FIITJEE

ALL INDIA TEST SERIES

OPEN TEST

JEE (Advanced)-2019

PAPER – 1

TEST DATE: 03-02-2019

ANSWERS, HINTS & SOLUTIONS

Physics

PART – I

SECTION – A

1. A, B, C, D

Sol. ${}^{n}C_2 = 3, n = 3$

So initially atoms was in n = 2.

$E_3 - E_2 = 68$ eV

Hence Z = 6

$\lambda_{min} = \dfrac{12400}{E_3 - E_1} = 28.49$ Å

2. A, B, C, D

Sol. Let potential of point A is x and potential of point B is zero. Consider charge flown through 3V battery is q_0.

$2(3-x) + q_0 + (0-x)2 = 0$ …(1)

$-q_0 - (x-3)\times 1 + (2-x+3)2 = 0$ …(2)

3. A, B, C

Sol. In figure-1

$\dfrac{1}{v} + \dfrac{1}{u} = \dfrac{1}{f}$

$\dfrac{1}{v} + \dfrac{1}{-60} = \dfrac{1}{-30}$

V = – 60

Hence $m = -\dfrac{v}{v} = -1$

In figure-2, images will not separated.

4. A, B

Sol. If $\vec{v}\cdot\vec{a} > 0$, then there must be a component of $\vec{a}$ along $\vec{v}$

If $\vec{r}\cdot\vec{v} > 0$, then there must be a component of $\vec{v}$ along $\vec{r}$

5. B, C, D

Sol. Phase difference between two particles in standing wave is either zero or π at any instant of time. Potential energy depends upon strain. Particle near to nodes will experience more strain.

6. A, B, C

Sol. $\vec{a}_0 = (2g\hat{i} + g\hat{j})$

$\vec{F}_B = \rho V(\vec{a}_0 - \vec{g}) = 2\rho Vg(\hat{i} + \hat{j})$

$\vec{F}_{net} = \vec{F}_B + m\vec{g} = 2\rho Vg(\hat{i} + \hat{j}) - \rho_0 Vg\hat{j}$

$\vec{a}_{net} = \frac{2\rho}{\rho_0} g(\hat{i} + \hat{j}) - g\hat{j}$

$\vec{a}_{relative} = \vec{a}_{net} - \vec{a}_0$

7. C

8. C

Sol. (for Q. 7 to Q. 8)

$f_t = \mu mg = 8N$ …(i)

$f_f = I\alpha$

$\alpha = \frac{11}{7}$ rad/s^2 …(ii)

$\omega = \frac{v}{R} = \frac{22}{7}$ ad/sec …(iii)

$\omega^2 = \omega_0^2 + 2\alpha\theta$

$\theta = \pi$ rad …(iv)

$\omega = \omega_0 + \alpha t$

t = 2 sec …(v)

$y = \frac{1}{2} \times 2 = 1m$ …(vi)

$x = \theta \cdot R = \frac{1}{2}m$ …(vii)

9. C

10. B

Sol. (for Q. 9 to Q. 10)

$P_1(V_1)^\gamma = P_2(V_2)^\gamma$

$P_2 = P_1\left(\frac{V_1}{V_2}\right)^\gamma = 21\left(\frac{50}{400}\right)^{4/3}$

$= 21 \times \frac{1}{16}$

= 1.3125 atm

Work done = $\frac{P_1V_1 - P_2V_2}{\gamma - 1} = \frac{(21\times 50 - 1.3125\times 400)10^5 \times 10^{-6}}{\frac{4}{3} - 1}$ = 157.5 Joule

SECTION – D

11. 00000.88

Sol. $F = \frac{dp}{dt} = \frac{\Delta P}{\Delta t} = \Delta u.\left(\frac{m}{t}\right)$

