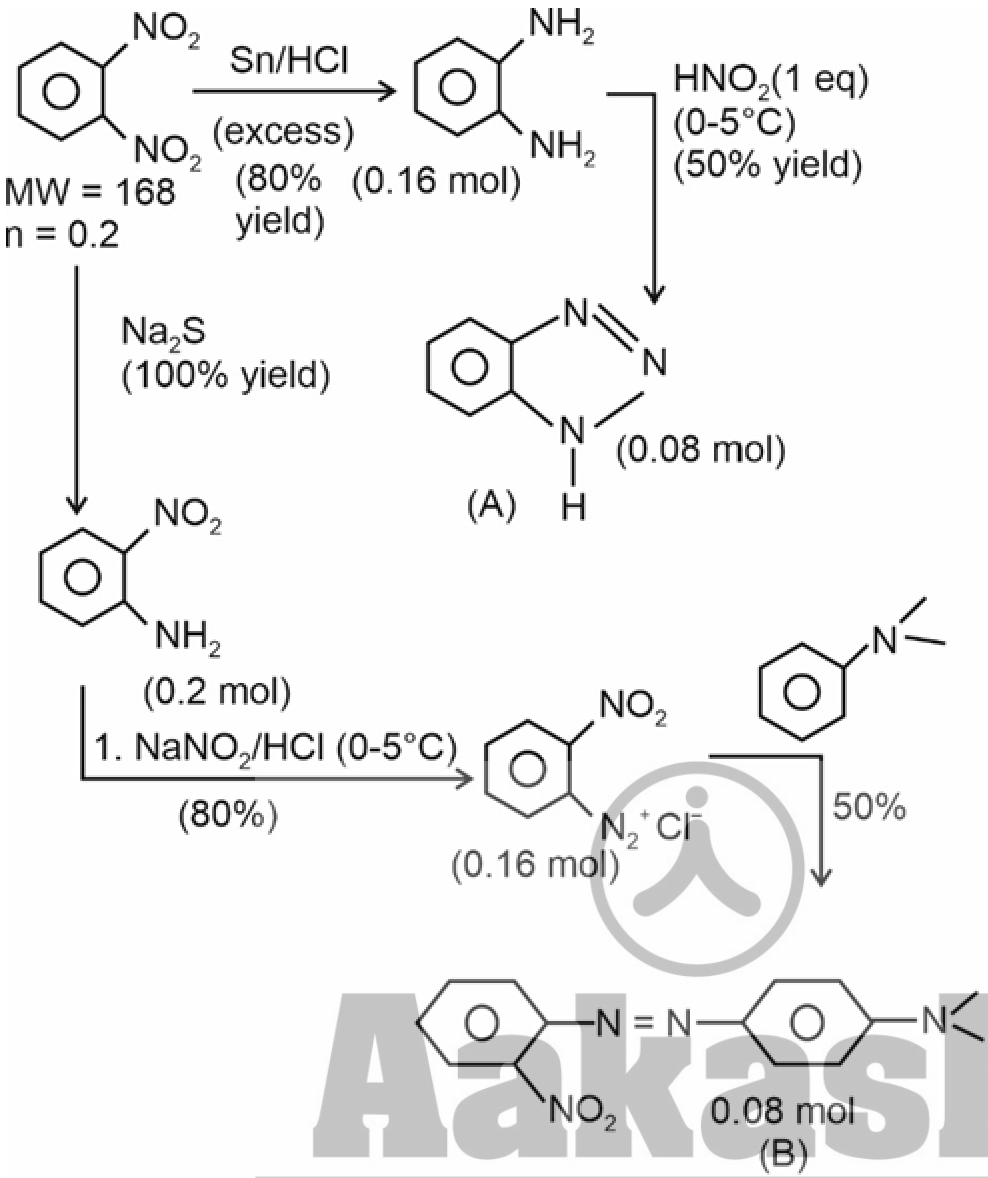


(42) **Answer :** 56.00

Hint:

