22/03/2026

Code-D

Aakash
Medical | IIT-JEE | Foundations

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 Two Year JEE(Advanced)-2027 (XI Studying-P1)_Test-4A_Paper-2_Online

Time : 180 Min.

PHYSICS

Section-I

1. (C)

2. (B)

3. (C)

4. (C)

Section-II

5. (A,C)

6. (B,D)

7. (B,D)

8. (A,D)

Section-III

9. (12.80)

10. (05.00)

11. (00.80)

12. (03.00)

13. (15.00)

14. (02.00)

15. (02.00)

16. (27.00)

CHEMISTRY

Section-I

17. (B)

18. (C)

19. (A)

20. (D)

Section-II

21. (B,C)

22. (B,C)

23. (A,B,C)

24. (A,D)

Section-III

25. (03.46)

26. (11.00)

27. (00.04)

28. (04.00)

29. (08.24)

30. (08.00)

31. (03.00)

32. (12.50)

MATHEMATICS

Section-I

33. (A)

34. (C)

35. (C)

36. (C)

Section-II

37. (A,C)

38. (A,D)

39. (A,B)

40. (A,C)

Section-III

41. (04.00)

42. (02.00)

43. (00.00)

44. (35.00)

45. (05.00)

46. (29.00)

47. (05.00)

48. (06.00)

Hints and Solutions

PHYSICS

Section-I

(1) **Answer :** (C)

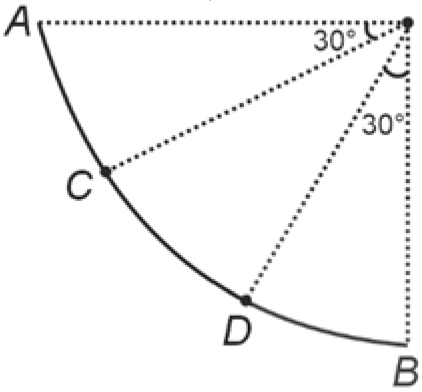
Hint:

$V_C = \sqrt{g\ell},\ V_D = \sqrt{\sqrt{3}\,g\ell}$

Solution:

$t_{AP} > \sqrt{\frac{2\ell\ \sin 30}{g}} = \sqrt{\frac{\ell}{g}}$

$V_C = \sqrt{g\ell},\ V_D = \sqrt{\sqrt{3}\,g\ell}$



The bob clearly covers the $\frac{\ell\pi}{6}$ long arcs *CD* and *DB* more rapidly than if it had moved along the first section with a constant speed V_C and along the later one with speed V_D .

$t_{CB} < \frac{\ell\,\pi}{6\,V_P} + \frac{\ell\,\pi}{6\,V_Q} \approx 0.92\sqrt{\frac{\ell}{g}}$

So, $t_1 > t_2$

(2) **Answer :** (B)

Hint:

$\vec{a} = \frac{d^2x}{dt^2}\,\hat{i} + \frac{d^2y}{dt^2}\,\hat{j} + \frac{d^2z}{dt^2}\,\hat{k}$

Solution:

$\frac{dz}{dt} = 3\alpha\,x^2\frac{dx}{dt} + 2\beta y\frac{dy}{dt} = 3\alpha\,vx^2 + 2\beta vy$

$\frac{d^2z}{dt^2} = 6\alpha\,vx\left(\frac{dx}{dt}\right) + 2\beta\,v\left(\frac{dy}{dt}\right)$

$= 6\alpha\,v^2 + 2\beta\,v^2$

Now, acceleration of particle is

$\vec{a} = \frac{d^2x}{dt^2}\,\hat{i} + \frac{d^2y}{dt^2}\,\hat{j} + \frac{d^2z}{dt^2}\,\hat{k}$

$= \left(6\alpha\,v^2x + 2\beta\,v^2\right)\hat{k}$

(3) **Answer :** (C)

Hint:

Area = displacement

Solution:

Area = displacement

⇒ $v_0 = \frac{3}{2}$ m/s

(4) **Answer :** (C)

Hint:

$Y_{\text{com}} = \frac{m_1y_1 + m_2y_2}{m_1 + m_2}$

Solution:

Centre of gravity first goes down then rise up.