$= (2 \times 2.2) \times \frac{200}{1000}$

= 0.88 Newton

12. 00031.63

Sol. $\frac{1}{2}\ mv^2 - \frac{GmM}{r}\ =\ -\frac{GmM}{2a}$

$v^2 = GM\left(\frac{2}{r} - \frac{1}{a}\right)$

$= 6.67 \times 10^{-11} \times 2 \times 10^{30}\ \left(\frac{2}{2} - \frac{1}{4}\right) \times 10^{-11} = 10.005 \times 10^{8}$

v = 31.63 km/sec

13. 00007.10

Sol. 1 MSD = 1 mm

1 VSD = 0.9 mm

L.C. = 0.1 mm

–ve error = 4 × 0.1 mm = 0.4 mm

Reading = 6 mm + 7 × 0.1 mm = 6.7 mm

Diameter = 6.7 + 0.4 = 7.1 mm

14. 00003.00

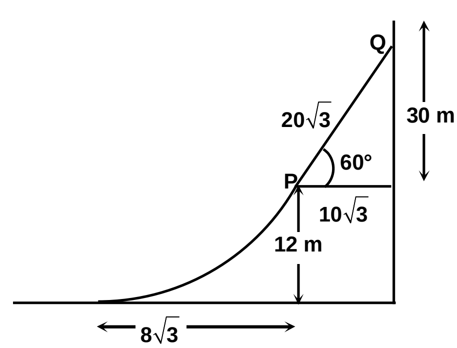
Sol. $q_0 = \int \rho dv = \int_0^R \rho_0 r^n 4\pi r^2 dr$

$q = \int \rho dv = \int_0^{R/2} \rho_0 r^n . 4\pi r^2 dr$

$\frac{kq_0}{R^2} = 16.\frac{kq}{\left(\frac{R}{2}\right)^2}$

So n = 3

15. 01800.00



Sol. $x^2 = 16y$

$2x = \frac{16dy}{dx}$

$\frac{dy}{dx} = \frac{x}{8} = \sqrt{3}$

$\theta = 60°$

$W = \Delta K$

$W_F + W_{ff} + W_g + W_N = 0$

$W_F = -W_{ff} - W_g$

$= \mu mg\left(8\sqrt{3} + 10\sqrt{3}\right) + mg(42)$

= 1800 J

16. 00256.00

Sol. $a \propto \frac{1}{n^4}$

where, a is acceleration of electron and 'n' is no. orbits.

17. 00033.33

Sol. Acceleration of container $a = \frac{100 - v}{200 + t}$

$$\int_0^v \frac{dv}{100 - v} = \int_0^{100} \frac{dt}{200 + t}$$

$$v = \frac{100}{3}\ m/s.$$

18. 00001.33

Sol. $T_1 = 2\pi\sqrt{\frac{I_1}{mgd}},\ I_1 = \frac{mL^2}{3} + mL^2$

$$T_2 = 2\pi\sqrt{\frac{I_2}{mgd}},\ I_2 = \frac{mL^2}{3} + \left[\frac{m(L/2)^2}{6} + mL^2\right]$$

$$\frac{T_1}{T_2} = \sqrt{\frac{I_1}{I_2}} = \frac{4}{3}\sqrt{\frac{6}{11}},$$

Chemistry PART – II

SECTION – A

19. A, B
Sol. In first molecule, lone pair of electrons lie in equatorial position, hence decreases θ_2 more rapidly the θ_2'. In second molecule, π-electron cloud lie closer to axial bonds and pushes them more, so $\theta_1' < \theta_1$.

20. A, B, D
Sol. Since AB is an isobaric process, so

$$\frac{V_B}{V_A} = \frac{T_B}{T_A} \Rightarrow 2 = \frac{T_B}{300} \Rightarrow T_B = 600K$$

$$W_{ABCDA} = W_{AB} + W_{BC} + W_{CD} + W_{DA}$$

$$W_{AB} = -nR\Delta T = -1200 \text{ cal}$$

$$W_{BC} = -2.303nRT_B \log\frac{V_C}{V_B} = 2.303nRT_B \log\frac{V_B}{V_D} \quad (\text{as } V_C = V_D)$$

$$W_{BC} = 2.303 \times 2 \times 2 \times 600 \times \log\frac{V_B}{V_A} \times \frac{V_A}{V_D}$$

= 2.303 × 2 × 2 × 600 × log 2/4
= - 1663.68 cal.

$$W_{C\to D} = 0$$

$$W_{D\to A} = 2.303nRT_A \times \log\frac{V_D}{V_A}$$

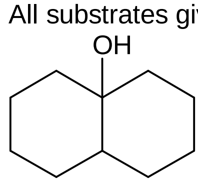
= 2.303 × 2 × 2 × 300 × log4
= 1663.68 cal.

$$W_{A\to B\to C\to D\to A} = -1200 - 1663.68 + 0 + 1663.68$$

= - 1200 cal

21. A, B, C, D
Sol. A → Curtius degradation type reaction
B → Hydration + deprotonation + tautomerisation
C → Friedel-Crafts reaction followed by benzylic acid rearrangement
D → Baeyer-Villiger + Perkin condensation reaction.

