FIITJEE

ALL INDIA INTERNAL TEST SERIES

CHEMISTRY, MATHEMATICS & PHYSICS

CLASS XIIth

SET – A | 126884 | Ai^{2}TS – 7

ANSWER KEY

Chemistry (Section – I)			Mathematics (Section – II)			Physics (Section – III)		
1	D	C114705	1	C	M110102	1	B	P120406
2	C	C121403	2	C	M110116	2	A	P111027
3	A	C121601	3	D	M110303	3	C	P112328
4	C	C121602	4	A	M111214	4	B	P120414
5	D	C122901	5	C	M110413	5	A	P112314
6	D	C121402	6	B	M110411	6	B	P111009
7	A	C121504	7	C	M110518	7	A	P120302
8	D	C122906	8	B	M110514	8	A	P110912
9	A	C122901	9	D	M110308	9	A	P110903
10	D	C122901	10	B	M110308	10	A	P110903
11	B	C121808	11	C	M110514	11	A	P111211
12	B	C121809	12	C	M111222	12	A	P111211
13	A	C121407	13	C	M111210	13	B	P120305
14	B	C121407	14	B	M111210	14	B	P120305
15	C	C121802	15	C	M113205	15	B	P120414
16	A	C121802	16	D	M113205	16	C	P120414
17	R,P,S,Q	-	17	S,R,Q,P	M110115	17	R,P,S,Q	P110921
18	PQST,ST,P,R	C121401	18	Q,P,R,S	M110310	18	P,P,Q,S	P111203
19	PR,R,S,PR	C121402	19	S,Q,Q,PR	M112108	19	S,R,S,Q	P111030
20	PS,QS,P,R	C122811	20	Q,S,R,P	M110322	20	QS,PS,QR,R	P120404

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CHEMISTRY, MATHEMATICS & PHYSICS

CLASS XII[th]

SET – B | 126885 | Ai^{2}TS – 7

ANSWER KEY

Chemistry (Section – I)			Mathematics (Section – II)			Physics (Section – III)		
1	D	C122901	17	C	M110116	1	A	P112314
2	D	C121402	18	A	M111214	2	B	P111009
3	A	C121504	19	B	M110411	3	A	P120302
4	D	C122906	20	B	M110514	4	A	P110912
5	D	C114705	17	C	M110102	5	B	P120406
6	C	C121403	18	D	M110303	6	A	P111027
7	A	C121601	19	C	M110413	7	C	P112328
8	C	C121602	20	C	M110518	8	B	P120414
9	B	C121808	17	C	M110514	9	B	P120305
10	B	C121809	18	C	M111222	10	B	P120305
11	A	C122901	19	D	M110308	11	B	P120414
12	D	C122901	20	B	M110308	12	C	P120414
13	C	C121802	13	C	M113205	13	A	P110903
14	A	C121802	14	D	M113205	14	A	P110903
15	A	C121407	15	C	M111210	15	A	P111211
16	B	C121407	16	B	M111210	16	A	P111211
17	PR,R,S,PR	C121402	17	Q,P,R,S	M110310	17	S,R,S,Q	P111030
18	PS,QS,P,R	C122811	18	Q,S,R,P	M110322	18	QS,PS,QR,R	P120404
19	R,P,S,Q	-	19	S,R,Q,P	M110115	19	R,P,S,Q	P110921
20	PQST,ST,P,R	C121401	20	S,Q,Q,PR	M112108	20	P,P,Q,S	P111203

