ALLEN® CAREER INSTITUTE KOTA (RAJASTHAN) — path to success

CLASSROOM CONTACT PROGRAMME

(Academic Session : 2020 - 2021)

JEE(Main)
MINOR
21-05-2021

JEE(Main) : CRASH COURSE (Phase-IX)

Test Type : MINOR | Test Pattern : JEE-Main

TEST DATE : 21 - 05 - 2021

ANSWER KEY

PART-1 PHYSICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	A	B	A	B	A	A	C	D	D	C
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	C	B	D	C	C	A	C	B	B	A
SECTION-II	Q.	1	2	3	4	5	6	7	8	9	10
	A.	55.00	5.00	6.00	887.00	16.00	20.00	1.00	650.00	4.00	517.00

PART-2 CHEMISTRY

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	C	C	D	B	B	B	B	C	C	D
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	D	A	A	D	C	B	D	C	B	B
SECTION-II	Q.	1	2	3	4	5	6	7	8	9	10
	A.	7.00	5.00	3.00	6.00	8.00	1.00	19.00	70.02	16.00	240.00

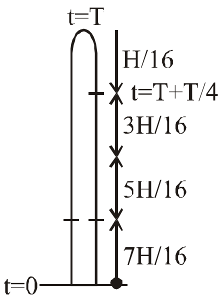
PART-3 MATHEMATICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	D	B	D	B	A	C	A	D	C	A
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	C	D	C	A	A	C	C	C	A	B
SECTION-II	Q.	1	2	3	4	5	6	7	8	9	10
	A.	15.00	10.10	360.00	6.00	25.00	48.00	0.00	18.00	-1.00	10.00

HINT – SHEET

PART–1 : PHYSICS
SECTION-I

1.



$$H = \frac{1}{2}gT^2$$

$$\text{Let } y_{t=T \to t=t+\frac{T}{4}} = \frac{1}{2}g\left(\frac{T}{4}\right)^2 = \frac{H}{16}$$

hence in first $\frac{T}{4}$ seconds of descent journey particle full $\frac{H}{16}$

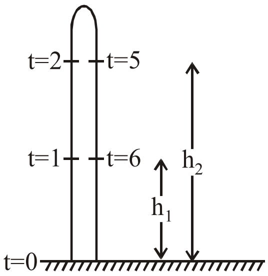
the instant at which it is at height $\frac{7H}{16}$

and $t_1 = \left(T - \frac{3T}{4}\right)$, and $t_2 = \left(T + \frac{3T}{4}\right)$

$$t_1 = \frac{T}{4},\ t_2 = \frac{7T}{4}$$

$$\frac{t_1}{t_2} = \frac{1}{7}$$

2.



At any two instant of upward thrown particle from ground the particle is at same height and this height is $\frac{g}{2}t_1t_2$

$h_2 = \frac{1}{2}g(2 \times 5)$

$h_1 = \frac{1}{2}g\,(1 \times 6)$

$h = h_2 - h_1$

$= \frac{g}{2}(10 - 6)$

$= 2g = 2 \times 10 = 20m$

3. $x\,cm = \frac{\int x.dx}{\int dm}$

Mass per unit length $\frac{dm}{dx} = \lambda = \frac{Kx^2}{L}$

$dm = \frac{Kx^2dx}{L}$

$x_{cm} = \frac{\int_0^L x\left(\frac{Kx^2}{L}\right)dx}{\int_0^L \frac{Kx^2}{L}dx} \equiv \frac{3L}{4}$

4. $v_1 = \frac{(m_1 - em_2)u_1}{m_1 + m_2} + \frac{(1+e)m_2u_2}{m_1 + m_2}$

$v_2 = \frac{(m_2 - em_1)u_2}{m_1 + m_2} + \frac{(1+e)m_1u_1}{m_1 + m_2}$

here $u_2 = 0$, $m_1 = m_2$

$v_2 = 3v_1$

7. $-\frac{dT}{dt} = K(T - T_0)$

$\frac{50 - 45}{5} = K(47.5 - T_0)$

$\frac{45 - 40}{8} = K\,(42.5 - T_0)$

On dividing

$\frac{8}{5} = \frac{47.5 - T_0}{42.5 - T_0}$

$340 - 8T_0 = 237.5 - 5T_0$

$\Rightarrow T_0 = 34°C \quad 3T_0 = 102.5$

8. Zero error (+ve)

$= 0 + 5 \times 0.005$ mm

$\Rightarrow$ error = + 0.025 mm

$LC = \frac{\text{pitch}}{\text{Total CSD}}$

$0.005\text{ mm} = \frac{\text{pitch}}{200}$

$\Rightarrow$ pitch = MSD = 0.005 mm × 200 = 1 mm

New observed diameter then radius of the sphere = 2.05 mm

= (4div. × MSD) + (25 × 0.005 mm)