22. A, B, C, D
Sol. All substrates give the same major product which is given below



23. A, B, C, D
Sol. Coordination number of Al in $AlCl_3$(s) is 6.
Anhydrous $AlCl_3$ is covalent but becomes ionic when dissolved in water.
BI_3 is the strongest Lewis acid among all boron halides.
All BX_3 are covalent in nature.

24. A, C, D

Sol. $\left[CuCl_2\left\{O=C\left(NH_2\right)_2\right\}_2\right]$ – Dichloridodicarbamidocopper(II)

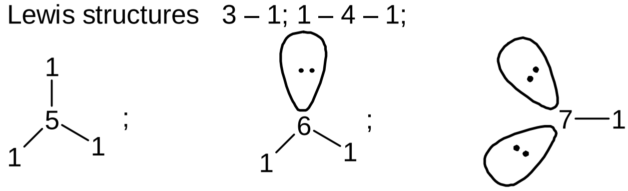
25. C

Sol.

1 $1s^1$									2 $1s^2$
3 [ ] $2s^1$	4 [ ] $2s^2$					5 $2s^2 2p^1$	6 $2s^2 2p^2$	7 $2s^2 2p^3$	8 $2s^2 2p^4$
9 [ ] $3s^1$	10 [ ] $3s^2$					11 $3s^2 3p^1$	12 $3s^2 3p^2$	13 $3s^2 3p^3$	14 $3s^2 3p^4$
15 [ ] $4s^1$	16 [ ] $4s^2$	17 $4s^2\ 3d^1$	18 $4s^2, 3d^2$	19 $4s^2, 3d^3$	20 $4s^2, 3d^4$	21 $4s^2 3d^4 4p^1$	22 $4s^2 3d^4 4p^2$	23 $4s^2 3d^4 4p^3$	24 $4s^2 3d^4 4p^4$

26. C

Sol. Lewis structures 3 – 1; 1 – 4 – 1;



27. D

28. C

Sol. (for Q. 27 to Q. 28)

(i) The solid must contain Na and I. The yellow colouration of the flame indicates the presence of Na^+ ion; a yellow silver salt that is dissolved only by strong complexing agent such as CN^- or $S_2O_3^{2-}$ must be AgI.

(ii) Reaction (i) to (iv) indicates a sodium salt of an oxygen containing acid containing iodine.
Both SO_2 and I^- are oxidized, while in the first case I^- is formed with an intermediate of I_2 or I_3^- (brown solution) and in the second I_2 or (I_3^-) is formed. As the solution is neutral $NaIO_3$ or $NaIO_4$ come into consideration.

(iii) Conditions given in observation(v) proves that solid (x) is $NaIO_4$.
1 mole of $NaIO_4$ = 213.90 g $NaIO_4$ = 8 moles of $S_2O_3^{2-}$.

$$\therefore 0.1000\text{ g } NaIO_4 = \frac{0.1000\times 8}{213.90} = 3.740\times 10^{-3}\text{ mol of } S_2O_3^{2-}$$

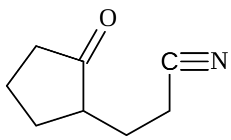
$$\left(IO_4^- + 7I^- + 8H^+ \longrightarrow 4I_2 + 4H_2O\right)$$

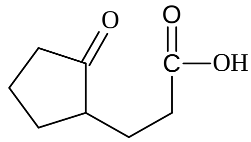
SECTION – D

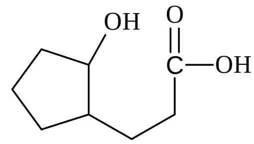
29. 00006.11

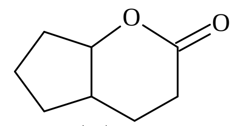
30. 00002.20

Sol.


