(1001CJA102119081) Test Pattern

ALLEN CAREER INSTITUTE KOTA (RAJASTHAN) path to success

CLASSROOM CONTACT PROGRAMME

(Academic Session : 2019 - 2020)

JEE(Advanced)
FULL SYLLABUS
09-06-2020

JEE(Main+Advanced) : ENTHUSIAST COURSE [SCORE-II (PHASE-TEAS, T-AS, TOAS, TNAS, TRAS & TMAS)]

ANSWER KEY

PART-1 : PHYSICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	B	A	A	A	A	D	A	B,C	A,B,C	A,B,C
	Q.	11	12	13	14	15	16	17	18		
	A.	A,B,C	A,B,C	B,C	A,C	B	B	A	A		

PART-2 : CHEMISTRY

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	B	D	C	C	D	B	A	C,D	A,D	B,D
	Q.	11	12	13	14	15	16	17	18		
	A.	A,B,C,D	B	A,B,C,D	A,C,D	C	C	A	B		

PART-3 : MATHEMATICS

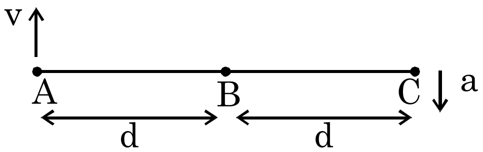
SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	A	A	D	A	C	A	B	A,B	B,C,D	A,B
	Q.	11	12	13	14	15	16	17	18		
	A.	A,B,C	A,B,C	C,D	A	C	C	A	B		

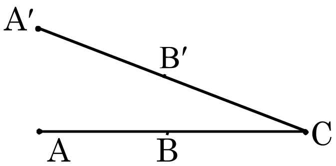
PART-1 : PHYSICS SOLUTION

SECTION–I

1. Ans. (B)
2. Ans. (A)

Sol.





Let us observe the motion of A and B relative to C.

$$\frac{AA'}{2d} = \frac{BB'}{d}$$

$$BB' = \frac{AA'}{2} = \frac{vt + \frac{1}{2}at^2}{2}$$

$$BB' = \frac{Vt}{2} + \frac{1}{4}at^2$$

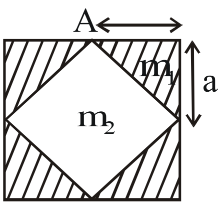
$\frac{V}{2}$ is initially speed of B w.r.t. C as well as ground.

$\frac{a}{2}$ is acceleration of B w.r.t. C

$$\vec{a}_{B/g} = \vec{a}_{B/C} + \vec{a}_{C/g}$$

$$= \frac{a}{2} - a = \frac{-1}{2}a$$

3. Ans. (A)
4. Ans. (A)



Sol. $I_1 = \frac{I_A}{2}$

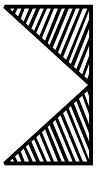
$$m = (\sigma a^2)$$

$$m_1 = \sigma(2a)^2 = 4m$$

$$m_2 = \sigma(\sqrt{2}\,a)^2 = 2m$$

$$I_A = \left(\frac{m_1(2a)^2 + m_1a^2}{6}\right) - \left(\frac{m_2(\sqrt{2}a)^2 + m_2a^2}{6}\right)$$

$$I_A = 4ma^2\left(\frac{2+1}{3}\right) - 2ma^2\left(\frac{1}{3}+1\right)$$



$$= ma^2\left[\frac{20-8}{3}\right] = 4ma^2$$

$$I_1 = 2ma^2$$

$$I_2 = \frac{ma^2}{6} + m\left(\frac{a}{\sqrt{2}}\right)^2$$

$$I_2 = ma^2\left(\frac{1}{6}+\frac{1}{2}\right) \Rightarrow \frac{ma^2}{2}\,\frac{4}{3}$$