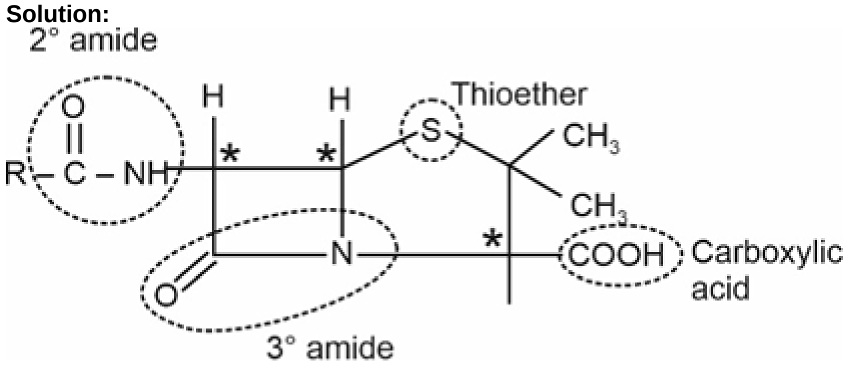


Solution:



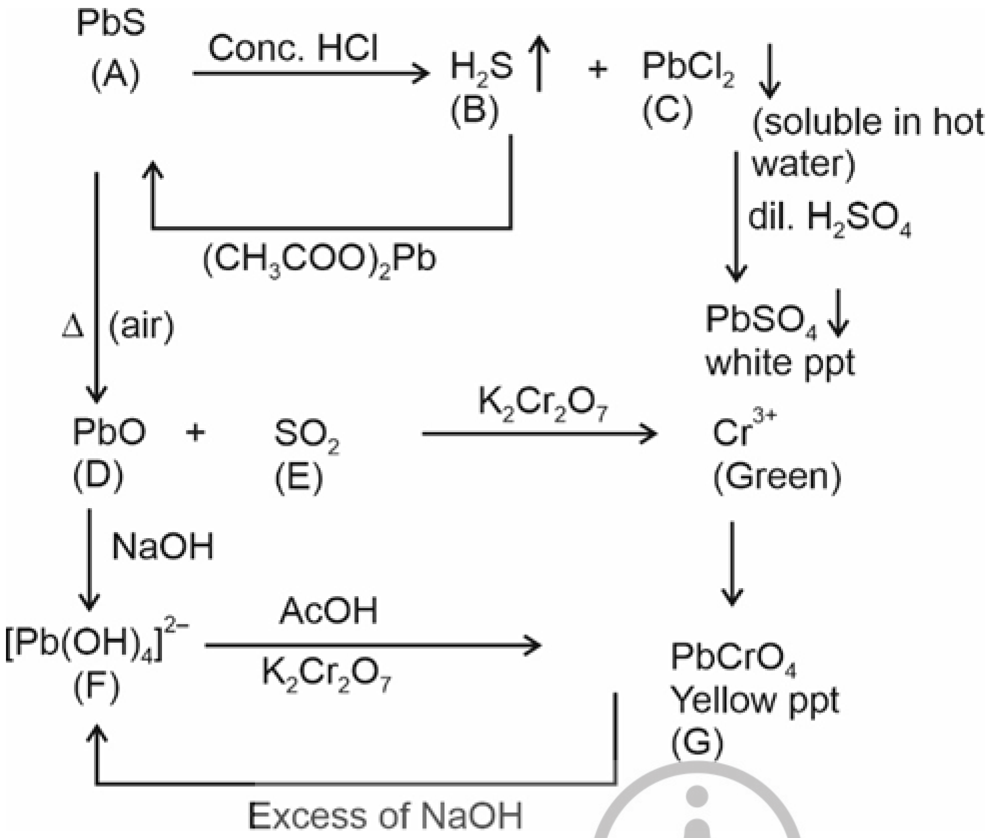
∴ Trivalent atoms
in A = 0.08 × 3 = 0.24 mol
∴ Trivalent atoms in B = 0.08 × 4 = 0.32
Sum = 0.56 = 56 × 10^{-2} ∴ P = 56.00

(43) **Answer :** 07.00
Hint:
Penicilin contains 3 chiral carbons.
Solution:



· 3 chiral carbons
· 4 different F.G.