(P)


(Q)


(R)


(S)

31. 00003.50

Sol. PV = RT (for 1 mole of ideal gas)

$PV = R(K + \beta V^2)$

$$P = \frac{RK}{V} + \beta RV$$

For minimum pressure

$$\frac{dP}{dV} = 0 \text{ and } \frac{d^2P}{dV^2} = +ve$$

So, $P_{min} = 2R\sqrt{\beta K}$

32. 00000.61

Sol. H_2O

$$\cos 104.5^o = \frac{s}{s-1} \Rightarrow s = 0.20$$

So, fraction of s-character of lone pair in H_2O = 0.30

Similarly, fraction of s-character of lone pair in NH_3 = 0.31

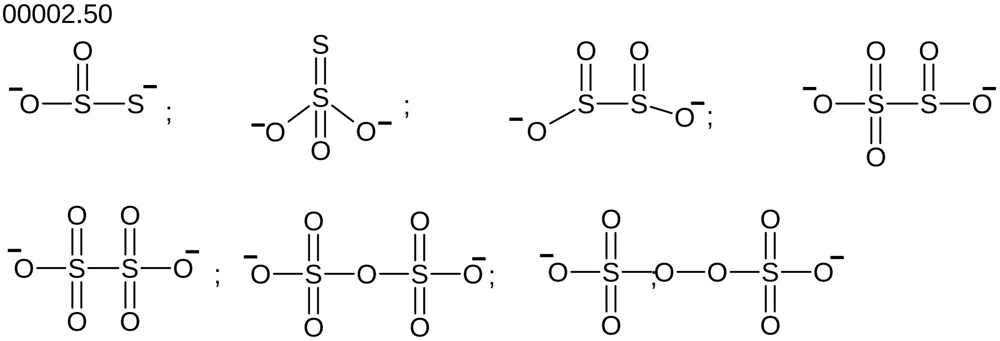
33. 00001.25

Sol. x = 5 and y = 4

Only a, b, d, e and h will form buffer.

34. 00002.50

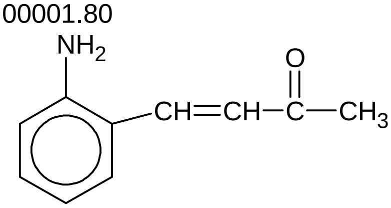
Sol.

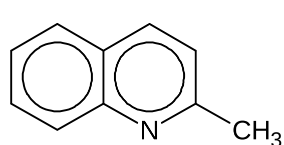


x = 5, y = z = 1

35. 00001.80

Sol.


(A)


(B)

36. 00007.50

Sol. Let, x ml of 2.0 M NaOH solution be added, then

	H_3PO_4	+ NaOH	$\longrightarrow$ NaH_2PO_4	$+ H_2O$
millimoles	10	2x	0	0
	0	$(2x-10)$		

NaH_2PO_4	+ NaOH	$\longrightarrow$ $Na_2HPO_4 + H_2O$
10	$(2x-10)$	0
$10-(2x-10)$	0	$2x-10$

= 20 – 2x

So, $7.2 = 7.2 + \log\dfrac{2x-10}{20-2x}$, on solving x = 7.5

Mathematics

PART – III

SECTION – A

37. A, B

Sol. $x = 4k + 1$, $y = 2m$ ($k_1 m \in N$)
$y^x = (2m)^{4n+1}$ (it is divisible by 8)
$x^y = (4n + 1)^{2m}$ (it leave remainder 1)

38. A, C, D

Sol. As $f(x)f''(x) > 0 \ \forall x \in R$
For $y = f(x)f'(x)$; $y' = (f'(x))^2 + f(x)f''(x) > 0$
If $f(x)_0 < 0$ then $f''(x_0) < 0$

39. B, D

Sol. If it is parallelogram $z_1 + z_3 = z_2 + z_4 = 0$ (in some order)
$\Rightarrow$ If it is rhombus then area is $2|z_1||z_2|$ where $|z_1|^2|z_2|^2 = \left|\frac{d}{a}\right|$

40. A, C, D

Sol. $y = f_k(x)$ is periodic with period 10 and $f_k(f_{4k+1}(x) - x) = 0$

41. B, C, D

Sol. R.H.D. at $x = -1$ is $(p - m^2)$ where $n = 2m$ or $2m - 1$
L.H.D. at $x = -1$ is $(m^2 - p)$ for differentiability $m^2 = p$