Section-II

(5) **Answer :** (A,C)
Hint:
$a=\frac{dV}{dt}$
Solution:
$a=\frac{d}{dt}\left(\alpha\sqrt{x}\right)=\frac{\alpha^2}{2}$ = constant
$a=\frac{dV}{dt},\ v=\frac{\alpha^2}{2}t$
$$\langle v\rangle=\frac{\int_0^t v-dt}{\int dt}=\frac{5}{t}$$
$a=\frac{\alpha^2}{2},\ t=\frac{2\sqrt{3}}{\alpha}$
$\langle v\rangle=\frac{\alpha\sqrt{x}}{2}$

(6) **Answer :** (B,D)
Hint:
$[x]=ML^{-1}$
Solution:
$[x]=\frac{\lfloor F\rfloor\lfloor V^2\rfloor}{[Y^2]}$
and $\frac{[2\pi]\lfloor Y\rfloor}{[V^2]}=1$
$[Y]=L^2T^{-2}$
$\lfloor X\rfloor=ML^{-1}$

(7) **Answer :** (B,D)
Hint:
$Q=Q_{AB}+Q_{BC}+Q_{CA}$
Solution:
$Q=Q_{AB}+Q_{BC}+Q_{CA}$
$Q_{AB}=C_P\Delta T=C_P\frac{\Delta U}{C_V}=-5\ V_0$
$Q_{BC}=\Delta U=3U_0$
$Q_{CA}=nRT\ \ln\ \left(\frac{V_A}{V_C}\right)=\frac{10u_0}{3}\ \ln\ \left(\frac{\rho_C}{\rho_A}\right)$
$\rho_A=2\rho_0,\ \rho_C=\rho_B=5\rho_0$
$Q_{CA}=\frac{10u_0}{3}\ \ln\ \left(\frac{5}{2}\right)$
$Q=\left[\frac{10}{5}\ \ln\ \left(\frac{5}{2}\right)-2\right]u_0$
$W_{AB}=\Delta Q_{AB}-\Delta U_{AB}=-2u_0$

(8) **Answer :** (A,D)
Hint:
$mg\left(2x_0\right)=mg\ x_0+\frac{1}{2}\ k\ x_0^2$
Solution:
$mg\left(2x_0\right)=mg\ x_0+\frac{1}{2}\ k\ x_0^2$
x_0 = amplitude of block A = $\frac{2mg}{K}$
$mgx_0=mg\left(\frac{x_0}{2}\right)+\frac{1}{2}\ K\left(\frac{x_0}{2}\right)^2+\frac{1}{2}\ mV_m^2+\frac{1}{2}\ m\left(\frac{V_m}{2}\right)^2$
$V_m=2g\sqrt{\frac{m}{5K}}$
$\frac{V_m}{2}=\omega\left(\frac{x_0}{2}\right)$
$T=\frac{2\pi}{\omega}=\frac{1}{2\pi}\sqrt{\frac{K}{5m}}$

Section-III

(9) **Answer :** 12.80
Hint:

$\Delta T\sin\theta = \Delta mg$

Solution:

Let change in tension is ΔT

2, $\Delta T\sin\beta = \Delta mg$, $\Delta\ell = \frac{(\Delta T)L}{AY}$

But $\Delta\ell = L\alpha\ \Delta\theta$

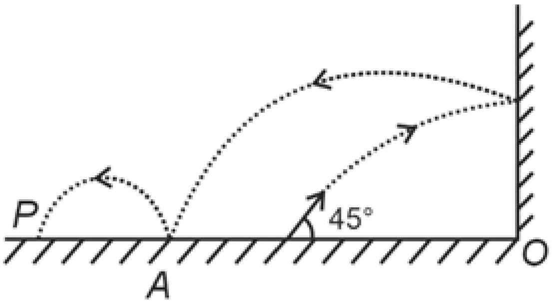
$\Delta m = \frac{\alpha\ \Delta\theta\times A\times Y\times 2\sin\beta}{g} = \frac{64}{5}$ kg

(10) **Answer :** 05.00

Hint:

$T = \frac{2u}{g}$

Solution:



$u_x = 10$ m/s, $u_y = 10$ m/s

Due to the collision the direction of u_x changes, while u_y remains same.

Hence time of flight does not change.

