AVIRAL
JEE | NEET | FOUNDATIONS

# FINAL TEST SERIES JEE -2020
# TEST-02 ANSWER KEY

Test Date :15-12-2019

## [PHYSICS]

**1.** $$-\frac{GMm}{2R^3}\left(3R^2-\frac{R^2}{4}\right)+\frac{1}{2}mv_e^2=0$$

$$v_e = \sqrt{\frac{11}{4}\frac{GM}{R}}$$

**2.** $$V_T = \frac{2}{9}r^2g\left[\frac{\rho_{liquid}}{\eta}\right]$$

$$0.2 = \frac{2}{9} \times 1^2 \times 1000\left[\frac{1.5}{\eta}\right]$$

$$\eta = 1.5 \times \frac{10^3}{0.9}$$

$$\eta = 1.66 \times 10^3 \text{ poise}$$

**3.** Breaking force = Breaking stress × Area

$$\frac{F_1}{F_2} = \left(\frac{r_1}{r_2}\right)^2$$

$$\frac{200}{F_2} = \left(\frac{r}{2r}\right)^2 \Rightarrow F_2 = 800N$$

**4.** Apply $W = T\Delta A$

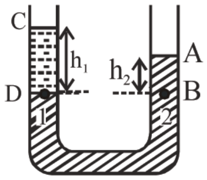
and as for bubble there are two surfaces

$$W = T\left[2\times4\pi\left(\frac{2D}{2}\right)^2 - 2\times4\pi\left(\frac{D}{2}\right)^2\right] = 6\pi D^2T$$

**5.** A

**6.** C

**7.**




$$P_1 = P_2$$

$$P_o + \rho_{oil} \times g \times h_1 = P_o + \rho_w \times g \times h_2$$

$$\frac{\rho_{oil}}{\rho_w} = \frac{h_2}{h_1}$$

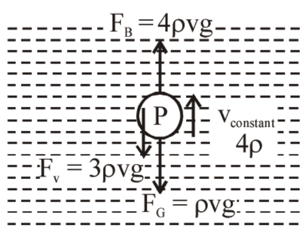
**8.** D

**9.** C

**10.** $$F_B = F_v + F_G$$

$$F_v = 3\rho vg$$

$$\frac{F_V}{F_G} = \frac{3\rho vg}{\rho vg}$$




**11.** A

**12.** B

**13.** $$x = \frac{0\times\pi(28)^2 - 7\times\pi(21)^2}{\pi(28)^2 - \pi(21)^2}$$

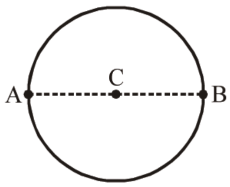
$$x = -\frac{7\pi(21)^2}{\pi\times 7\times 49} = -9 \text{ cm}$$

distance from origin = 9 cm

**14.** $$\frac{I_2}{I_1} = \frac{m_2\, r_2^2}{m_1\, r_1^2} = \frac{(A\times 2\pi r_2)\rho r_2^2}{(A\times 2\pi r_1)\rho r_1^2} = \frac{r_2^3}{r_1^3}$$

$$\frac{r_2}{r_1} = (4)^{1/3}$$

**15.** $$\frac{\omega_A}{\omega_C} = \frac{\frac{V_A}{r_A}}{\frac{V_C}{r_C}} = \frac{r_C}{r_A}$$




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

**16.** $$3m(200\cos 60°)\,\hat{i} = (m\times 100)\,\hat{j} + (m\times 100)\left(-\hat{j}\right) + m\vec{v}$$

$$\vec{v} = \left(300\,\hat{i}\right) \text{ m/s}$$

300 m/s in the horizontal direction.

**17.** $$mgh = \frac{1}{2}mv^2 + \frac{1}{2}Iw^2$$

$$mgh = \frac{1}{2}mv^2 + \frac{1}{2}\,\frac{MR^2}{2}\times\frac{v^2}{R^2}$$

$$v = \sqrt{\frac{4mgh}{2m+M}}$$

**18.** $$\vec{\tau} = \frac{d\vec{J}}{dt} = \frac{d}{dt}\left(\vec{r}\times p\right) = m\,\frac{d}{dt}\left(\vec{r}\times\vec{v}\right)$$

$$\vec{\tau} = [16\,t]\,\hat{k}$$

at t = 2 $\quad \vec{\tau}_{t=2} = (16\times 2)\,\hat{k} = 32\,\hat{k}$ N-m

**19.** $P = \tau\,.\,\omega$

$$P = I\ \alpha\,.\,\omega = I\left(\omega\frac{d\omega}{d\theta}\right).\omega$$

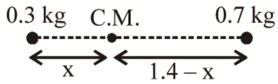
$$\omega^2 d\omega = \frac{P}{I}d\theta$$

$\omega \propto \theta^{1/3}$

$\omega \propto (n)^{1/3}$

**20.** $0.3X = 0.7\,(1.4 - X)$

$x = 0.9$ m




**21.** $A_1V_1 = A_2V_2$

$$= \pi\left(\frac{3}{2}\right)^2 \times 4 = \pi\left(\frac{6}{2}\right)^2 \times v$$