(44) **Answer :** 05.00
Hint:
PbS is black.
Solution:
(1), (2), (3), (6), (7) are correct.



Section-II

(45) **Answer :** (A,B,C)

Hint:

Zn is used as reducing agent in cyanide process.

Solution:

$4Au + 8NaCN + 2H_2O + O_2 \rightarrow$

$4Na[Au(CN)_2] + 4NaOH$

$2Na[Au(CN)_2] + Zn \rightarrow Na_2[Zn(CN)_4] + 2Au\downarrow$

(46) **Answer :** (A,B)

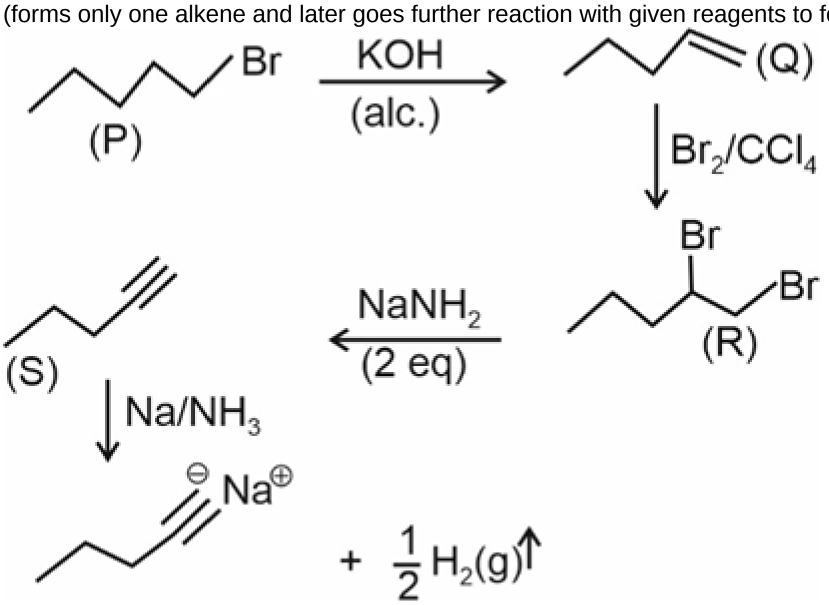
Hint:

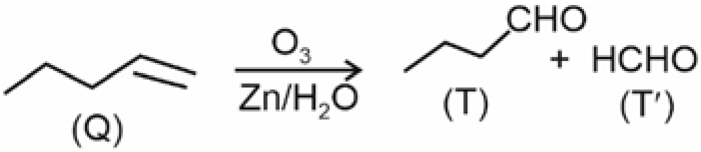
Terminal alkyne reacts with Na to release H_2 gas.

Solution:

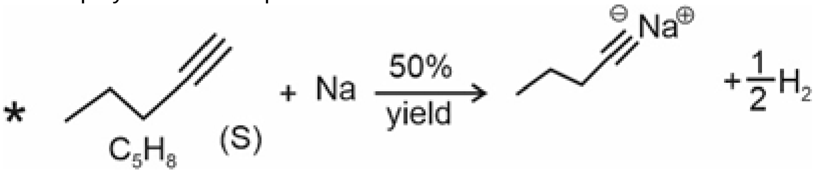
P ⇒ 

(forms only one alkene and later goes further reaction with given reagents to form terminal alkyne)





HCHO polymerises with phenol to form novolac.