T = $\frac{2u_y}{g}$ = 2 sec

Particle strikes at t = 0.5 sec, hence it remains in air for 1.5 sec more, and travels, OA = $u_x \times 1.5$ = 15 m

Now when it strikes the ground and rebounds its horizontal velocity does not change while vertical becomes, $V_y' = e\, v_y$ = $0.5 \times 10 = 5$ m/s

Now the range of this projectile,

AP = $\frac{\left(2u_x V_y'\right)}{g} = \frac{2\times10\times5}{10}$ = 10 m

OP = 25 m

(11) **Answer :** 00.80

Hint:

$a = \alpha R$

Solution:

About centre of disc

$\frac{3mg}{2} + Mg = N \Rightarrow N = \frac{5Mg}{2}$

$f = \frac{5}{2}\ \mu\ mg$

$\alpha R = a_{com},\ a_{com} = \frac{f}{m}$

$\frac{MR^2}{2}\ \alpha = \frac{3Mg}{2}\times 2R - \frac{2\mu\ MRg}{2}$

$\alpha = \frac{6g\ -\ 5\ \mu g}{R}$

$\alpha R = \frac{f}{m} = 6g - 5\mu g$

$\mu = \frac{4}{5}\ =\ 0.8$

(12) **Answer :** 03.00

Hint:

$\int F dt = \Delta p$

Solution:

$F = \frac{4F_0}{T_0^2}\ t\left(T_0 - t\right)$

$a = \frac{4F_0}{mT_0^2} t\left(T_0 - t\right)$

$V = \frac{4F_0}{mT_0^2}\left[T_0\ \frac{t^2}{2} - \frac{t^3}{3}\right]$

$$\int_0^s ds = \frac{4F_0}{mT_0^2}\left[\frac{T_0}{2}\int_0^{T_0} t^2 dt - \frac{1}{3}\int_0^{T_0} t^3 \, . \, dt\right]$$

$$S = \frac{F_0 T_0^2}{3m}$$

(13) **Answer :** 15.00

Hint:

$y = \frac{\omega^2}{2g}x^2$

Solution:

$\Delta h = \frac{\omega^2(r_2^2 - r_1^2)}{2g}$

$= \frac{100 \times \left(0.2^2 - 0.1^2\right)}{2 \times 10}$

$= \frac{100 \times 3}{100 \times 2 \times 10} \times (100)$

= 15 cm

(14) **Answer :** 02.00

Hint:

$\Delta P = \rho g \Delta h$

Solution:

$OM(\rho - d)g + OM(\rho + d)g = ON(\rho + d)g + ON(\rho)g$

$OM(\rho - d) + (R - OM)(\rho + d) = (R - ON)(\rho + d) + ON(\rho)$

$OM(\rho - d - \rho - d) = ON(\rho - \rho - d)$

$2OM = ON$

$\frac{ON}{OM} = 2$

(15) **Answer :** 02.00

Hint:

$\Delta P = -\beta\frac{\Delta V}{V}$

Solution:

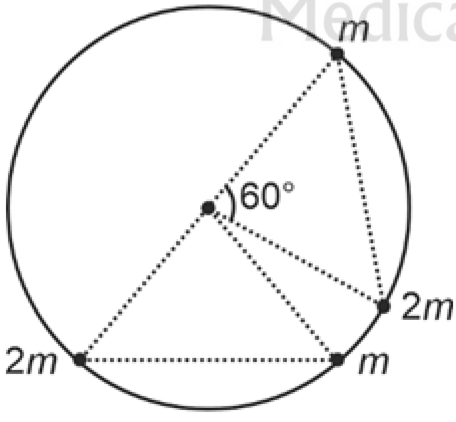
$\frac{W}{V_0} = \frac{(P - P_0)^2}{2B}$

(16) **Answer :** 27.00

Hint:

Work energy theorem

Solution:



$\frac{1}{2}(2m)V^2 + \frac{1}{2}mV^2 = \Delta P.E$

$\Delta P.E = 2mg(\ell\cos 30 - \ell\sin 60^\circ)$

$+mg\left(\ell \cos 30 + \frac{\ell}{2}\right)$

$= mg\ell\left[\frac{3\sqrt{3}-1}{2}\right]$

$V = \sqrt{\left(\frac{3\sqrt{3}-1}{3}\right)g\ell}$

CHEMISTRY

Section-I

(17) Answer : (B)

Hint:

Acc. to Bohr model of atom, $r = \frac{n^2}{Z} a_o$

Solution:

Acc. to Bohr model of atom, $r = \frac{n^2}{Z} a_o$

A. For H-atom $r = \frac{2^2}{1} a = 4a_o$

B. For Li^{2+} ion $r = \frac{3^2}{3} a_o = 3a_o$

C. For He^+ ion $r = \frac{3^2}{2} a_o = 4.5a_o$

D. For H atom (3^{rd} orbit) $r = \frac{3^2}{1} a_o = 9a_o$

(18) Answer : (C)

Hint:

Polluted water could have a BOD value of 17 ppm or more.

Solution:

Freons are non-reactive, non-flamable, non-toxic organic molecules and therefore used in refrigerators, air conditioners etc.