= 4 mm + 0.125 mm

= 4.125 mm

Actual diameter = obs. – error

= 4.125 mm – (+0.025 mm)

= 4.10 mm

The radius of the sphere = 2.05 mm

9. $\lambda = \frac{h}{mv} = \frac{h}{qrB}$

$= \frac{\lambda_\alpha}{\lambda_{pr}} = \frac{q_{pr} \times r_{pr}}{q_\alpha \times r_\alpha} = \frac{1}{2}$

10. ${}_{90}X^{200} \rightarrow {}_{80}Y^{168} + a \times {}_2\alpha^4 + b \times {}_1\beta^0$

11. $Y = A \cdot \overline{B} + \overline{A} \cdot B$

12. Potential energy of the system

$U = \frac{kQ_1Q_2}{r}$ where $K = \frac{1}{4\pi \in_0}$

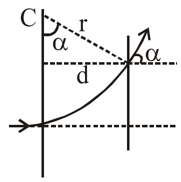
Potential energy of the configuration

$U = \frac{kQq}{a} + \frac{kq^2}{a} + \frac{kqQ}{a\sqrt{2}} = 0$

$Q = \frac{-\sqrt{2}\,q}{\sqrt{2} + 1}$

Hence Q is equal to $\frac{-\sqrt{2}\,q}{\sqrt{2} + 1}$

14.

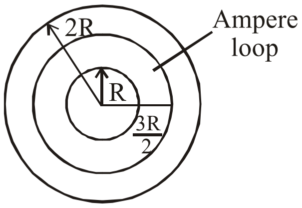


$\sin\alpha = \frac{d}{r}$

$= \frac{dqB}{\sqrt{2mk}}$

$= \frac{dqB}{\sqrt{2mqV}}$

$= Bd\sqrt{\frac{q}{2mV}}$

15. 

$$\oint \vec{B}.\vec{dl} = \mu_0 i$$

$$B2\pi\left(\frac{3R}{2}\right) = \frac{\mu_0 I\left(\pi\left(\frac{3R}{2}\right)^2 - \pi R^2\right)}{\pi(2R)^2 - \pi R^2}$$

16. $$\frac{\frac{E_1}{r_1}+\frac{E_2}{r_2}}{\frac{1}{r_1}+\frac{1}{r_2}} = K\ell_{AP} = \left(\frac{10}{10+10}\right)\frac{10}{1}\ell_{AP}$$

18. $\nu_1 = \dfrac{330}{2\times l_1} \Rightarrow l_1 = \dfrac{330}{2\times 500} = 33$ cm

Similarly $l_2 = 2 \times 33 = 66$ cm

$l_3 = 3 \times 33 = 99$cm

$l_4 = 4 \times 33 = 132$cm

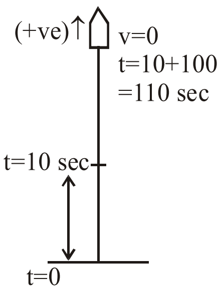
$\therefore$ Number of resonances will be 3.

19. $\Delta x = (2n-1)\dfrac{\lambda}{2} = (2 \times 3 - 1) \times \dfrac{6\times10^{-7}}{2}$

$= 1.5 \times 10^{-6}$ m $= 1.5$ μm

20. $\theta = \dfrac{\Delta x}{a} = \dfrac{(2n+1)\lambda}{2a}$

SECTION-II

1. 

$v_{t=10} = +1000$ m/sec

but at t = 10 fuel is finished after this it's motion is under gravity

$v = u - gt$

$0 = 1000 - 10t$

$t = 100$ sec

Area under (v–t) curve represent total upward displacement (height) of rocket

$= \dfrac{1}{2}\times1000\times110 = 55$ km

2. **Case (1)**

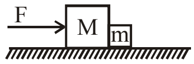


figure (i)

$$a = \frac{F}{M+m}$$

$$N_1 = \frac{mF}{m+M}$$

Case (2)

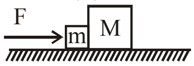
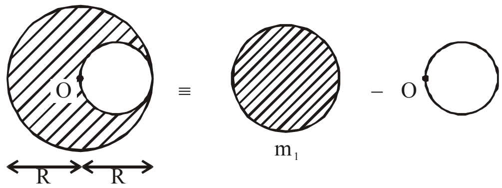


figure (ii)

$$F - N_2 = \frac{mF}{M+m}$$

$$N_2 = F - \frac{mF}{m+M} = \frac{MF}{m+M}$$

$$\frac{N_2}{N_1} = \frac{M}{m} = \frac{10}{2} = 5$$

3. 