MW = 68 g

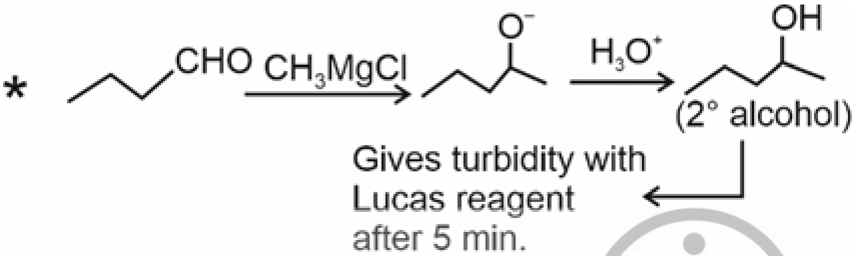
$n = \frac{13.6}{68} = 0.2$

∴ 0.2 mol of C_5H_8 produces

⇒ 0.05 mol H_2

⇒ 0.05 × 2 g

⇒ 0.1 g H_2



* T and T′ both can't be separated through Cu_2Cl_2/NH_4OH or with iodoform test.
* T and T′ both give red ppt with Cu_2Cl_2/NH_4OH.
* T and T′ both do not give iodoform test.

(47) **Answer :** (A,C,D)

Hint:

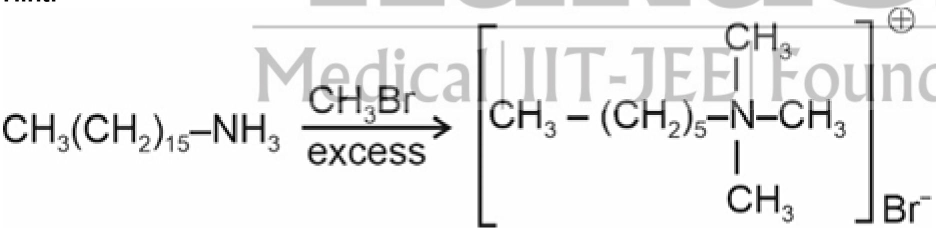
Flocculation value is inversely proportional to the charge of ion causing coagulation.

Solution:

$CH_3(CH_2)_{14}COO^- Na^+$ has lower CMC than $CH_3(CH_2)_{10}COO^- Na^+$

(48) **Answer :** (A,B,C)

Hint:



Solution:

$2C_{17}H_{35}COONa + CaCl_2 \rightarrow$

$2NaCl + (C_{17}H_{35}COO)_2 Ca$

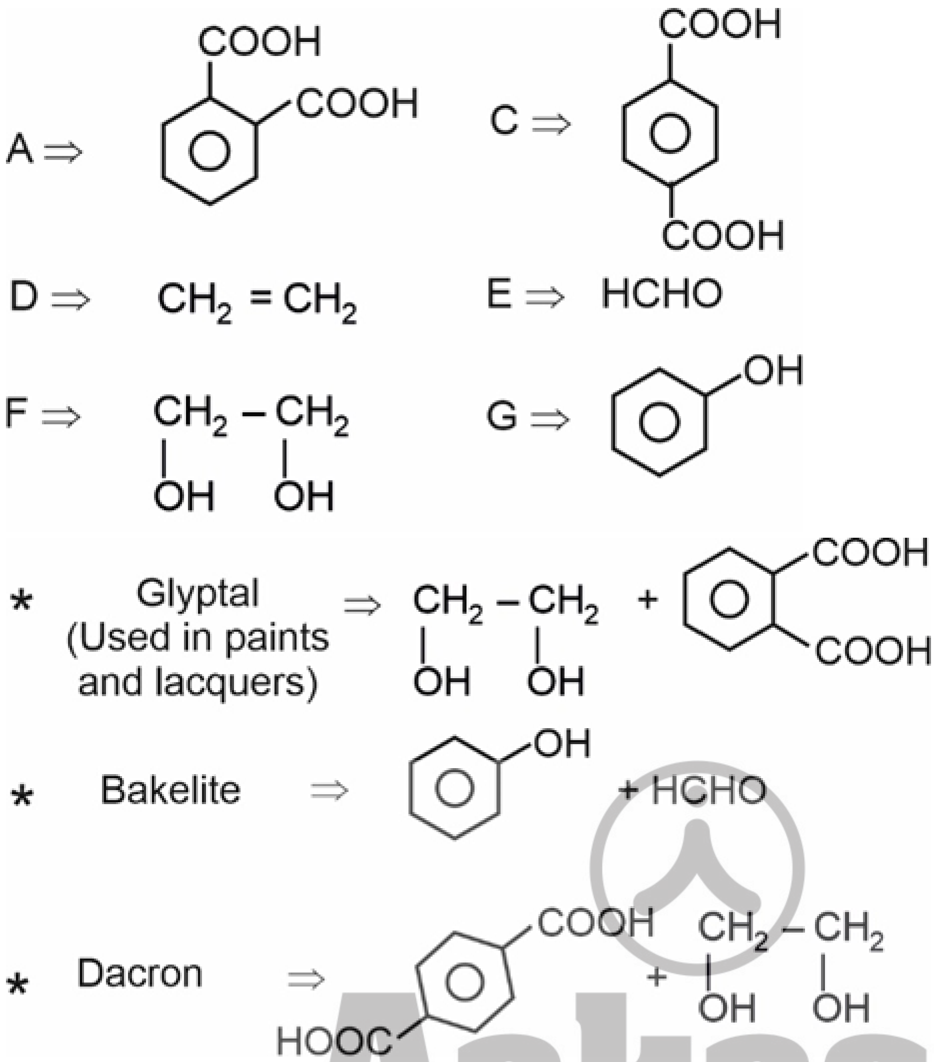
(soap reaction)

(49) **Answer :** (A,B,C)

Hint:

Glyptal is used in paints and lacquers.

Solution:



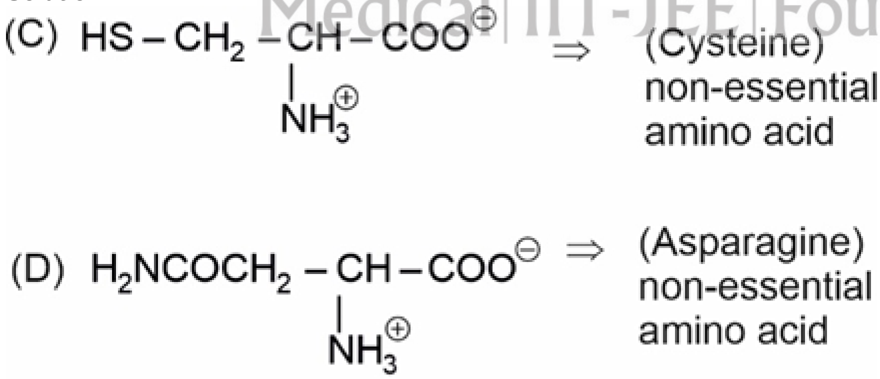
E and F don't form polymer together.

(50) Answer : (C,D)

Hint:

Cysteine is non-essential amino acid.

Solution:



Section-III

(51) Answer : (A)

Hint:

$CO + H_2 \xrightarrow{Cu} HCHO$

Solution:

$CO + 3H_2 \xrightarrow{Ni} CH_4 + H_2O$

$CH_4 + O_2 \xrightarrow[\Delta]{Mo_2O_3} HCHO$

$CO + 2H_2 \xrightarrow{Cu/ZnO-Cr_2O_3} CH_3OH$

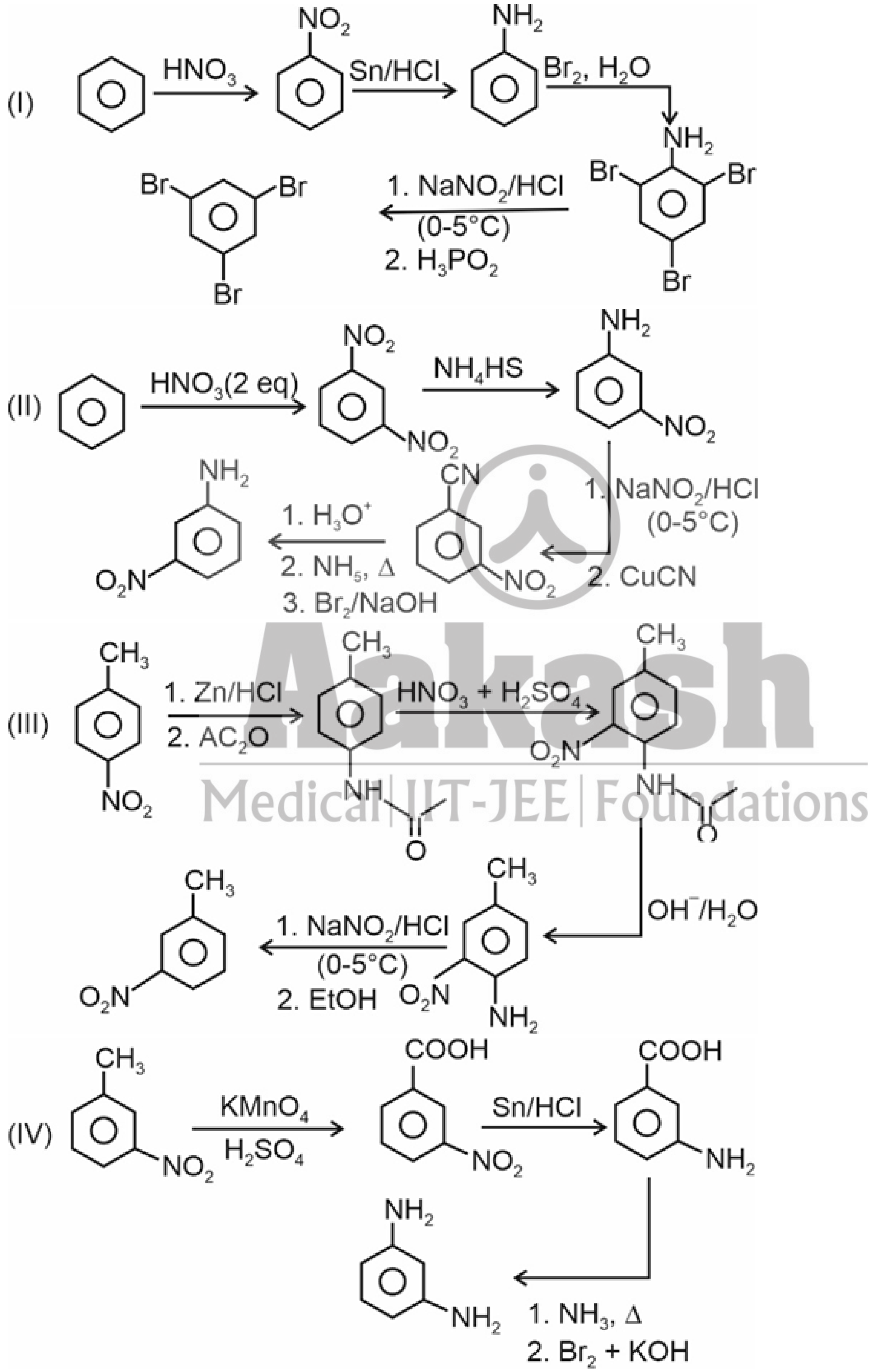
$$Urea + H_2O \xrightarrow{Urease} CO_2 + NH_3$$

(52) Answer : (C)

Hint:

Sn/HCl reduces nitrobenzene to aniline.

Solution:



(53) Answer : (A)
Solution:
(I) → (S); (II) → (R); (III) → (P); (IV) → (Q)

(54) Answer : (C)
Solution:
(I) → (T); (II) → (P); (III) → (Q); (IV) → (R, S)