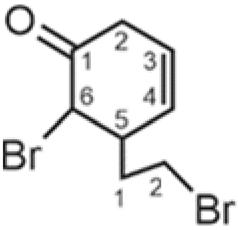
Polluted water could have a BOD value of 17 ppm or more.

(19) Answer : (A)

Hint:

Functional group is present in ring.

Solution:



6-Bromo-5-(2-bromo ethyl) cyclohex-3-enone

(20) Answer : (D)

Hint:

$\Delta v \times \Delta x \geq \frac{h}{4\pi m}$

Solution:

Given Δx = 4 × ΔV

$\Delta v \times \Delta x \geq \frac{h}{4\pi m}$

$\Delta v \times 4\Delta v \geq \frac{h}{4\pi m}$

$\Delta v^2 \geq \frac{h}{16\,\pi m}$

$\Delta v \geq \frac{1}{4}\sqrt{\frac{h}{\pi m}}$

Section-II

(21) Answer : (B,C)

Hint:

Since no heat exchange occurs

$\Delta S_{surrounding} = 0$

Solution:

Since no heat exchange occurs

$\Delta S_{surrounding} = 0$

$\Delta S_{system} = nC_v \ln \frac{T_2}{T_1} + nR \ln \frac{v_2}{v_1}$

$= 0 + 2 \times 8.3 \ln \frac{10}{4}$

$= 15.23\ JK^{-1}$

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

Hint:

$(meq)_{K_2Cr_2O_7} = (meq)_{Fe^{2+}}$

Solution:

$\underset{n-factor=1}{Fe^{2+}} \rightarrow Fe^{3+} + e^-$

$\underset{n-factor=5}{KMnO_4} + 5e^- \rightarrow Mn^{2+}$

$\underset{n-factor=6}{K_2Cr_2O_7} \rightarrow Cr^{3+}$

m.eq of Fe^{2+} = meq of $K_2Cr_2O_7$

m.eq Fe^{2+} = 0.1 × 20 × 6 = 12

meq Fe^{2+} = meq $KMnO_4$

12 = 0.1 × V × 5

V = 24 mL

% purity $= \frac{\frac{12\times10^{-3}}{1}\times152\times100}{2}$

= 91.2

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

Hint:

Generally odd e⁻ species can form dimer

Solution:

NO_2 forms N_2O_4

ICl_3 forms I_2Cl_3

$Al(CH_3)_3$ forms $Al_2(CH_3)_6$

ClO_2 does not form dimer.

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

Hint:

% of free SO_3 = $\frac{40x}{9}$

Solution:

% of free SO_3 = $\frac{40x}{9} = \frac{40\times4.5}{9} = 20\%$

Mass of H_2SO_4 in sample after addition of water = 261.25

g eq of H_2SO_4 = g eq of NaOH

$\frac{261.25}{98} \times 2 = 2 \times V$

2.66 L = V

Section-III

(25) **Answer :** 03.46

Hint:

$[H^+]$ coming from second dissociation of H_2CO_3 is negligible

Solution:

$[CH_3COOH]_{\text{after mixing}}$ = 0.001

$[H_2CO_3]_{\text{after mixing}}$ = 0.2

$[H^+] = \sqrt{K_{a_{CH_3COOH}} \times C + K_{a_{1_{H_2CO_3}}} \times C}$

$= \sqrt{2\times10^{-5}\times0.001 + 0.2 \times 5\times10^{-7}}$

$= \sqrt{2 \times 10^{-8} + 1 \times 10^{-7}}$

$= \sqrt{12} \times 10^{-4}$

$pH = -\log\left(\sqrt{12} \times 10^{-4}\right) = \left[4 - \frac{1}{2} (2\log 2 + \log 3)\right]$

$= 4 - \frac{1}{2} [2 \times 0.3 + 0.48]$

= 3.46

(26) **Answer :** 11.00

Hint:

$\Delta_r G^\circ = \Delta_r H^\circ - T\Delta_r S^\circ$

Solution:

$\Delta_r G^\circ = \Delta_r H^\circ - T\Delta_r S^\circ$

$\Delta_r G^\circ = (80-120) \times 10^3 - 300 \times (70-110)$
$\Delta_r G^\circ = -40 \times 10^3 + 12 \times 10^3$
$\Delta_r G^\circ = -28 \times 10^3$
$-RT \ln K = -28 \times 10^3$
$-8.30 \times 300 \ln k = -28 \times 10^3$
$\ln k = 11.24$