Hints & Solutions

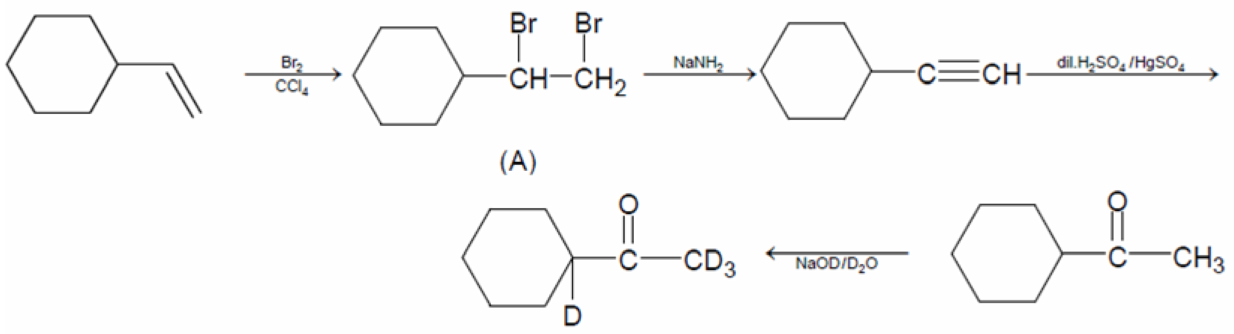
Chemistry

PART – A

(Single Correct Choice Type)

1. D (Concept Code: C114705)

Sol.

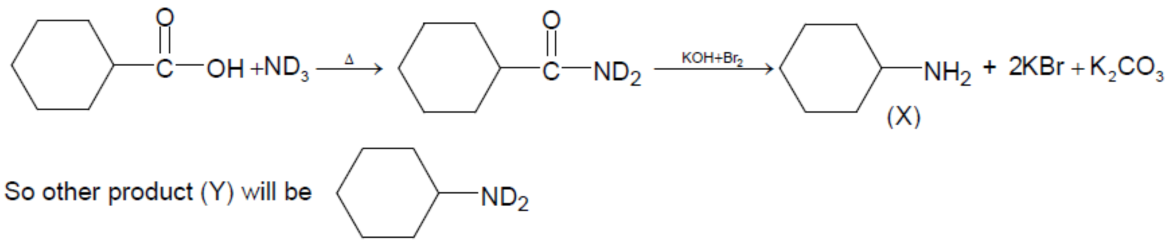


2. C (Concept Code: C121403)

Sol. Haloform reaction & then nucleophilic addition reaction.

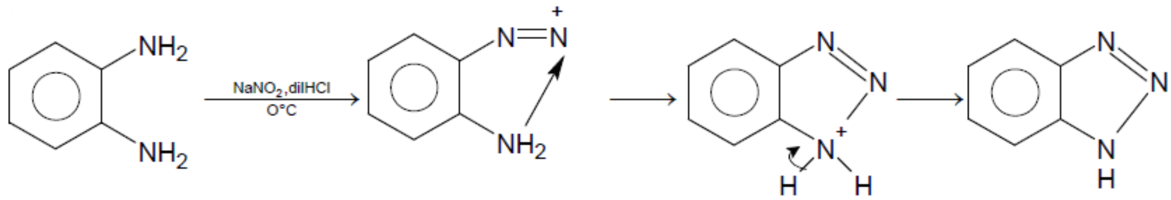
3. A (Concept Code: C121601)

Sol.



4. C (Concept Code: C121602)

Sol.



5. D (Concept Code: C122901)

Sol. Glucose is oxidised by Br_2/H_2O to gluconic acid while fructose.

6. D (Concept Code: C121402)

Sol. Gaseous formaldehyde when passed into inert solvent containing an amine catalyst, it forms polyoxymethylene[HO – $(CH_2O)_nH$]

7. A (Concept Code: C121504)

Sol. -NO_2 group being EQG, increases electrophilicity of carbonyl group.

8. D (Concept Code: C122906)

Sol. Fact based.