$= v = 1$ m/s

**22.** 5

**23.** 9

**24.** 2

**25.** 9

# [CHEMISTRY]

**26.** $\pi_1 = \pi_2$ for isotonic

$i_1C_1ST = i_2C_2ST$

$i_1C_1 = i_2C_2$

**27.** Krichoff's equation

$$\Delta C_p = \frac{\Delta H_2 - \Delta H_1}{T_2 - T_1}$$

**28.** $$PbCl_2(s) \rightleftharpoons \underset{S}{Pb^{2+}}{}_{(aq)} + \underset{2S}{2}\,Cl^-{}_{(aq)}$$

$K_{sp} = 4s^3$

$1\times 10^{-6} = 4s^3$

$$S^3 = \frac{1}{4}\times 10^{-6}$$

$$= \left(\frac{1}{4}\right)^{\frac{1}{3}}\times 10^{-2}$$

$= 0.63\times 10^{-2} = 6.3\times 10^{-3}$

**29.** **FACT**

**30.** $\int \Delta S = \frac{q}{T} = \int \frac{nC_p dT}{T}$

$\Delta S = nC_p \ \ell n \ \frac{T_2}{T_1}$

**31.** $\Delta n = \oplus ve$

$P\uparrow$ backward shifting

**32.** $H_2O(s) \rightarrow H_2O(\ell)$

$\Delta S = \frac{\Delta H}{T}$

$\Delta S = S_{product} - S_{reactant}$

**33.** $2AB_{2(g)} \rightleftharpoons 2AB_{(g)} + B_{2(g)}$

| | | |
|---|---|---|
| 1 | 0 | 0 |
| 1 – x | x | x/2 |

$\therefore K_p = \frac{x^2.x}{2(1-x)^2} \times \left[\frac{P}{1+\frac{x}{2}}\right]^1$

**34.** $w = -2.303 \ nRT \log_{10} \frac{V_2}{V_1}$

**35.** $\Delta U = q + w$

$w = -P_{ext}.\Delta V$

**36.** $\Delta H - T\Delta S = 0$

**37.** $T\uparrow$ viscoity$\downarrow$

**38.** $NV = (N_1V_1)_{base} - (N_2V_2)_{acid}$

**39.** At low P and high T real gas behave as ideal gas.

**40.** $pH = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$

**41.** **A**

**42.** **C**

**43.** $K_P = \frac{\alpha^2}{1-\alpha^2}P \approx \alpha^2 P.$

so, $\alpha \approx \sqrt{\frac{K_P}{P}}$ .

**44.** pH = 2

$(H^+) = 0.01 \ M = C\alpha = 0.1 \times \alpha$

$\alpha = 0.1$

$i = 1 - \alpha + n\alpha$

$= 1 - 0.1 + 2 \times 0.1$

$= 1.1$

$\pi = i \times CRT$

**45.** **B**

**46.** $pH = pKa + \log \frac{[X^-]}{[HX]}$

**47.** **1**

**48.** **0**

**49.** **2**

**50.** 4

# [MATHEMATICS]

**51.** **Ans.(4)**

$|z|^2 - |z| - 2 < 0$

$\Rightarrow (|z|-2)(|z|+1) < 0 \Rightarrow |z| < 2$

Now $|z^2 + z\sin\theta| \le |z|^2 + |z\sin\theta| \le |z|^2 + |z| < 4 + 2 = 6$

**52.** **Ans. (2)** $[(n+1)n - (n-1)]n!$

$T_n = (n^2+1)\underline{|n} = n\underline{|n+1} - (n-1)\underline{|n}$

$\therefore S_n = n\underline{|n+1}$

$\frac{T_{10}}{S_{10}} = \frac{101\underline{|10}}{10\underline{|11}} = \frac{101}{110}. \ \therefore \ b - a = 9$

**53.** **Ans. (2)**

| p | q | p∧q | (p∧q)→p | ~q | q∧~q | [(p∧q)→p] →(q∧~q) |
|---|---|---|---|---|---|---|
| T | T | T | T | F | F | F |
| T | F | F | T | T | F | F |
| F | T | F | T | F | F | F |
| F | F | F | T | T | F | F |

Given compound statement is always false. So it is a contradiction.