$$I_2 = \frac{2ma^2}{3}$$

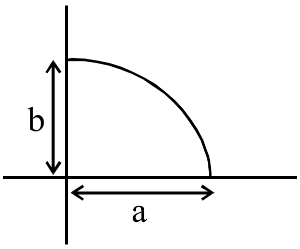
$$\frac{I_1}{I_2} = 3$$

5. Ans. (A)

Sol. $x = \frac{\int dm\,x}{\int dm} = \frac{\int dv\,x}{\int dv}$

$$\int dv = \int \pi y^2 dx\ ;\ \frac{y^2}{b^2} = \frac{1-x^2}{a^2}$$

$$= \pi b^2 \int \left(\frac{1-x^2}{a^2}\right) dx$$



$$= \pi b^2 \left[\frac{x - x^3}{3a^2}\right]_0^a$$

$$= \pi b^2 \left(\frac{a-a}{3}\right) = \frac{2\pi}{3} b^2 a$$

$$\int dvx = \int \pi y^2\, dx\, x$$

$$= \pi b^2 \int \left(1 - \frac{x^2}{a^2}\right) x dx$$

$$= \pi b^2 \left(\frac{x^2}{2} - \frac{x^4}{4a^2}\right)_0^a$$

$$= \pi b^2 \left(\frac{a^2}{2} - \frac{a^4}{4}\right) = \mu b^2 \frac{a^2}{4}$$

$$\left(X_{cm} = \frac{\frac{\pi b^2 a^2}{4}}{\frac{2\pi}{3} b^2 a} = \frac{3}{8} a\right)$$

6. Ans. (D)

Sol. $mv = -mv_1 + Mv_2$

$$t = \frac{d}{v} + \frac{d}{ev} + \frac{d}{e^2 v} + ...$$

$$t = \frac{d}{v}\left(1 + \frac{1}{e} + \frac{1}{e^2} + ...\right)$$

Common ratio > 1 so $t \rightarrow \infty$

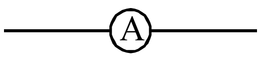
7. Ans. (A)

Sol. $\sqrt{f} = (Z - b)\left(1 - \frac{1}{n^2}\right)^{1/2}$

8. Ans. (B, C)

Sol. $R_A = 100\Omega$

$I_f = 50 \times 10^{-6}$



(a) $V_{max} = 50 \times 10^{-6}[100 + 10 \times 10^3]$

$V_{max} \cong 50 \times 10^{-6} \times 10^4 \cong 0.5V$

(b) $V_{max} = 50 \times 10^{-6}[100 + 200 \times 10^3]$

$\cong 50 \times 10^{-6} \times 200 \times 10^3 \cong 10V$

(c) $50 \times 10^{-6} \times 100 = x\, 5 \times 10^{-3}$

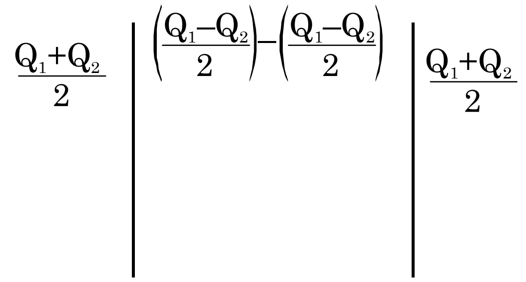
x = 10A $\quad$ $I_{max} \cong 10A$

(d) $50 \times 10^{-6} \times 100 = x$

$x = 5 \times 10^{-6} A$ $\quad$ $I_{max} = 55 \times 10^{-6} A$

9. Ans. (A, B, C)

Sol. Charges on the inner and outer plates will be



$$q = \left(\frac{\theta_1 - \theta_2}{2}\right) e^{-t/RC}$$

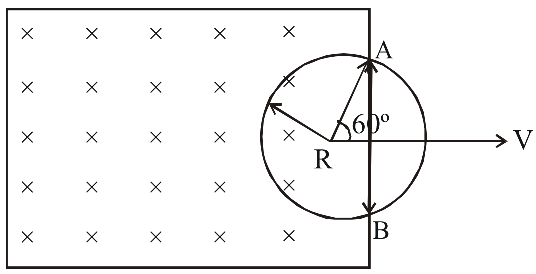
10. Ans. (A, B, C)

Sol. At any time t

$$I = \frac{\varepsilon}{\lambda 2\pi R} = \frac{B(2AB)v}{\lambda 2\pi R}$$

$$I = \frac{Bv}{\lambda \pi R}\sqrt{R^2 - \left(\frac{R}{2} - vt\right)^2}$$

$$I = \frac{Bv}{\lambda \pi}\sqrt{1 - \left(\frac{1}{2} - \frac{vt}{R}\right)^2}$$



