DISTANCE LEARNING PROGRAMME

(Academic Session : 2020 - 2021)

JEE(Main)
TEST # 02
21-02-2021

JEE(Main) : NURTURE TEST SERIES / JOINT PACKAGE COURSE

Test Type : Major Test

ANSWER KEY

PART-1 PHYSICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	D	B	D	D	A	B	B	C	D	C
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	C	A	C	D	A	B	B	D	B	B
SECTION-II	Q.	1	2	3	4	5	6	7	8	9	10
	A.	13.00	2.00	9.50	0.00	20.00	7.00	10.00	14.00	0.13	900.00

PART-2 CHEMISTRY

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	C	C	D	B	A	B	D	B	A	C
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	B	C	A	D	C	B	D	D	B	A
SECTION-II	Q.	1	2	3	4	5	6	7	8	9	10
	A.	400.00	1200.00	10.10	11.00	2.45	6.52	4.00	8.00	2.00	4.00

PART-3 MATHEMATICS

SECTION-I	Q.	1	2	3	4	5	6	7	8	9	10
	A.	B	A	A	D	B	D	D	A	A	A
	Q.	11	12	13	14	15	16	17	18	19	20
	A.	A	C	B	A	A	D	C	B	C	A
SECTION-II	Q.	1	2	3	4	5	6	7	8	9	10
	A.	6.00	10.10	7.00	3.00	96.00	60.00	15.00	4.00	17.00	49.00

HINT – SHEET

PART-1 : PHYSICS

SECTION-I

1. We know

$Cz = M^\circ L^\circ T^\circ$

So $C = Z^{-1}$ and dim of x = dim of B

dim of x = Ay

or B = Ay

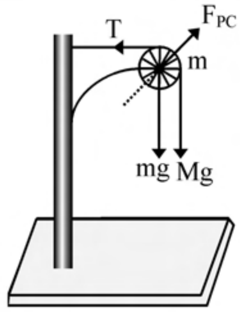
y = B/A

2. $H = I^2RT$

$$\frac{\Delta H}{H}\times 100 = \pm 2\frac{\Delta I}{I}\times 100 \pm \frac{\Delta R}{R}\times 100 \pm \frac{\Delta t}{t}\times 100$$

$= \pm 2 \times 3\% \pm 4\% \pm 6\% = \pm 16\%$

3. Force on the pulley by the clamp

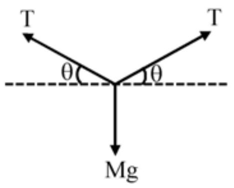


$$F_{PC} = \sqrt{T^2 + [(M+m)g]^2}$$

$$F_{PC} = \sqrt{(Mg)^2 + [(M+m)g]^2}$$

$$F_{PC} = \sqrt{M^2 + (M+m)^2}\,g$$

4.



$2T \sin\theta = Mg$

T become horizontal

$\theta = 0°$

$\Rightarrow T = \infty$

which is not possible.

5. $\tan\theta = \frac{u\sin\theta}{u\cos\theta} = \frac{2}{1}$

The desired equation is

$$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta}$$

$$= x \times 2 - \frac{10x^2}{2\left(\sqrt{2^2+1^2}\right)^2\left(\frac{1}{\sqrt{5}}\right)^2}$$

or $y = 2x - 5x^2$

11. Apparent weight = actual weight – upthrust force

$Vdg' = Vdg - V\rho g$

$\Rightarrow g' = \left(\frac{d-\rho}{d}\right)\rho$

12. $h = \frac{2T}{Rdg} \Rightarrow hR = \frac{2T}{dg}$ = constant

13. Rise in temperature, $\Delta\theta = \frac{3T}{JSd}\left(\frac{1}{r} - \frac{1}{R}\right)$

$\therefore \Delta\theta = \frac{3T}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$ [For water S = 1 and d = 1]

14. (Based on theory)

First speed decreases and then becomes constant.