9. A (Concept Code: C122901)

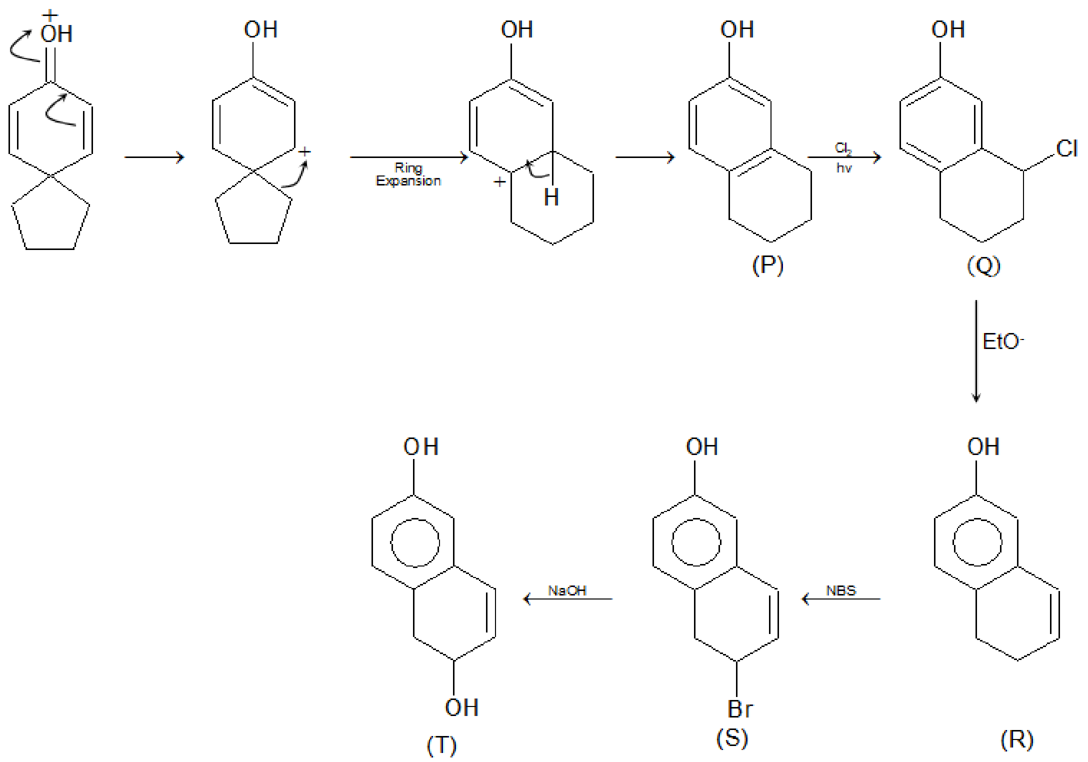
Sol. They differ in orientation of –OH on C_1(anomeric carbon)

10. D (Concept Code: C122901)

Sol. Compound (d), on hydrolysis gives free aldehyde group.

11. B (Concept Code: C121808)

12. B (Concept Code: C121809)
Sol. Elimination will occur

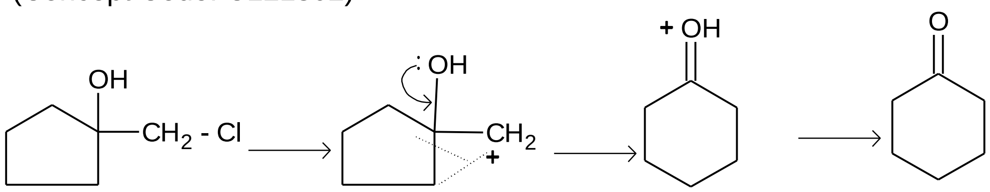


13. A (Concept Code: C121407)

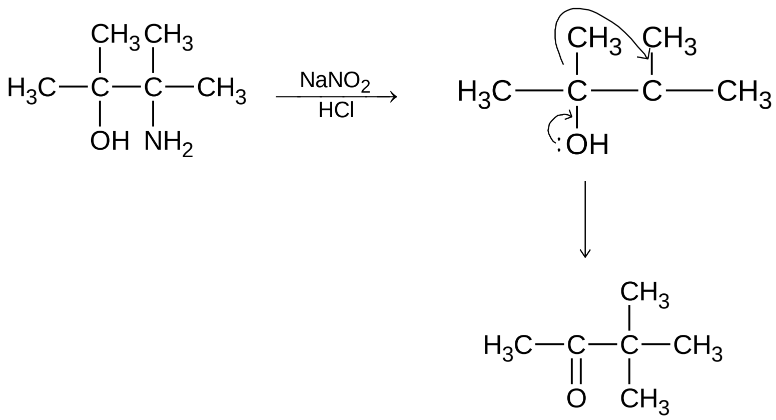
14. B (Concept Code: C121407)
Sol for Q. No. 13 & 14.
More α-hydrogen and more stable carbanion.