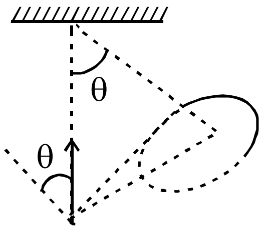
$$I = \frac{2Bv}{\lambda 2\pi R}\sqrt{R^2 - \frac{R^2}{4} + Rvt - v^2 t^2}$$

$$I = \frac{Bv}{\lambda 2\pi R}\sqrt{3R^2 + 4Rvt - 4v^2 t^2}$$

11. Ans. (A,B,C)

12. Ans. (A,B,C)

Sol. $g_{eff} = \sqrt{g^2 + \left(\frac{qE}{m}\right)^2}$

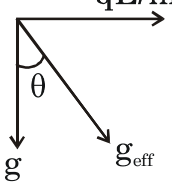


$T\cos\theta = m\ g_{eff}$

$T\cos\theta = mR\ \omega^2$

$$\frac{R\omega^2}{g_{eff}} = \tan\theta$$

$$\omega^2 = g_{eff}\frac{\tan\theta}{l\sin\theta} \Rightarrow \frac{g_{eff}}{l\cos\theta}$$



$$\omega = \sqrt{\frac{g_{eff}}{l\cos\theta}}$$

$$\cos\theta = \frac{I}{g_{eff}} \qquad \sin\theta = \frac{qE}{mg_{eff}}$$

Time period

$$= \frac{2\pi}{\omega} = \frac{2\pi}{g_{eff}}\sqrt{lg} = 2\pi\sqrt{\frac{lg}{g^2 + \left(\frac{qE}{m}\right)^2}}$$

$$v = Rw = l\sin\theta\sqrt{\frac{g_{eff}}{l\cos\theta}}$$

$$v = l\frac{qE}{mg_{eff}}.\sqrt{\frac{g^2{}_{eff}}{lg}}$$

$$v = \frac{qE}{m}.\sqrt{\frac{l}{g}}$$

$$T = \frac{mg^2{}_{eff}}{g} \Rightarrow \frac{m}{g}\left[g^2 + \left(\frac{qE}{m}\right)^2\right]$$

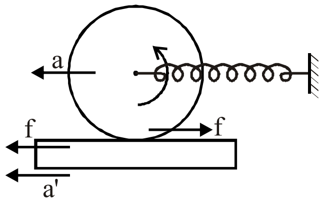
$$T = \left[mg + \frac{q^2E^2}{mg}\right]$$

13. Ans. (B,C)

Sol. $kx - f = Ma$

$f = Ma'$

$a' = a - R\alpha$



$$fR = \frac{1}{2}MR^2\ \alpha$$

$$\frac{f}{M} = a - \frac{2f}{M}$$

$$\frac{3f}{M} = a$$

$$a' = \frac{3f}{M} - \frac{2f}{M} = \frac{f}{M}$$

14. Ans. (A,C)

Sol. Intensity is maximum when the area over which the power is distributed is minimum i.e. at the point 1.

Frequency is max. when relative velocity of approach is maximum.

15. Ans. (B)

Sol. $\Delta x = \mu_1 SS_2 + \mu_2 S_2P$

$$-\left[\mu_1\ SS_1 + \mu_2(S_1P - t) + \int\mu_3 dx\right]$$

from graph $\int\mu_3 dx = \text{Area}$

$$= \frac{1}{2}(1+3)t \Rightarrow 2t$$

$$\Delta x = \mu_1 SS_2 + \mu_2 S_2P$$

$$-\left[\mu_1 SS_1 + \mu_2 S_1P - \mu_2 t + 2t\right]$$

In order to get central maxima at centre $\Delta x = 0$

$$\Delta x = -\mu_1\left[SS_2 - SS_1\right] + \mu_2\left[S_2P - S_1P\right] + \mu_2 t - 2t$$

$$SS_2 - SS_1 = \sqrt{D^2 + d^2} - D$$

$$\Rightarrow\ D\left[1 + \frac{d^2}{D^2}\right]^{1/2} - D$$

$$= D\left[1 + \frac{1}{2}\frac{d^2}{D^2}\right] - D$$

$$SS_2 - SS_1 = \frac{1}{2}\frac{d^2}{D}$$

$$\Delta x = \mu_1\left(\frac{1}{2}\frac{d^2}{D}\right) + \mu(0) + \mu_2 t - 2t$$

$$2t - \mu_2 t = 2 \times \frac{1}{2}\frac{(10^{-3})^2}{(1m)}$$

$$2t - \frac{3t}{2} = 10^{-6}$$

$$\frac{t}{2} = 10^{-6}$$

$t = 2 \times 10^{-6}$ m ($t = 2\mu$m)