Mass of disc α are a

$m_1 \ \alpha\ \pi(R)^2$; $m_2 \propto \dfrac{(1+e)m_1u_1}{m_1+m_2}$

$m_1 = m$; $m_2 = \dfrac{m}{4}$

CM of remaining part

$$x_{cm} = \frac{m_1x_1 - m_2x_2}{m_1+m_2} = \frac{m(0) - \frac{m}{4}\left(\frac{R}{2}\right)}{m - \frac{m}{4}} = -\frac{R}{6}$$

4. $\dfrac{E}{t} = \sigma AT^4$

$= 6 \times 10^{-8} \times 1.6 \times 310^4$

$= 9.6 \times 10^{-8} \times 81$

$= 887$

5. $P^1 = 10\times\dfrac{66}{100} = 6.6$ Watt

$$P^1 = \frac{nE}{t} = \frac{n}{t}\times\frac{hc}{\lambda} \Rightarrow \frac{n}{t} = \frac{P^1\times\lambda}{hc} = \frac{6.6\times5896\times10^{-10}}{20\times10^{-26}}\ /s$$

$$\frac{n}{t} = 1965.6\times10^{16}\ /\ s$$

6. $K = \dfrac{2.303}{10}\log\dfrac{a}{a-0.2928a}$

$K = \dfrac{2.303}{10}\log\dfrac{a}{0.7072\,a}$

$K = \frac{2.303}{10} \log \frac{1}{0.7072}$

$K = \frac{2.303}{10} \log (1.414)$

$K = \frac{2.303}{10} \times 0.150$

$K = 0.034545 \text{ min}^{-1}$

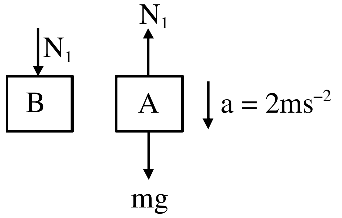
$K = \frac{0.693}{0.034545}$

$K = 20.06 \approx K = 20$ minutes

7. Let A applies force N_1 on B

Then B also applies an opposite force N_1 on A

As shown



For A $\quad mg - N_1 = ma$

$N_1 = m(g - a) = 0.5\,(10 - 2)$

$N_1 = 4$

$N_1 = 2x \Rightarrow x = 2$

8. $\frac{P}{Q} = \frac{S}{625}$

$\frac{Q}{P} = \frac{S}{676}$

$\therefore \frac{S}{625} = \frac{676}{S}$

S $= 25 \times 26$

$= 650\ \Omega$

10. After filling frequency increases, so n_A increases(↑). Also it is given that beat frequency increases (i.e., x↑)

Hence $n_A\uparrow - n_B = x\uparrow$ ...(i) $\longrightarrow$ Correct

$n_B - n_A\uparrow = x\uparrow$ ...(ii) $\longrightarrow$ Wrong

$\Rightarrow n_A = n_B + x = 512 + 5 = 517$ Hz.

PART–3 : MATHEMATICS
SECTION-I

1. Consider $\sim [p \rightarrow (\sim p \vee q)] \equiv p \wedge \sim (\sim p \vee q)]$

$\equiv p \wedge (p \wedge \sim q) \equiv p \wedge p \wedge \sim q \equiv p \wedge \sim q$

2. Let p : "I become a teacher"

and q : "I will open a school", then given statement is

$P \rightarrow q = \sim p \vee q.$

Hence, the negation of the given statement is

$\sim (\because \sim p \vee q) = \sim (\sim p) \wedge \sim q$

$= P \wedge \sim q.$

$(\sim (p \vee q) = \sim p \wedge \sim q)$

$\therefore$ The negation of the given statement is "I will become a teacher and I will not open a school."