15. C (Concept Code: C121802)

Sol.



16. A (Concept Code: C121802)
Sol.



PART – B
(*Matrix Match Type*)

1. A → R B → P C → S D → Q (No code)
Sol. Fact based.

2. A $\rightarrow$ PQST B $\rightarrow$ ST C $\rightarrow$ P D $\rightarrow$ R
(Concept Code: C121401)

3. A $\rightarrow$ PR B $\rightarrow$ R C $\rightarrow$ S D $\rightarrow$ PR
(Concept Code: C121402)

4. A $\rightarrow$ PS B $\rightarrow$ QS C $\rightarrow$ P D $\rightarrow$ R
(Concept Code: C122811)

Mathematics
PART – A
(Single Correct Choice Type)

Single Correct Type (01 – 08)

1. $D \ge 0$
$3(ab + bc + ca) - (a + b + c)^2 \ge 0$
$ab + bc + ca - (a^2 + b^2 + c^2) \ge 0$
$\Rightarrow (a - b)^2 + (b - c)^2 + (c - a)^2 \le 0$

2. Use transformation $\left(\text{replace x by } \frac{x-1}{x+1}\right)$.

3. Put $z = x + iy$. We get $z = \frac{9}{4} + iy$, where $y < 0$.

4. $(x-6)(y-15) = 2 \times 3^2 \times 5$
When both x and y are even, (x – 6) and (y – 15) are even and odd respectively. So, 2 must be used with the first bracket. Number of ways = 6.

5. $^nC_1 - \left(1+\frac{1}{2}\right)\,^nC_2 + \left(1+\frac{1}{2}+\frac{1}{3}\right)\,^nC_3 - ... + (-1)^{n-1}\left(1+\frac{1}{2}+...+\frac{1}{n}\right)\,^nC_n$
$= (C_1 - C_2 + C_3 - ...) - \frac{1}{2}(C_2 - C_3 + C_4 - ...) + \frac{1}{3}(C_3 - C_4 + C_5 - ...) - ...$
$= C_0 + \frac{1}{2}(C_0 - C_1) + \frac{1}{3}(C_0 - C_1 + C_2) + ...$
$= {}^{n-1}C_0 + \frac{1}{2}\,{}^{n-1}C_1(-1)^1 + \frac{1}{3}\,{}^{n-1}C_2(-1)^2 + \frac{1}{4}\,{}^{n-1}C_3(-1)^3 + ... = \frac{1}{n}$ (consider $(1-x)^n \times (1-x)^{-1}$)

6. $a_n = (\ln 3)^n \times \sum_{r=1}^{n} \frac{r^2}{r!(n-r)!} = \frac{(\ln 3)^n}{n!}\left(n(n-1).2^{n-2} + n.2^{n-1}\right)$
$= (\ln 3)^2 \times \frac{(2\ln 3)^{n-2}}{(n-2)!} + (\ln 3) \times \frac{(2\ln 3)^{n-1}}{(n-1)!}$
Hence, $\sum_{r=1}^{\infty} a_r = (\ln 3)^2 \times e^{2\ln 3} + (\ln 3) \times e^{2\ln 3} = 9(\ln 3)^2 + 9\ln 3$.

7. $\sum_{r=2}^{n} \frac{1}{2}\left(\frac{(r+1)-(r-1)}{r(r+1)(r-1)}\right) = \frac{1}{2}\sum_{r=2}^{n}\left(\frac{1}{r(r-1)} - \frac{1}{r(r+1)}\right) = \frac{1}{2}\left(\frac{1}{2} - \frac{1}{n(n+1)}\right)$

8. $(0,0,0)$ or $\left(\frac{1}{2}, \frac{1}{2}, \frac{1}{2}\right)$
$x = y = z = 0$ is obviously true.
Let x, y, z be non-zero. Then, $y = \frac{2x}{2x + \frac{1}{2x}} \le x$.
Similarly, $z \le y$ and $x \le z$. This is possible only when $x = y = z = \frac{1}{2}$.