16. Ans. (B)

Sol. $\Delta x = \mu_1[SS_2 - SS_1] + \mu_2[S_2P - S_1P] + \mu_2 t - 2t$

For central maxima

$$0 = 2\frac{1}{2}\frac{d^2}{D} + \frac{3}{2}(S_2P - S_1P) + \frac{3t}{2} - 2t$$

$$\frac{3}{2}(S_2P - S_1P) = 2t - \frac{3t}{2} - \frac{d^2}{D}$$

$$(S_2P - S_1P) = \frac{2}{3}\left[\frac{t}{2} - 10^{-6}\right]$$

$$\Rightarrow \frac{2}{3}\left[\frac{10^{-6}}{2} - 10^{-6}\right]$$

$$S_2P - S_1P \Rightarrow -\frac{1}{3}\mu m$$

$$d\sin\theta \cong d\tan\theta$$

$$d\frac{y}{D} = -\frac{1}{3}\mu m$$

$$y = -\frac{1}{3}\frac{10^{-6} \times 1}{10^{-3}} m$$

$$y = -\frac{1}{3} mm$$

17. Ans. (A)

Sol. $\eta_{th} = \dfrac{\text{Net workdone}}{\text{Net heat added}}$

Since processes 1-2 and 3-4 are adiabatic processes, the heat transfer during the cycle takes place only during processes 2-3 and 4-1 respectively. Therefore, thermal efficiency can be written as,

$$\eta_{th} = \frac{\text{Heat added} - \text{Heat rejected}}{\text{Heat added}}$$

Consider 'm' kg of working fluid,

Heat added = $mC_V (T_3 - T_2)$

Heat Rajected = $mC_V (T_4 - T_1)$

$$\eta_{th} = \frac{mC_V(T_3 - T_2) - mC_V(T_4 - T_1)}{mC_V(T_3 - T_2)} = 1 - \frac{T_4 - T_1}{T_3 - T_2}$$

For the reversible adiabatic processes 3-4 and 1-2, we can write,

$$\frac{T_4}{T_3} = \left(\frac{v_3}{v_4}\right)^{\gamma-1} \text{ and } \frac{T_1}{T_2} = \left(\frac{v_2}{v_1}\right)^{\gamma-1}$$

$v_2 = v_3$ and v4 = v_1

$$\frac{T_4}{T_3} = \frac{T_1}{T_2} = \frac{T_4 - T_1}{T_3 - T_2} = \left(\frac{V_2}{V_1}\right)^{\gamma-1}$$

$$\eta_{th} = 1 - \frac{T_1}{T_2} = 1 - \left(\frac{V_2}{V_1}\right)^{\gamma-1}$$

The ratio $\dfrac{V_1}{V_2}$ is called as compression ratio, r.

$$\eta_{th} = 1 - \left(\frac{1}{r}\right)^{\gamma-1}$$

Net work done = $mC_V\{(T_3 - T_2) - (T_4 - T_1)\}$

Displacement volume = $(V_1 - V_2)$

$$= V_1\left(1 - \frac{1}{r}\right) = \frac{mRT_1}{P_1}\left(\frac{r-1}{r}\right)$$

$$= \frac{mC_V(\gamma - 1)T_1}{P_1}\left\{\frac{r-1}{r}\right\}$$

Since, $R = C_V(\gamma - 1)$

18. Ans. (A)

Sol. (18) $\text{mep} = \dfrac{mC_V[(T_3 - T_2) - (T_4 - T_1)]}{\dfrac{mC_V(\gamma-1)T_1}{P_1}\left\{\left(\dfrac{r-1}{r}\right)\right\}}$

$$= \left(\frac{1}{\gamma - 1}\right)\left(\frac{P_1}{T_1}\right)\left(\frac{r}{r-1}\right)\{(T_3 - T_2) - (T_4 - T_1)\}$$