3. $A^T = A$

$B^T = -B$

$A - B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ ...(1)

$A^T - B^T = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$

$A + B = \begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$ ...(2)

on adding eq. (1) and (2)

$2A = \begin{bmatrix} 2 & 5 \\ 5 & 8 \end{bmatrix}$

$A = \begin{bmatrix} 1 & 5/2 \\ 5/2 & 4 \end{bmatrix}$

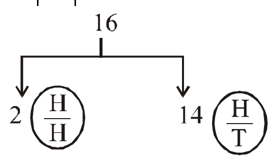
$|A| = \frac{4 - 25}{4} = \frac{-9}{4}$

4. Let $\left(\frac{A}{3}\right) = B$

$|\text{adj}B^{-1}| = |B^{-1}|^2 = \frac{1}{|B|^2} = \frac{1}{\left|\frac{A}{3}\right|^2}$

$= \frac{3^6}{|A|^2} = \frac{3^6}{9^2} = 3^2 = 9$

5.



$\frac{2}{16} \times 1 + \frac{14}{16} \times \frac{1}{2} = \frac{9}{16}$

8. Let $S_1 = 2^2 + 4^2 + 6^2 + \ldots\ldots + 100^2$ ..... (1)

and $S = 1^2 + 3^2 + 5^2 + \ldots\ldots + 99^2$ .... (2)

eq^n (1) – (2) $S_1 - S = [(2^2 - 1^2) + (4^2 - 3^2)] + \ldots.. + (100^2 - 99^2)]$

$\Rightarrow S_1 = S + (1 + 2 + 3 + 4 + \ldots + 100)$

$\Rightarrow S_1 = S + 5050$

9. $\bar{x} = \frac{\sum x_i}{n}$

$\Rightarrow 4 = \frac{1+2+6+x_1+x_2}{5}$

$\Rightarrow x_1 + x_2 = 11$ ....(1)

$\Rightarrow \sigma^2 = \frac{1}{n}\sum x_i^2 - x^{-2}$

$\Rightarrow 5.2 = \frac{1+4+36+x_1^2+x_2^2}{5} - 16$

$\Rightarrow 106 = x_1^2 + x_2^2 + 41$

$\Rightarrow x_1^2 + x_2^2 = 65$ ....(2)

Solving (1) and (2)

$x_1 = 4$; $x_2 = 7$

10. P $\Rightarrow$ q is false only when P is true and q is false
$\therefore$ P $\Rightarrow$ (q $\vee$ r) is false only when P is true and q $\vee$ r is false (if q and r both false)

11. $\sin\frac{\pi}{14}\ \sin\frac{3\pi}{14}\ \sin\frac{5\pi}{14}\ \sin\frac{9\pi}{14}\ \sin\frac{11\pi}{14}\ \sin\frac{13\pi}{14}$

$\left(\sin\frac{13\pi}{14} = \sin\left(\pi - \frac{\pi}{14}\right)\right) = \sin\frac{\pi}{14}$

$\sin\frac{11\pi}{14} = \sin\left(\pi - \frac{3\pi}{14}\right) = \sin\frac{3\pi}{14}$

$\sin\frac{9\pi}{14} = \sin\left(\pi - \frac{5}{14}\right) = \left(\sin\frac{5\pi}{14}\right)$

$= \left(\sin\frac{\pi}{14}\sin\frac{3\pi}{14}\sin\frac{5\pi}{14}\right)^2$

$= \left[\cos\left(\frac{\pi}{2} - \frac{\pi}{14}\right)\cos\left(\frac{\pi}{2} - \frac{3\pi}{14}\right)\cos\left(\frac{\pi}{2} - \frac{5\pi}{14}\right)\right]^2$

$= \left(\cos\frac{\pi}{7}\cos\frac{2\pi}{7}\cos\frac{3\pi}{7}\right)^2$

$= \left(\cos\frac{\pi}{7}\cos\frac{2\pi}{7}\cos\left(\pi - \frac{4\pi}{7}\right)\right)^2$

$= \left(-\cos\frac{\pi}{7}\cos\frac{2\pi}{7}\cos\frac{4\pi}{7}\right)^2 = \left(\frac{\sin 2^3 . \frac{\pi}{7}}{2^3 \sin\frac{\pi}{7}}\right)^2$

$= \left(\frac{1}{8}\right)^2 = \frac{1}{64}$

12. $2\sin^2 x + 3\sin x - 2 > 0$

$\Rightarrow (2\sin x - 1)(\sin x + 2) > 0$

$\Rightarrow \sin x > \frac{1}{2} \quad \Rightarrow x \in \left(\frac{\pi}{6}, \frac{5\pi}{6}\right)$