15. $v = \sqrt{\frac{T}{m}} = \sqrt{\frac{T}{\pi r^2\rho}} = \sqrt{\frac{T}{A\rho}}$

$$= \sqrt{\frac{20}{0.20\times10^{-6}\times7.5\times10^{3}}} = 116 \text{ m/s}$$

SECTION-II

1. Given

$A + B = 17$ .....(i)

$A - B = 7$ .....(ii)

$2A = 24$

$A = 12$

$B = 5$

When $A \perp B$

$R = \sqrt{A^2 + B^2}$

$R = \sqrt{12^2 + 5^2}$

$R = 13$

2. we know that $T = \frac{u\sin\theta}{g} = 2$ $T = \frac{2u\sin\theta}{g}$

$\Rightarrow u\sin\theta = 2g$ ....(1)

$\tan 45° = \frac{u\sin\theta - g}{u\cos\theta} = 1$

$u\sin\theta - g = u\cos\theta$

$2g - g = u\cos\theta$

$u\cos\theta = g$ ....(2)

by (1) & (2)

$\tan\theta = 2$

$\theta = \tan^{-1}(2)$

6. $v = \frac{\sqrt{\gamma p}}{\rho} = \sqrt{\frac{\gamma RT}{M}}$

$\therefore$ $v \propto \frac{1}{\sqrt{M}}$

$$\frac{v_{N_2}}{v_{H_e}} = \sqrt{\frac{M_{H_e}}{M_{N_2}}} = \sqrt{\frac{4}{28}} = \sqrt{\frac{1}{7}}$$

7. for damped oscillation, amplitude is given as

$A = A_0 e^{-0.1t} = \frac{A_0}{2}$

$e^{-0.1t} = \frac{1}{2}$

$(-0.1)t = -\ell n(2)$

$t = 10\ \ell n(2)$ sec

PART-2 : CHEMISTRY

SECTION-I

1. $K_P = K_C (RT)^{\Delta n}$

$\Delta n = 1 - \left(1 + \frac{1}{2}\right) = -\frac{1}{2}$

$$\frac{K_P}{K_C} = (RT)^{-\frac{1}{2}} \Rightarrow \frac{K_P}{K_C} = \frac{1}{\sqrt{RT}}$$

2. $w = -\Delta ng.RT$

$= -(50 \times 8.3 \times 300)/1000$

$= -124.50$ kJ

SECTION-II

1. $T = \frac{\Delta H}{\Delta S} = \frac{30 \times 10^3}{75}$

$= 400$

3. $pH = pKa + \log \frac{[salt]}{[acid]}$

$= -\log(4 \times 10^{-11}) + \log \frac{.1}{.2}$

$= 10.1$

4. $k_{sp} = [CU^+][I^-]$

$5 \times 10^{-12} = [CU^+](10^{-1})$

$[CU^+] = 5 \times 10^{-11}$

5. $CaSO_4(aq) \rightleftharpoons Ca^{2+}(aq) + SO_4^{2-}(aq)$

If S is the solubility of $CaSO_4$ in moles L^{-1}

$K_{sp} = [Ca^{2+}] \times [SO_4^{2-}] = S^2$

$\therefore\ S = \sqrt{K_{sp}} = \sqrt{9.0 \times 10^{-6}}$

$= 3 \times 10^{-3}$ mol L^{-1}

$= 3 \times 10^{-3} \times 136$ g $L^{-1} = 0.408$ gL^{-1}

For dissolving 0.408 g of $CaSO_4$ water required = 1 L

$\therefore$ For dissolving 1g $CaSO_4$ water required = $\frac{1}{0.408}L = 2.45$ L

6. **Ans.** 6.52 atm L^2 mol^{-2}

$(V - nb) = nRT$

$[4 - 2 \times 0.05] = 2 \times 0.0821 \times 300$

$\Rightarrow a = 6.52$ atm L^2 mol^{-2}

PART-3 : MATHEMATICS

SECTION-I

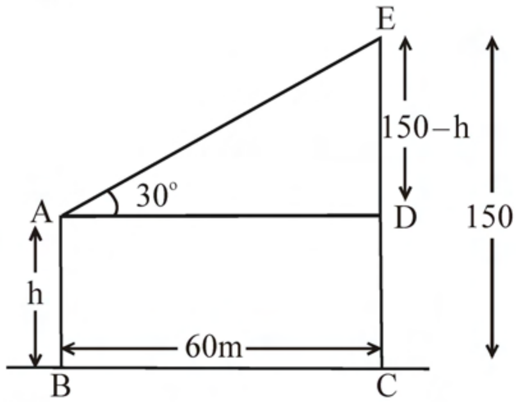
1. $\cos C = \frac{8^2 + 10^2 - 12^2}{2 \cdot 8 \cdot 10} = \frac{1}{8}$