PART–2 : CHEMISTRY SOLUTION

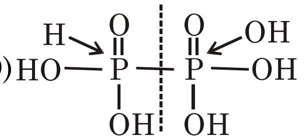
SECTION-I

1. **Ans.(B)**
2. **Ans.(D)**
3. **Ans.(C)**
4. **Ans.(C)**
5. **Ans.(D)**
6. **Ans.(B)**
7. **Ans.(A)**
8. **Ans.(C,D)**
9. **Ans.(A,D)**
10. **Ans.(B,D)**

Sol. (A) $(Mg(OH)_2 + H_3C-C\equiv CH)$ are produced through a non-redox reaction

(B) N of NH_3 does not have vacant orbital.

(C) $(H_3BO_3 + NH_3 + H_2)$ are produced when $B_3N_3H_6$ react with water on heating.

(D)  $\longrightarrow H_3PO_3 + H_3PO_4$

11. **Ans.(A,B,C,D)**

Sol. (A) CO_2 is produced

(B) SO_2 is produced

(C) CO & CO_2 are produced

(D) NO_2 and O_2 are produced.

12. **Ans.(B)**
13. **Ans.(A,B,C,D)**
14. **Ans.(A,C,D)**
15. **Ans.(C)**
16. **Ans.(C)**
17. **Ans.(A)**
18. **Ans.(B)**

PART-3 : MATHEMATICS SOLUTION

SECTION–I

1. **Ans. (A)**

Sol. Let (λ, λ, λ) point of intersection then

$\lambda(\sin A + \sin B + \sin C) = 2d^2$ and

$\lambda(\sin 2A + \sin 2B + \sin 2C) = d^2$

dividing $\dfrac{\sum \sin 2A}{\sum \sin A} = \dfrac{1}{2}$

$\Rightarrow \sin\dfrac{A}{2}\sin\dfrac{B}{2}\sin\dfrac{C}{2} = \dfrac{1}{16}$

2. **Ans. (A)**

Sol. $(1 + y^2e^{-2x})dy = y^3e^{-2x}dx$

$\dfrac{dy}{y} + ye^{-2x}dy - y^2e^{-2x}dx = 0$

Now integrate

3. **Ans. (D)**

Sol. $g(x) = f(x^2 - 2x - 1) + f(5 - x^2 + 2x)$

$= 2x^4 - 8x^3 - 4x^2 + 24x + 18$

$g'(x) = 8x^3 - 24x^2 - 8x + 24 = 0 \Rightarrow x = -1, 1, 3$

$g(x) \geq \min\{g(-1), g(1), g(3)\} = 0$

$g(x) \geq 0 \ \forall \ x \in R$

4. **Ans. (A)**

Sol. $\bar{d} = x\bar{a} + y\bar{b} + z\bar{c}$ take dot product with

$\bar{b}\times\bar{c},\ \bar{c}\times\bar{a},\ \bar{a}\times\bar{b}$

$\bar{d} = \dfrac{[\bar{d}\ \bar{b}\ \bar{c}]\bar{a} + [\bar{d}\ \bar{c}\ \bar{a}]\bar{b} + [\bar{d}\ \bar{a}\ \bar{b}]\bar{c}}{[\bar{a}\ \bar{b}\ \bar{c}]}$

5. **Ans. (C)**

Sol. $(2a)^2 + b^2 = \sin^2 x$, $(2b)^2 + a^2 = \cos^2 x$ where 3a and 3b legs of triangle then hypotenuse

$= 3\sqrt{a^2 + b^2} = \dfrac{3\sqrt{5}}{5}$

6. **Ans. (A)**

Sol. Equation of directrix is $x - 2y = 0$

7. **Ans. (B)**

Sol. $A^2 = I$ then $\begin{bmatrix} a & 0 & 0 \\ 0 & a & 0 \\ 0 & 0 & a \end{bmatrix}^2 = I$