Also, $x^2 - x - 2 < 0$

$(x - 2)(x + 1) < 0$

$-1 < x < 2$

Also; $2 < \frac{5\pi}{6}$, we obtain that x must lie in $\left(\frac{\pi}{6}, 2\right)$

13. $\int_0^{\pi} \frac{x\tan x}{\sec x + \tan x}dx$

$= \frac{\pi}{2}\int_0^{\pi} \frac{\tan x}{\sec x + \tan x}dx$

$= \frac{\pi}{2}\int_0^{\pi} \tan x(\sec x - \tan x)dx$

$= \frac{\pi}{2}\int_0^{\pi} (\tan x\sec x - \tan^2 x)dx$

$= \frac{\pi}{2}\int_0^{\pi} (\sec x\tan x - \sec^2 x + 1)dx$

$= \frac{\pi}{2}[\sec x - \tan x + x]_0^{\pi}$

$= \frac{\pi}{2}[(-1 - 0 + \pi) - (1 - 0 + 0)]$

$= \frac{\pi}{2}(\pi - 2)$

15. $\frac{dy}{dx} = \frac{y}{x} + \sec\frac{y}{x}$

Let y = vx

$\frac{dy}{dx} = v + x\frac{dv}{dx}$

$v + \frac{xdv}{dx} = v + \sec v$

$\cos v\, dv = \frac{dx}{x}$

$\sin v = \ell nx + c$

$\sin\left(\frac{y}{x}\right) = \ell nx + c$

$\because$ passing through $\left(1, \frac{\pi}{6}\right) \Rightarrow \sin\frac{\pi}{6} = c \Rightarrow c = \frac{1}{2}$

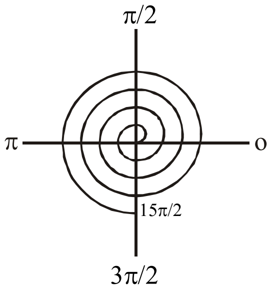
SECTION-II

1. $2\tan^2 x - 5\sec x = 1$

$2(\sec^2 x - 1) - 5\sec x = 1$

$2\sec^2 x - 5\sec - 3 = 1$

$\therefore \cos x = \frac{1}{3}$



2. $\bar{x} = \frac{1}{101}$ [1 + (1 + d) + (1 + 2d)+ ....+ (1+100d)]

$= \frac{1}{101} \times \frac{101}{2}$ [1 + (1 + 100d)] = 1 + 50d.

∴ Mean deviation from mean

$= \frac{1}{101}$ [| 1– (1 + 50d)| + | 1 + d–(1 + 50d) | +....+ |1 + 100d –(1+50d)|]

$= \frac{2|d|}{101}$ [1 + 2 +... + 50]

$= \frac{2|d|}{101}\frac{50(51)}{2} = \frac{2550}{101}|d|$

Now, $\frac{2550}{101}|d| = 255 \Rightarrow |d| = 10.1$

Thus, we may take d = 10.1

3. for z → 10 choice

for First two x and y → $^9C_2$ choice

Last two y and x → 1 choice

$10 \times {}^9C_2 \times 1 = 360$

4. $|Z_1| = 1, |Z_2| = 1$

$Z_1^2 + Z_2^2 = 5$

so $\bar{Z}_1^2 + \bar{Z}_2^2 = 5$

$(Z_1 - \bar{Z}_1)^2 + (Z_2 - \bar{Z}_2)^2$

$= Z_1^2 + Z_2^2 + \bar{Z}_1^2 + \bar{Z}_2^2 - 2|Z_1|^2 - 2|Z_2|^2$

10 – 4 = 6

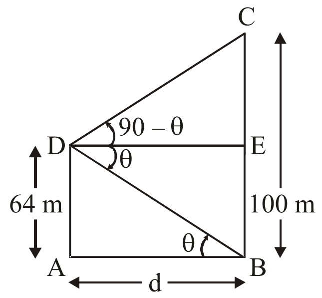
5. Sum of 9 term = 9 × 15 = 135

New sum when Mean is 16

= 16 × 10 = 160

New term = 160 – 135 ⇒ 25

6.



7. $\int_0^1 \tan^{-1}\left(\frac{2x-1}{1+x-x^2}\right)dx$

$= \int_0^1 \tan^{-1}\left(\frac{x-(1-x)}{1+x(1-x)}\right)dx$

$= \int_0^1 (\tan^{-1}(x) - \tan^{-1}(1-x))dx$

$= \int_0^1 \tan^{-1}(x) - \int_0^1 \tan^{-1}(1-x)dx$

= 0