(27) Answer : 00.04
Hint:
$K_p = \frac{(p_B)^3 (p_c)}{(p_A)^2}$
Solution:

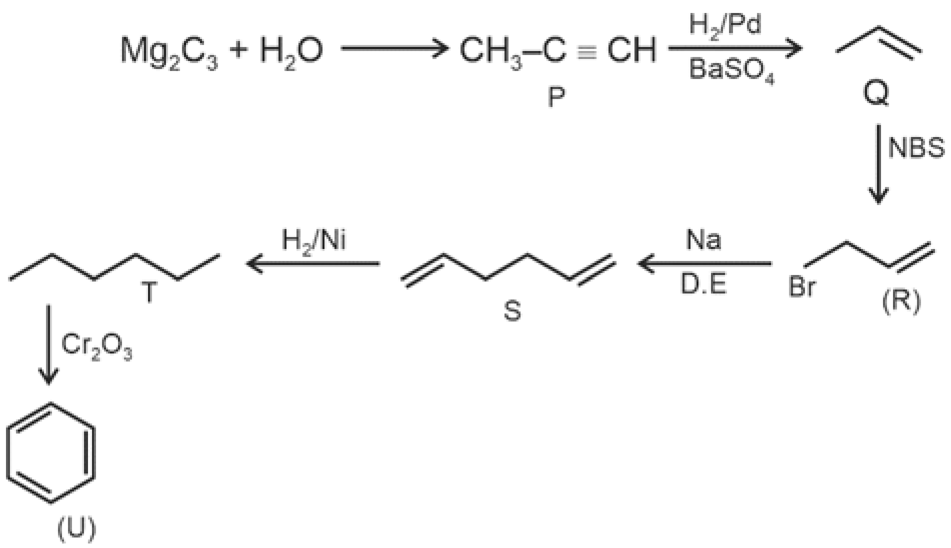
	$2A(g)$	$\rightleftharpoons$	$3B(g)$ +	$C(g)$
$t=0$	P_0		0	0
$t=t_{eq}$	$P_0(1-\alpha)$		$\frac{3P_0\alpha}{2}$	$\frac{P_0\alpha}{2}$

$\alpha << 1$
$K_p = \frac{27\alpha^4}{16} P^2$
$\alpha = 2 \sqrt[\frac{1}{4}]{\frac{K_p}{27P^2}} = 2 \sqrt[\frac{1}{4}]{\frac{432 \times 10^{-12}}{27 \times (0.01)^2}}$
$= 2 \times 2\sqrt{10^{-8}}$
= 0.04

(28) Answer : 04.00
Hint:
PF_3 is pyramidal
Solution:
$XeOF_4$, BrF_5, SO_3 & PCl_3F_2
have at least 4 atom in same plane.

(29) Answer : 08.24
Hint:
$K_{sp} = [Ag^+][Br^-]$
Solution:
$K_{sp} = [Ag^+][Br^-]$
$K_{sp} = [2 \times 10^{-5}][2 \times 10^{-5}]$
$K_{sp} = 4 \times 10^{-10}$ M
For precipitation
$Q_{iP} = K_{sp}$
$[Ag^+][Br^-] = 4 \times 10^{-10}$
$[Br^-] = \frac{4 \times 10^{-10}}{0.5} = 8 \times 10^{-10}$
$8 \times 10^{-10} = [NaBr] = \frac{w}{103 \times 10}$
$8 \times 103 \times 10 \times 10^{-10} = w$
$8.24 \times 10^{-7} g = w$

(30) Answer : 08.00
Hint:
$Mg_2C_3 + H_2O \rightarrow CH_3C \equiv CH$
Solution:



(31) **Answer :** 03.00

Hint:

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Solution:

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{\frac{710-26}{760}\times 45}{300} = \frac{1 \times V_{mL}}{273}$

36.855 mL = V_{mL}

Moles of N_2 = $\frac{36.855}{22400}$

Mass of N atoms = 0.0460 g

Molar mass of compound $= \frac{0.5 \times 28}{0.046}$

= 304.347 g

(32) **Answer :** 12.50

Hint:

b = $4 \times \frac{4}{3}\pi r^3 \times N_A$

Solution:

b = $4\pi \times 10^{-4} \times 1000 = 4 \times \frac{4}{3}\pi r^3 \times 6 \times 10^{23}$

r = 5 × 10^{-9} cm

Distance of closest approach = 2r

= 2 × 5 × 10^{-9} cm = 10^{-8} cm = 10^{-10} m

y = 10

1.25y = 12.50

MATHEMATICS

Section-I

(33) **Answer :** (A)