Comprehension Type (9 – 16)

(9 – 10)

The given equation, after multiplying both sides by z, can be written as $z^5 - 5z^4 + 10z^3 - 10z^2 + 5z = 0$ or $(z-1)^5 = -1$, where $z \neq 0$. The roots of this equation are $z - 1 = e^{i\frac{\pi}{5}}, e^{i\frac{3\pi}{5}}, e^{i\frac{7\pi}{5}}, e^{i\frac{9\pi}{5}}$.

(11 – 12)

11. $f(1) + f(2) + f(3) = 1100$
$S = f(1) + 2f(2) + 3f(3)$
Apply $AM \geq GM$.
$\frac{S}{3} \geq \left(6f(1)f(2)f(3)\right)^{1/3} \quad \Rightarrow \quad S^3 \geq 162f(1)f(2)f(3)$
Hence, $f(1) = 2f(2) = 3f(3)$.

12. $x_1 = 99$ and $x_2 = 1101$

(13 – 14)

13. Let P contain r elements. The number of ways of selecting P is ${}^nC_r$.
The common element can be selected in r ways. The remaining elements of Q can be selected in 2^{n-r} ways. So, total number of ways of selecting P and Q is $\sum_{r=1}^{n} {}^nC_r \times r \times 2^{n-r} = n \times 3^{n-1}$.

14. Let P contain r elements. The number of ways of selecting P is ${}^nC_r$.
The number of ways of selecting Q is ${}^nC_{r+1}$. So, total number of ways of selecting P and Q is $\sum_{r=0}^{n-1} {}^nC_r \times {}^nC_{r+1} = {}^{2n}C_{n-1}$.

(15 – 16)

Let $b_k = \frac{1}{a_k}$.

$b_1, b_2, b_3, \ldots$ are in A.P. with $b_1 = \frac{1}{5}, b_{20} = \frac{1}{25}$

If d is the common difference of this A.P., then $19d == \frac{1}{25} - \frac{1}{5} = -\frac{4}{25}$

$d = -\frac{4}{475}$

$b_n = b_1 + (n-1)d = \frac{1}{5} - \frac{4(n-1)}{475} = \frac{99-4n}{475}$

$\Rightarrow a_n = \frac{475}{99-4n}$

Note that a_n is maximum if $99 - 4n > 0$ and $99 - 4n$ is least, which happens when $n = 24$.
Also, $a_n < 0$ if $99 - 4n < 0$

$\Rightarrow n > \frac{99}{4} \Rightarrow n \geq 25$

Thus, the least value of n for which $a_n < 0$ is 25.

PART – B
(*Matrix Match Type*)

Matrix Match (1 – 4)

1. $a = -\left(|x| + \frac{1}{|x|}\right) \le -2$ for real x

2. $|z_1 - z_2|^2 = |z_1|^2 + |z_2|^2 - 2\text{Re}\left(z_1\overline{z_2}\right)$

or $AB^2 = OA^2 + OB^2 - 2\text{Re}\left(z_1\overline{z_2}\right)$ $\Rightarrow$ $\text{Re}\left(z_1\overline{z_2}\right) = -2$

3. Total number of ways of arranging the letters of the word INDIANOIL is $\frac{9!}{3!2!}$.

(A) Treating INDIAN as a single object, we can permute INDIAN, O, I and L in 4! ways.

$\therefore$ Probability of the required event $= \frac{4!3!2!}{9!} = \frac{1}{\left({}^7C_3\right)\left({}^9C_2\right)}$

(B) We can permute OIL, I, N, D, I, A and N in $\frac{7!}{2!}$ ways.

$\therefore$ Probability of the required event $= \frac{2!2!3!2!}{7!9!} = \frac{1}{\left({}^5C_2\right)\left({}^7C_2\right)(9!)}$

(C) Fixing an I at the first place and L at the last place, we can permute the remaining letters in $\frac{7!}{2!2!}$ ways.