$\cos A = \frac{10^2 + 12^2 - 8^2}{2 \cdot 10 \cdot 12} = \frac{3}{4}$

$\cos 2A = 2\cos^2 A - 1 = 2 \times \frac{9}{16} - 1 = \frac{1}{8}$

So, $\cos C = \cos 2A \Rightarrow C = 2A$

2. From figure,



In ΔADE,

$\frac{150 - h}{60} = \tan 30^\circ = \frac{1}{\sqrt{3}}$

$\therefore\ h = 150 - \frac{60}{\sqrt{3}}$

$= (150 - 20\sqrt{3})$ meters

3. $A = \cos 5420^\circ + \sin 5420^\circ$

$A = \cos(90^\circ \times 60^\circ + 20] + \sin[90^\circ \times 60^\circ + 20]$

$= + \cos 20^\circ + \sin 20^\circ$

$A = +ive$

4. Consider $\sim[p \to (\sim p \vee q)] \equiv p \wedge \sim(\sim p \vee q)]$

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

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

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

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

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

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

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

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

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

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

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

6. $x^4 - 100x^3 + 2x^2 + 4x + 10 = 0 \rightarrow \alpha,\beta,\gamma,\delta$

eq^n whose roots are $\frac{1}{\alpha},\frac{1}{\beta},\frac{1}{\gamma},\frac{1}{\delta}$ is

$10x^4 + 4x^3 + 2x^2 - 100x + 1 = 0 \rightarrow \frac{1}{\alpha},\frac{1}{\beta},\frac{1}{\gamma},\frac{1}{\delta}$

SOR $\Rightarrow \frac{1}{\alpha}+\frac{1}{\beta}+\frac{1}{\gamma}+\frac{1}{\delta} = \frac{-4}{10} = \frac{-2}{5}$

7. $\sum_{i=0}^{200}(1+x)^i = 1 + (1+x) +$

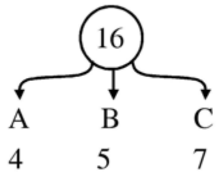
$(1+x)^2 + ... + (1+x)^{200} \rightarrow$ G.P.

$= \frac{1.\{(1+x)^{201} - 1\}}{(1+x) - 1} = \frac{(1+x)^{201} - 1}{x} \rightarrow$ Coeff. of x^{100}

$\Rightarrow (1+x)^{201} - 1 \rightarrow$ Coeff. of x^{101}

$\Rightarrow {}^{201}C_{101} = {}^{201}C_{100}$

8.



$= \frac{16!}{4!5!7!}$

10. Total ways = 7

fav. cases = 1

$P = \frac{1}{7}$

11. $\therefore$ $\log_e a$ is defined for $a > 0$.

$\therefore$ $\log\left\{\sqrt{(4-x^2)}/(1-x)\right\}$ is defined for

$\sqrt{(4-x^2)}/(1-x) > 0$ ....(1)

Now $\sqrt{(4-x^2)} = \sqrt{[(2-x)(2+x)]}$ is real

if $-2 \le x \le 2$.

$\therefore$ (1) holds if $-2 < x < 2$ and $1 - x > 0$

$\because$ $\sqrt{(4-x^2)} = 0$ when $x = \pm 2$

$\Rightarrow -2 < x < 2$ and $x < 1$ $\Rightarrow -2 < x < 1$.

Thus, the domain of f(x) is (–2, +1).

12. $f(x) = \log_2\{-\log_{1/2}(1 + x^{-4}) - 1\}$ is defined

if $-\log_{1/2}(1 + x^{-4}) - 1 > 0$

$\Rightarrow \log_2(1 + x^{-4}) > 1$ $\Rightarrow 0 < 1 + x^{-4} > 2$

$\Rightarrow x^{-4} > 1$ i.e., $0 < x^4 < 1$

$\Rightarrow 0 < x < 1$.

$\therefore$ Domain f(x) = (0, 1).