Hint:

$e_H = 2$

Solution:

$\frac{x^2}{36} + \frac{y^2}{11} = 1$

$e^2 = 1 - \frac{11}{36} \Rightarrow e = \frac{5}{6}$

Foci of ellipse is (± *ae*, 0) = (± 5, 0)

hyperbola is $\frac{x^2}{\frac{100}{16}} - \frac{y^2}{\frac{P}{16}} = 1$

$a = \frac{10}{4} = \frac{5}{2}$

$b^2 = \frac{P}{16}$

$ae_H = 5$

$\frac{5}{2} \cdot e_H = 5$

$e_H = 2$

$4 = 1 + \frac{\frac{P}{16}}{\frac{100}{16}}$

$\Rightarrow\ 3 = \frac{P}{100}$

$\Rightarrow P = 300$

Length of latus rectum

$= \frac{2.300}{16.\frac{5}{2}} = 15.$

(34) Answer : (C)

Hint:

$D = \left(\frac{1+5+x_1}{3},\ \frac{3+7+y_1}{3}\right)$

Solution:

Take point $A(x_1, y_1)$ & $D(\alpha, \beta)$

$D = \left(\frac{1+5+x_1}{3},\ \frac{3+7+y_1}{3}\right) = (\alpha,\ \beta)$

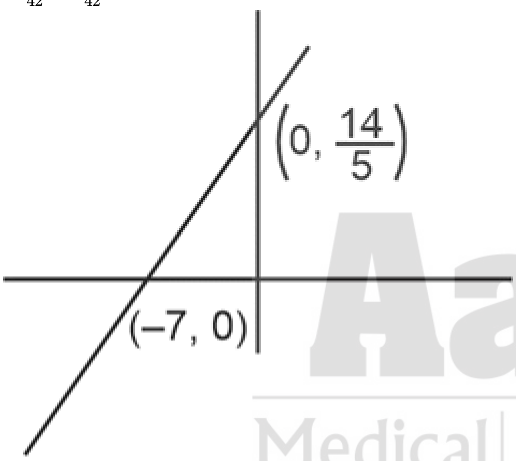
$x_1 = 3\alpha - 6$

$y_1 = 3\beta - 10$

also $2x_1 - 5y_1 + 4 = 0$

$2(3\alpha - 6) - 5(3\beta - 10) + 4 = 0$

$-\frac{6\alpha}{42} + \frac{15\beta}{42}\ = 0$



Area $= \frac{1}{2}\ \times\ 7\ \times\ \frac{14}{5}$

$= \frac{49}{5}$

(35) Answer : (C)

Hint:

For $f(x)\ >\ 0\ \forall\ x\ \in R$

$D < 0$

Solution:

For $f(x)\ >\ 0\ \forall\ x\ \in R$

as $a > 0$

so $D < 0$

$[2(P + 3)]^2 - 4(-6P + 3) < 0$

$4(P^2 + 9 + 6P) + 24P - 12 < 0$

$4P^2 + 48P + 24 < 0$

so $P \in [-11, -1]$

probability $= \frac{11}{31}$

(36) Answer : (C)

Hint:

$\left(\frac{0}{0}\right)$ form, apply L'Hopital's

Solution:

$\left(\frac{0}{0}\right)$ form, so here we apply L'Hopital's

$\lim_{x\to 3}\frac{2x(1+f(3))-9f'(x)-6}{1}$
= 2 × 3 (1 + 2) – 9f'(3) – 6
= 18 – 15
= 3

Section-II

(37) **Answer :** (A,C)
Hint:
$n(A) = 2(50)^2 + 1$
Solution:
$A = S_1 \cup S_2 \cup \ldots \cup S_{50} = S_{50}$
$B = S_1 \cap S_2 \cap \ldots \cap S_{38} = S_1$
$S_1 < S_{50}$
$A < B$
$n(A) = 2(50)^2 + 1 = 5001$
$n(B) = 2(1)^2 + 1 = 3$
$A < B \Rightarrow n(A - B) = n(A) - n(B)$
$n(A \Delta B) = n(A - B)$

(38) **Answer :** (A,D)
Hint:
$\frac{a+b+c}{3} = 8$
Solution:
$a < b < c$
Median = 10
$\Rightarrow b = 10$
$\frac{a+b+c}{3} = 8$
$a + c = 14$
As there is no mode.
$0 < a < 10$
$c > 10$
$a + c = 14$.
(a, c) can be (1, 13), (2, 12), (3, 11). So possible ordered triplet → (1, 10, 13), (2, 10, 12), (3, 10, 11)