$\therefore$ Probability of the required event $= \frac{2!2!3!2!}{7!9!} = \frac{1}{\left({}^5C_2\right)\left({}^7C_2\right)(9!)}$

(D) Vowels can be arranged at odd places in $\frac{5!}{3!}$ ways.

The remaining letters can be arranged at 4 even places in $\frac{4!}{2!}$ ways.

$\therefore$ Probability of the required event $= \frac{5!4!}{3!2!} \times \frac{3!2!}{9!} = \frac{1}{{}^9C_4} = \frac{1}{{}^9C_5}$

4.

(A) $z^2 = -|z|$

$\Rightarrow |z|^2 = |z| \Rightarrow |z| = 0$ or $|z| = 1$

If $|z| = 0$, then $z = 0$

If $|z| = 1$, then $z^2 = -1 \Rightarrow z = \pm i$

$\therefore z^2 + |z| = 0$ has 3 solutions.

(B) If $z = a + ib$, $z^2 + \overline{z}^2 = 0$ gives $a = \pm b$ which is satisfied by each complex number of the form $a(1 \pm i)$, where $a \in R$.

(C) $|z^2| = |-8\overline{z}|$

$\Rightarrow$ $|z|^2 = 8|z| \Rightarrow |z| = 0$ or $|z| = 8$

If $|z| = 8 \Rightarrow z\bar{z} = 64$

$\therefore\ z^2 = -8\bar{z} = -\frac{8^3}{z}$

$\Rightarrow\ z^3 = -8^3$

$\Rightarrow\ z = -8, -8\omega, -8\omega^2$

Thus, $z^2 + 8\bar{z} = 0$ has 4 solutions.

(D) The circles $|z-2| = 1$ and $|z-1| = 2$ touch each other internally.

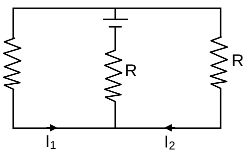
Thus, $|z-2| = 1$ and $|z-1| = 2$ have just one solution.

Physics
PART – A
(Single Correct Choice Type)

1. **B** P120406

Sol. A moving conductor is equivalent to a battery of emf $= vB\ell$ (motion emf)

Equivalent circuit



$I = I_1 + I_2$

Applying Kirchoff's law

$I_1R + IR - vB\ell = 0$ …(1)

$I_2R + IR - vB\ell = 0$ …(2)

Adding (1) and (2)

$2IR + IR = 2vB\ell$

$I = \frac{2vB\ell}{3R}$; $I_1 = I_2 = \frac{vB\ell}{3R}$

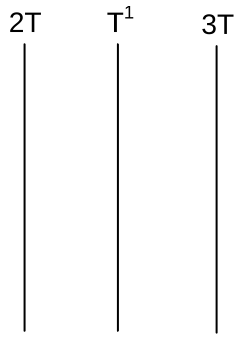
2. **A** P111027

Sol. $\rho_1 Vg - \rho_2 Vg = kv_T^2$

$\Rightarrow \quad V_T = \sqrt{\frac{Vg(\rho_1 - \rho_2)}{k}}$

3. **C** P112328

Sol.



$\sigma A T_1^4 = \frac{\sigma A(2T)^4}{2} + \frac{\sigma A(3T)^4}{2}$

$T_1^4 = \frac{1}{2}(2T)^4 + \frac{1}{2}(3T)^4$

$= (16+81)T^4 = \frac{97}{2}T^4$

$T_1 = \left(\frac{97}{2}\right)^{\frac{1}{4}} T^4$

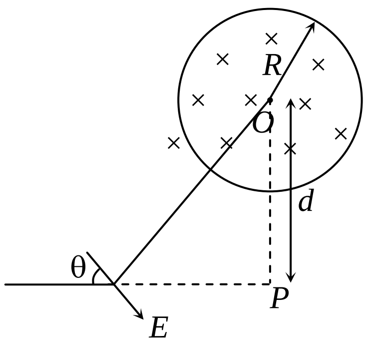
4. **B** P120414

Sol.