14. If $|b| \le |c|$, then range = $[-\infty, \min] \cup [\max. \infty)$

15. $\lim_{x\to 2}\frac{\sqrt{1+\sqrt{2+x}} - \sqrt{3}}{x-2} \times \left(\frac{\sqrt{1+\sqrt{2+x}} + \sqrt{3}}{\sqrt{1+\sqrt{2+x}} + \sqrt{3}}\right)$

$\lim_{x\to 2}\frac{\sqrt{2+x} - 2}{\left(\sqrt{1+\sqrt{2+x}} + \sqrt{3}\right)(x-2)}$

Again rationalizing

$= \frac{1}{\left(2\sqrt{3}\right)4} = \frac{1}{8\sqrt{3}}$

16. The tangent of slope m of parabola $y^2 = 8x$ is

$y = mx + \frac{2}{m}$

if this is also a tangent to $x^2 = -64y$ then

$\frac{2}{m} = 16m^2 \Rightarrow m^3 = \frac{1}{8} \Rightarrow m = \frac{1}{2}$

17. Let equation of ellipse is $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$\because$ it passes through (2, 3) $\Rightarrow \frac{4}{a^2} + \frac{9}{b^2} = 1$ …(i)

and $e = \sqrt{1 - \frac{b^2}{a^2}} = \frac{1}{\sqrt{3}}$ $\Rightarrow b^2 = \frac{2a^2}{3}$ …(ii)

Solving (i) and (ii) gives $a^2 = \frac{35}{2}$, $b^2 = \frac{35}{3}$

$\Rightarrow$ ellipse is $2x^2 + 3y^2 = 35$

18. Here be = 3 $\Rightarrow$ b = 1

and $e^2 = 1 + \frac{a^2}{b^2} = 1 + a^2 = 9 \Rightarrow a^2 = 8$

Hence, hyperbola is $\frac{-x^2}{a^2} + \frac{y^2}{b^2} = 1$

$\Rightarrow \frac{-x^2}{8} + \frac{y^2}{1} = 1 \Rightarrow -x^2 + 8y^2 = 8$

20. Slope of lines are

$m_1 = \frac{1}{\sqrt{3}}$

& $m_2 = -\sqrt{3}$

$\therefore \quad \tan\theta = \left|\frac{\frac{1}{\sqrt{3}} - \sqrt{3}}{1 - \frac{1}{\sqrt{3}}(\sqrt{3})}\right|$

$\theta = 90°$

SECTION-II

1. max cosθ = 1. So, cosx · siny = 1

$\Rightarrow$ cos x = 1, sin y = 1 or cos x = –1, sin y = –1

cos x = 1, sin y = 1 $\Rightarrow$ x = 0, 2π

and y = $\frac{\pi}{2}, \frac{5\pi}{2}$ (from the equation)

cos x = 1, sin y = –1

$\Rightarrow$ x = π, 3π and y = $\frac{3\pi}{2}$ (from the equation)

$\therefore$ the required number of ordered pair

= 2 × 2 + 2 × 1 = 6

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

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

$\therefore$ 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. $T_n = \frac{2n+1}{1^2 + 2^2 + ...n^2}$

$T_n = \frac{6}{n(n+1)}$

$S_n = \sum_{n=1}^{\infty} T_n$

$= 6\sum_{n=1}^{\infty}\frac{1}{n(n+1)}$

$= 6\sum_{n=1}^{\infty}\left[\frac{1}{n} - \frac{1}{n+1}\right]$

$= 6\left(1 - \frac{1}{2}\right) + \left(\frac{1}{2} - \frac{1}{3}\right) + \left(\frac{1}{3} - \frac{1}{4}\right)$

$= \frac{(6)}{1} = \frac{a}{b}$ a + b = 7

5. $i^{1!} + i^{2!} + i^{3!} + i^{100!} = a + bi$

i + (–1) + (–1) + [1 + 1 + ….. +1] = a + bi

← 97 times →

i + 95 = a + bi

a = 95, b = 1

a + b = 96

9. Image of (3, 8) in line x + 3y – 7 = 0 is

$\frac{\alpha - 3}{1} = \frac{\beta - 8}{3} = \frac{-2(3 + 24 - 7)}{1 + 9}$

$\Rightarrow \frac{\alpha - 3}{1} = \frac{\beta - 8}{3} = -4$

$\Rightarrow \alpha = -1, \beta = -4 \Rightarrow \alpha^2 + \beta^2 = 17$

10. Here $d = \frac{7}{10} \Rightarrow 100\, d^2 = \frac{49}{100} \times 100 = 49$