42. A, C

Sol. $x^3 - 3x + 2 = 2$; $x = 0, \pm\sqrt{3}$
$3(f^2(t) - 1)f'(t) = 1$

43. B

Sol. $x^2 + y^2 = r^2$ and $(x - 1)^2 + (y - 5)^2 = 4$ must be orthogonal

44. C

Sol. $OP \cdot OP' = r^2$
Using $P(r_1 \cos\theta, r_1 \sin\theta)$
Locus of P′ is

$$x^2 + y^2 + \frac{mr^2}{c}x - \frac{r^2}{c}y = 0$$

45. D

46. A

Sol. (for Q. 45 to Q. 46)
$ax^3 + bx = 8a + 2b \Rightarrow (x - 2)(ax^2 + 2ax + 4a + b) = 0$
$D = 0 \Rightarrow 3a + b = 0$ as $a = 1 \Rightarrow f(x) = x^3 - 3x$
Similarly for $g(x) = 4x^3 + ax^2 + bx + c$, $f(x) = (4x^3 - 3x)$ and $f(1) = 1$

SECTION – D

47. 00010.00

Sol. Minimum will occur at $z = 0$

$$\sum_{k=0}^{4}\sum_{r=0}^{2019}\frac{1}{1010}=10$$

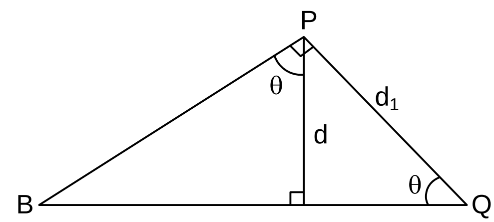
48. 00009.00

Sol. Let ABCD have coordinates

O, $\lambda(i + j)$, $\lambda(j + k)$, $\lambda(i + k)$ respectively

$$\frac{d_1}{d}=\operatorname{cosec}\theta=\sqrt{3}$$

Where θ is angle between AB and normal of BCD



49. 00002.25

Sol. $4f^3(x) = f^3(2x + 1) + c$

By taking $x=-\frac{1}{8},\frac{3}{4},\frac{5}{2}$ and 6, we get

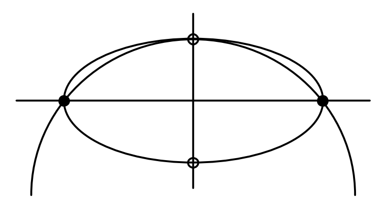
$$f^3\left(\frac{3}{4}\right)+c=4,\ f^3\left(\frac{5}{2}\right)+c=4f^3\left(\frac{3}{4}\right),\ 4f^3\left(\frac{5}{2}\right)=f^3(6)+c$$

So, we $c=\frac{8}{3}$ i.e., $4f^3(x) = f^3(2x + 1) + \frac{8}{3}$

50. 00002.00

Sol. The given equation reduces to $4f^2(x) + x^2 = 9$, an ellipse.

As in the figure it has two solutions



51. 00035.32

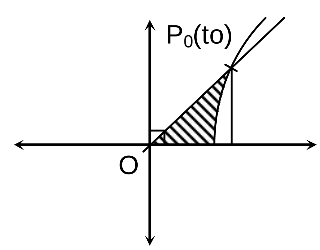
Sol. $P(x)=\sum_{k=1}^{4}\frac{{}^kC_1\ {}^4C_2\cdot 2!\ {}^6C_{2k-2}\ 2k-2!\,10-2k!}{10!}=\frac{8}{21}$ and P(d) = 0.4

52. 00480.00

Sol. $\frac{1}{2}\left(\frac{e^{to}+e^{-to}}{2}\right)\left(\frac{e^{to}-e^{-to}}{2}\right)-\int_0^{to} y\,dx$

$$\frac{1}{8}\cdot e^{2to}-e^{-2to}-\int_0^{to}\frac{\left(e^{t}-e^{-t}\right)^2}{4}dt=\frac{to}{2}=240$$

to = 480



53. 00003.00

Sol. $I = \cos\alpha\cos\beta + \sin^2\alpha\sin\beta - \cos^2\gamma\sin\alpha \le \cos\alpha\cos\beta + \sin\alpha\sin\beta = \cos(\alpha - \beta)$

$\Rightarrow \alpha - \beta = 0$ & $\cos\gamma = 0$, $\sin\alpha = 1$

$\Rightarrow \alpha = \beta = \gamma = \frac{\pi}{2}$

54. 57060.00

Sol. For point of intersection we take say two points A and B, from each we can draw ${}^9C_2$ lines cut of which ${}^8C_2$ are parallel. So total number of intersection points are

$${}^{10}C_2\left((36)^2-28\right)=57060$$