$E2\pi\sqrt{x^2 + d^2} = \pi R^2 k$

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

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



5. **A** P112314

Sol. $Q = Q_1 + Q_2$

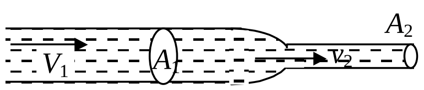
$\frac{n_1 + n_2}{\gamma_m - 1} = \frac{n_1}{\gamma_1 - 1} + \frac{n_2}{\gamma_2 - 1}$; $\gamma_m = \frac{3}{2}$

6. **B** P111009

Sol. From equation of continuity

$A_1 V_1 = A_2 V_2$

$\frac{V_1}{V_2} = \frac{A_2}{A_1}$



7. **A** P120302

Sol. The magnetic field in between because of each will be in opposite direction.

$$B_{\text{in between}} = \frac{\mu_o i}{2\pi x}\hat{j} - \frac{\mu_o i}{2\pi(2d - x)}(-\hat{j})$$

$$= \frac{\mu_o i}{2\pi}\left[\frac{1}{x} - \frac{1}{2d - x}\right](-\hat{j})$$

at $x = d$, $B_{\text{in between}} = 0$

for $x < d$, $B_{\text{in between}} = (\hat{j})$

for $x > d$, $B_{\text{in between}} = (-\hat{j})$

towards x net magnetic field will add up and direction will be $(-\hat{j})$

towards x′ net magnetic field will add up and direction will be $(\hat{j})$

8. **A** P110912

Sol. $$g = \frac{GM}{R^2} = \frac{G\frac{4\pi}{3}R^3\rho}{R^2} = \frac{4\pi G}{3}\rho R$$

$$\frac{\sqrt{6}}{11} = \frac{g_1}{g} = \frac{\rho_1 R_1}{\rho R} = \frac{2}{3}\frac{R_1}{R}$$

$$\frac{R_1}{R} = \frac{3\sqrt{6}}{22}$$

$$\frac{V_1}{V} = \sqrt{\frac{M_1}{M}\frac{R}{R_1}} = \sqrt{\frac{\rho_1}{\rho}\frac{R_1^3}{R^3}\frac{R}{R_1}} = \sqrt{\frac{2}{3}\left(\frac{3\sqrt{6}}{22}\right)^2} = \frac{3}{22}\sqrt{\frac{2}{3}\times 6}$$

$$v_1 = 11 \times \frac{3}{22} \times 2 = 3\ \text{kms}^{-1}$$

9. **A** P110903

10. **A** P110903

Sol. $$T = 2\pi\sqrt{\frac{3}{4\pi G\lambda}} \Rightarrow \frac{T}{4} = \sqrt{\frac{3\pi}{16G\lambda}} \quad ; \quad V = \omega A = (\sqrt{\pi G\lambda})r$$

$$N = \frac{4}{3}\pi G \times m\frac{r}{2}$$

11. **A** P111211

Sol. The compression is adiabatic

$$\therefore\ P_0V_0^{\gamma} = P_1V_1^{\gamma}, \qquad V_1 = \left(\frac{P_0}{P_1}\right)^{\frac{1}{\gamma}} V_0 = \frac{9V_0}{16}$$