$\Rightarrow a = -1$ hence $|A| = -1$

$A^{-1} = A \Rightarrow |2A| = -8$ hence $|3adj.2A|$

$= 27(-8)^2 = 1728$

8. Ans. (A,B)

Sol. Let circle $(x - h)^2 + (y - k)^2 = r^2$

$$r = \left|\frac{ah + bk + 1}{\sqrt{a^2 + b^2}}\right| \Rightarrow a^2(h^2 - r^2) + b^2(k^2 - r^2) +$$

$2abhk + 2ah + 2bk + 1 = 0$

comparing, we get centre (3, 0), $r = \sqrt{5}$

9. Ans. (B,C,D)

Sol. AM > GM

$$2^{\sin^{-1}x} + 2^{\cos^{-1}x} + 2^{\tan^{-1}x} > 3\left(2^{\frac{\pi}{2} + \tan^{-1}x}\right)^{1/3}$$

$$2^{\sin^{-1}x} + 2^{\cos^{-1}x} + 2^{\tan^{-1}x} > 3$$

No solution.

10. Ans. (A,B)

Sol. differentiable w.r.t. x,

we get

$$\frac{(mx\cos 4x - \ell\sin 4x)}{x^2} = \frac{\ell(4x\cos x - \sin 4x)}{x^2}$$

$m = 4\ell$

Put $m = 4\ell$ to get

$$\ell\int_0^x \left(\frac{4\cos 4t}{t} - \frac{\sin 4t}{t^2}\right)dt = \frac{\ell\sin 4x}{x} - 1$$

$$4\int_0^x \frac{\cos 4t}{t}dt + \int_0^x \sin 4t\left(-\frac{1}{t^2}\right)dt = \frac{\sin 4x}{x} - \frac{1}{\ell}$$

By parts $\frac{\sin 4x}{x} - 4 = \frac{\sin 4x}{x} - \frac{1}{\ell} \Rightarrow \ell = \frac{1}{4}$

$m = 1$

11. Ans. (A,B,C)

Sol. Any tangent $y = mx \pm 4\sin\theta\sqrt{-m}$ it will pass through centre of circle if (1, 1) satisfy this

$m^2 + 2\,[8\sin^2\theta - 1]\,m + 1 = 0$

$D < 0 \Rightarrow \sin^2\theta < \frac{1}{4}$

$$\theta \in \left(0, \frac{\pi}{6}\right) \cup \left(\frac{5\pi}{6}, \frac{7\pi}{6}\right) \cup \left(\frac{11\pi}{6}, 2\pi\right)$$

12. Ans. (A,B,C)

13. Ans. (C,D)

Sol. $$A = \left|2\int_0^1 \sqrt{1 - x}\,dx\right| + \left|2\int_{-1}^0 \sqrt{x + 1}\,dx\right| - (\sqrt{2})^2 = \frac{2}{3}$$

$$B = 2\left(\frac{1}{2} \times 1 - \int_0^1 x^2 dx\right) = \frac{1}{3}$$

14. Ans. (A)

Sol. $$x^2 - \frac{2p}{p - 5}x + \frac{p - 4}{p - 5} = 0$$

$f(0) > 0,\ f(2) < 0,\ f(3) > 0$

Paragraph for question no. 15 and 16

15. Ans. (C)

Sol. No. of subsets having any of first k – 1 elements = 2^{k-1}

16. Ans. (C)

Sol. No. = total no. – subsets having even integers

Paragraph for question no. 17 and 18

Sol. Total points generated = 20, two selected = ${}^{20}C_2$

No. of points with all odd co-ordinates = 4

No. of points with x odd, y even = 6

No. of points with x even, y odd = 4

No. of points with both even = 6

required number of points

$= {}^4C_2 + {}^6C_2 + {}^4C_2 + {}^6C_2 = 42$

17. Ans. (A)

Sol. $$P = \frac{42}{190}$$

18. Ans. (B)

Sol. If S is the reduced sample space then n(S) = ${}^5C_2 \times 4 = 40$; as there are four vertical lines. On each line we need to choose points such that their mid-point belong to set S only. So, we choose both y-coordinates odd or even.

Since, $y \in \{0, 1, 2, 3, 4\}$

So, $n(E) = 4 \times (1 + {}^3C_2) = 16$

$$\Rightarrow P(E) = \frac{16}{40} = \frac{2}{5}$$