(39) **Answer :** (A,B)
Hint:
Terms in $(8 + x^3)^{50} = 51$
Solution:
$(2 + x)^{52} (x^2 + 4 - 2x)^{50}$
$(2 + x)^2 [(2 + x) (x^2 + 4 - 2x)]^{50}$
$(2 + x)^2 (8 + x^3)^{50}$
Terms in $(8 + x^3)^{50} = 51$
Terms in $(2 + x)^2 = 3$
Total terms = 153 = a

$$\sum_{r=1}^{12} r \cdot \sum \frac{{}^{15}C_r}{{}^{15}C_{r-1}} = \sum_{r=1}^{12}(16-r) = 192 - 78$$

= 114 = b

(40) **Answer :** (A,C)
Hint:
$2ae = 5$
Solution:
$x + y - 2 = 0$
$2x + y - 3 = 0$
P.O.I. = (1, 1)
$2x + 3y - 23 = 0$
$2x - y - 3 = 0$
P.O.I. = (4, 5)

$$2ae = \sqrt{(4-1)^2 + (5-1)^2} = 5$$

$$2a = \sqrt{(-2-4)^2 + (5-5)^2} + \sqrt{(-2-1)^2 + (5-1)^2}$$

= 6 + 5 = 11

$2a = 11$
$e = \frac{5}{11}$
Area of triangle,
$\Delta = \frac{1}{2}\begin{vmatrix} 1 & 1 & 1 \\ 4 & 5 & 1 \\ -2 & 5 & 1 \end{vmatrix} = \frac{1}{2}\ [1\,(0) - 1\,(4+2) + 1\,(20+10)]$
= 12 sq. units

Section-III

(41) Answer : 04.00
Hint:
Put $x/y = t$
Solution:
$\ln x + \ln y = \ln (x - 2y)^2$
$xy = x^2 + 4y^2 - 4xy$
$x^2 + 4y^2 - 5xy = 0$
$\frac{x^2}{y^2} + 4 - 5\frac{x}{y} = 0$
Put $\frac{x}{y} = t$
$t^2 - 5t + 4 = 0$
$t = 1$ & $t = 4$
$\frac{x}{y} = 1$ or $\frac{x}{y} = 4$
$x \neq y$
so $\frac{x}{y} = 4$

(42) Answer : 02.00
Hint:
$\cos\frac{x}{2} = \ \pm\ \sqrt{\frac{1+\cos x}{2}}$
Solution:
$\frac{\sum_{K=1}^{44} \cos K^\circ}{\sum_{K=1}^{44} \sin K^\circ} = \frac{\cos 1^\circ + \cos 2^\circ + ... + \cos 44^\circ}{\sin 1^\circ + \sin 2^\circ + ... + \sin 44^\circ}$
$= \frac{\cos 1^\circ + \cos 2^\circ + ... + \cos 44^\circ}{\cos 89^\circ + \cos 88^\circ + ... + \cos 46^\circ}$
As $\cos x + \cos y = 2\cos\left(\frac{x+y}{2}\right)\cos\left(\frac{x-y}{2}\right)$
$= \frac{2\cos\left(\frac{45^\circ}{2}\right)\left[\cos\left(\frac{43^\circ}{2}\right) + \cos\left(\frac{41^\circ}{2}\right) + ... + \cos\left(\frac{1^\circ}{2}\right)\right]}{2\cos\left(\frac{135^\circ}{2}\right)\left[\cos\left(\frac{43^\circ}{2}\right) + \cos\left(\frac{41^\circ}{2}\right) + ... + \cos\left(\frac{1^\circ}{2}\right)\right]}$
$= \frac{\cos\left(\frac{45^\circ}{2}\right)}{\cos\left(\frac{135^\circ}{2}\right)}$
$\cos\frac{x}{2} = \pm\sqrt{\frac{1+\cos x}{2}}$
$= \frac{\sqrt{\frac{1+\frac{1}{\sqrt{2}}}{2}}}{\sqrt{\frac{1-\frac{1}{\sqrt{2}}}{2}}} \ \Rightarrow\ t = 1 + \sqrt{2}$
$[t] = 2$

(43) Answer : 00.00
Hint:
$\alpha = \arg(0 + 1)$
Solution:
$\alpha = \arg(\omega^2 - \omega^3 + \omega^4 - \omega^5 + \omega^6 - \omega^7 + ... + \omega^{676} - \omega^{677} + \omega^{678} - \omega^{679} + \omega^{681})$
$\alpha = \arg(0 + 1)$
$\alpha = 0$
$\Rightarrow 2\alpha = 0$