12. **A** P111211

Sol. $$\frac{P_0V_0}{T_0} = \frac{P_1V_1}{T_1}, \qquad T_1 = \frac{4T_0}{3}$$

13. **B** P120305

14. **B** P120305

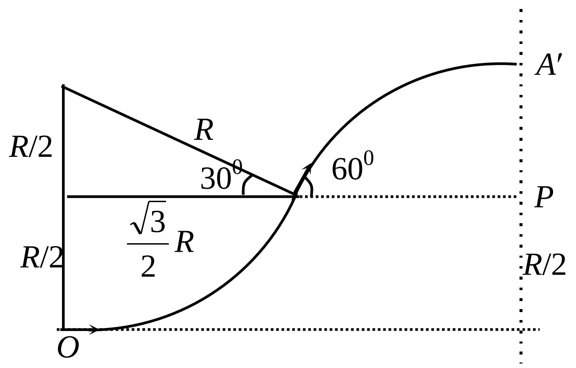
Sol. In magnetic field

$R = \frac{mv}{qB} = 1\,m$

$T = \frac{2\pi m}{qB} = 0.2\,\pi$

In electric field

Acceleration a =10 m/s^2



Now, $PA' =$ maximum height $= \frac{v^2 \sin^2\theta}{2a} = 3.75\,m$

$\therefore$ y-co-ordinate of A' is 4.25 m

$T' =$ time elapsed in $\vec{E}$ is half the time of flight $= \frac{v\sin\theta}{a} = \frac{\sqrt{3}}{2}$

$\therefore$ time t = $\frac{T}{6} + T' = 0.97$ sec

15. **B** P120414

16. **C** P120414

Sol. The cylinder has a uniform charge density on its surface. The angular velocity of the cylinder increases as the mass accelerates downward, the electric current caused by revolution of the cylinder that flows in azimuthal direction, increases. Due to increase in current, magnetic field varies with time, so electric field induces at the surface of the cylinder. Due to this electric field, a torque is generated on the cylinder.

So $mg - T = ma$; $v = at$ and $\omega = \frac{v}{R}$

$I = \frac{Q\omega}{2\pi} = \frac{Qv}{2\pi R} = \frac{Qat}{2\pi R}$

B at axis of cylinder

$B = \mu_0 nI = \frac{\mu_0 Qat}{2\pi Rl}$ $\left[\because n = \frac{1}{l}\right]$

Induced electric field at surface of cylinder

$E = \frac{R}{2}\frac{dB}{dt} = \frac{\mu_0 Qa}{4\pi l}$

Net torque on the cylinder is zero. So

$TR = QER$

$T = \frac{\mu_0 Q^2 a}{4\pi l}$

PART – B

(*Matrix Match Type*)

1. **A → R** **B → P** **C → S** **D → Q** P110921

Sol. Mass of original sphere = M

Radius of original sphere = R

Mass of cavity = M/8

Radius of cavity = R/2 [M α V α r^3]

Mass of substituted (introduced) sphere = 2M [1/8th volume 16 time denser]

Radius of substituted (introduced) sphere = R/2

At any point net potential [applying superposition]

= V_0 (potential due to original sphere) – V_C (potential due to cavity) + V_S (potential due to substituted sphere)

2. **A → P** **B → P** **C → Q** **D → S** P111203

Sol. $mg = \frac{v}{2}\rho_L g$, $v\rho_s g = \frac{v}{2}\rho_L g$, $\rho_s = \frac{\rho_L}{2}$

$mg = v'\rho_L g$, $mg = Ax\rho_L g$ … (i)

when temperature is raised by ΔT, $mg = A'x\rho'_L g$ … (ii)

From (i) and (ii) $A\rho_L = A'\rho'_L$

$$A\rho_L = A(1+2\alpha_s\Delta T)\frac{\rho_L}{1+\gamma_L\Delta T}$$

$\gamma_L = 2\alpha_s$ for fraction inside the liquid to be same $\frac{\rho_s}{\rho_L} = \frac{\rho'_s}{\rho'_L}$

$$\frac{\rho_s}{\rho_L} = \frac{\rho_s(1+\gamma_L\Delta T)}{\rho_L(1+3\alpha_s\Delta T)} \quad \therefore \quad \rho_L = 3\alpha_s$$

3. **A → S** **B → R** **C → S** **D → Q** P111030

Sol. Excess pressure in bubble = $\frac{4T}{R}$.

Excess pressure in drop = $\frac{2T}{R}$.

4. **A → QS** **B → PS** **C → QR** **S → R** P120404

Sol. At t = 1s, $\frac{d\varphi}{dt} = 5$ $\therefore$ i = – 0.5 A

Similarly at t = 7 s, $\frac{d\varphi}{dt} = -5$, $i = 0.5\,A$

Also, $E2\pi r = 5$, $E \times \frac{27}{7} \times \frac{7}{44} = 5$, $E = 5\,N/C$