(44) Answer : 35.00
Hint:

Let $x_1 = a \Rightarrow a + x_2 + 7 = 42$
Solution:
Let $x_1 = a$
so $a + x_2 + 7 = 42$
$\Rightarrow x_2 = 35 - a$
$x_2 + x_3 + x_4 = 42$
$\Rightarrow 35 - a + 7 + x_4 = 42$
$\Rightarrow x_4 = a$
$x_3 + x_4 + x_5 = 42$
$\Rightarrow x_5 = 35 - a$
$x_6 = 7, x_7 = a, x_8 = 35 - a$
$\Rightarrow x_1 + x_8 = 35$

(45) **Answer :** 05.00
Hint:
$\lambda = -2, -3$
Solution:
Lines are perpendicular, so
$\lambda\ .\ \lambda + (\lambda+5).1 + 2\left(2\lambda + \frac{1}{2}\right) = 0$
$\lambda^2 + \lambda + 5 + 4\lambda + 1 = 0$
$\lambda^2 + 5\lambda + 6 = 0$
$\lambda = -2, -3$
so modulus of sum is = $|-2-3| = \boxed{5}$

(46) **Answer :** 29.00
Hint:
$(x-2)(x^2 - x + 1) = 0$
Solution:
Clearly, $x = 2$ is a root.
$(x-2)(x^2 - x + 1) = 0$
Roots are $x = 2, -\omega, -\omega^2$
$2^{30} + (-\omega)^{30} + (-\omega^2)^{30}$
$2^{30} + \omega^{30} + \omega^{60}$
$2^{30} + 1 + 1$
$2^{30} + 2$
$2(1 + 2^{29})$

(47) **Answer :** 05.00
Hint:
$e^{2x} = 16,\ e^x = \frac{3}{5},\ \frac{4}{3}$
Solution:
$(e^{2x} - 16)(15e^{2x} - 29e^x + 12) = 0$
$(e^{2x} - 16)(5e^x - 3)(3e^x - 4) = 0$
$e^{2x} = 16,\ \ e^x = \frac{3}{5},\ \ e^x = \frac{4}{3}$
$x = \frac{1}{2}\ \ln\ 16,\ \ \ln\frac{3}{5},\ \ \ln\frac{4}{3}$
Sum of all roots:
$\ln\ \left[4 \times \frac{3}{5} \times \frac{4}{3}\right]$
$\Rightarrow K = 5$

(48) **Answer :** 06.00
Hint:
Sum of x-coordinates of the 7^{th} roots of unity is 0.
Solution:
$1 + \cos\frac{3\pi}{7} + \cos\frac{\pi}{7} - \cos\frac{2\pi}{7}$
As sum of x-coordinates of the 7^{th} roots of unity is 0, we have
$\cos\frac{2\pi}{7} + \cos\frac{4\pi}{7} + \cos\frac{6\pi}{7} + \cos\frac{8\pi}{7} + \cos\frac{10\pi}{7} + \cos\frac{12\pi}{7} + \cos\frac{14\pi}{7} = 0$
$\Rightarrow \cos\frac{2\pi}{7} + \cos\frac{4\pi}{7} + \cos\frac{6\pi}{7} + \cos\frac{8\pi}{7} + \cos\frac{10\pi}{7} + \cos\frac{12\pi}{7} = -1$
$\Rightarrow \cos\frac{2\pi}{7} + \cos\frac{4\pi}{7} + \cos\frac{6\pi}{7} + \cos\left(-\frac{6\pi}{7}\right) + \cos\left(-\frac{4\pi}{7}\right) + \cos\left(-\frac{2\pi}{7}\right) = -1$

$\Rightarrow 2\left(\cos\frac{2\pi}{7}+\cos\frac{4\pi}{7}+\cos\frac{6\pi}{7}\right)=-1$

$\Rightarrow \cos\frac{2\pi}{7}-\cos\frac{3\pi}{7}-\cos\frac{\pi}{7}=-\frac{1}{2}$

$\Rightarrow \cos\frac{\pi}{7}-\cos\frac{2\pi}{7}+\cos\frac{3\pi}{7}=\frac{1}{2}$

$\Rightarrow 1+\cos\frac{3\pi}{7}+\cos\frac{\pi}{7}-\cos\frac{2\pi}{7}=\frac{3}{2}=t$

$\Rightarrow\ 4t=4\ \times\ \frac{3}{2}$

= 6