**54. Ans. (4)**

$n_1 = 10,\ n_2 = 10$

average $m_1 = 60,\ m_2 = 40$

$\sigma_1 = 4,\ \sigma_2 = 6$

Standard deviation of combined series

$$\sigma = \sqrt{\frac{n_1\sigma_1^2 + n_2\sigma_2^2}{n_1+n_2} + \frac{n_1 n_2 (m_1 - m_2)^2}{(n_1+n_2)^2}}$$

$$= \sqrt{\frac{10\times16+10\times36}{10+10} + \frac{10\times10(60-40)^2}{(10+10)^2}}$$

$$= \sqrt{8+18+100} = \sqrt{126} = 11.2$$

**55. Ans. (1)**

$S = (1-\omega)(1-\omega^2) + \ldots.. + (2017-\omega)(2017-\omega^2)$

$$S = \sum_{n=1}^{2017} (n-\omega)(n-\omega^2) = \sum_{n=1}^{2017} (n^2+n+1)$$

$$= \frac{2017.2018.4035}{6} + \frac{2017.2018}{2} + 2017$$

$$\frac{S.\pi}{2017} = \left(\frac{2018.4035}{6} + \underbrace{1009+1}_{\text{even}}\right)$$

$= (\text{odd} + \text{even})\pi = \text{odd} \times \pi$

$$= \cos\left(\frac{S\pi}{2017}\right) = \cos(\text{oddx}\pi) = -1$$

**56. Ans. (2)**

| p | ~p | q | p→q | q ∨ ~p | (p→q) ↔ (q ∨ ~p) |
|---|---|---|---|---|---|
| T | F | T | T | T | T |
| T | F | F | F | F | T |
| F | T | T | T | T | T |
| F | T | F | T | T | T |

**57. Ans. (4)**

Total cases ⇒ $^{15}C_2.2! = 15.14$

$2x = 3y \Rightarrow (3, 2), (6, 4), (9, 6), (12, 8), (15, 10)$

Fovourable cases = 5

$$\text{Probability} = \frac{5}{15.14} = \frac{1}{42}$$

**58. Ans. (2)**

$$\left(\frac{n(n+1)}{2}\right)^2 - \sum_{p=1}^{n} \frac{m(m+1)}{2} = 80$$

$$\frac{n^2(n+1)^2}{4} - \frac{n(n+1)(2n+1)}{12} - \frac{n(n+1)}{4} = 80$$

$\Rightarrow n = 4$

**59. Ans. (2)**

$\overline{\text{I}}\ \overline{\text{II}}\ \overline{\text{III}}$ — — — — — $\overline{\text{IX}}\ \overline{\text{X}}$

Total number of numbers = $10^{10}$

(without any restriction)

Total number of numbers = $9^{10}$

(when we do not use 1)

**60. Ans. (1)**

$^nC_{r-2} = 36,\ ^nC_{r-1} = 84,\ ^nC_r = 126$

$$\frac{^nC_{r-1}}{^nC_{r-2}} = \frac{84}{36} \Rightarrow \frac{n-r+2}{r-1} = \frac{7}{3}$$

$\Rightarrow 3n + 13 = 10r$ ...(1)

$$\frac{^nC_r}{^nC_{r-1}} = \frac{126}{84} \Rightarrow \frac{n-r+1}{r} = \frac{3}{2}$$

$\Rightarrow 2n + 2 = 5r$ ....(2)

$\therefore n = 9,\ r = 4$

$^nC_{2r} = {}^9C_8 = 9$

**61. Ans. (1)**

$|z-3-4i| = 4$

$||z|-5| \le 4$

$|z| \le 9$

**62. Ans. (2)**

Use : contrapositive of $p \to q$ is $(\sim q) \to (\sim p)$

**63. Ans. (3)**

$\sum_{n=0}^{4} (1009-2n)^4\ {}^4C_n (-1)^n$

$(1009)^4 - 4(1007)^2 + 6.(1005)^4 - 4(1003)^4 + (1001)^4$

$(1005+4)^4 + (1005-4)^4$

$-4[(1005+2)^4 + (1005-2)^4] + 6(1005)^4$

$= 512 - 4 \times 32 = 384$

**64. Ans. (4)**

$P = \frac{2 \times 19}{10 \times 9} = \frac{19}{45}$

favourable : {(3,4),(3,5),......(3,10)
(6,7), (6,8),....(6,10)
(9,10),
(1,4),(2,4)
(1,8),(2,8),(4,8),(5,8),(7,8)}

**65. Ans. (4)**

$np = 2$

$npq = 1 \quad \therefore\ p = q = \frac{1}{2}, n = 4$

$P(x) = 1 - {}^4C_0\left(\frac{1}{2}\right)^4 - {}^4C_1\left(\frac{1}{2}\right)^4 = 1 - \frac{1}{16} - \frac{4}{16} = \frac{11}{16}$

**66. Ans. (1)**

$T_n = \tan^{-1}\left(\frac{3}{n^2+n-1}\right) = \tan^{-1}(n+2) - \tan^{-1}(n-1)$

Use : $S_n = \Sigma T_n$

**67. Ans. (3)**

$\frac{1}{20}\sum_{i=1}^{20}(x_i - \overline{x})^2 = 5$

$\sum_{i=1}^{20}(x_i - \overline{x})^2 = 100$

new observations are $2x_1, 2x_2, \ldots\ldots, 2x_{20}$.

Their mean $= \overline{x}_1 = \frac{2(x_1 + x_2 + \ldots + x_{20})}{20} = 2\overline{x}$

Now, variance $= \frac{1}{20}\sum_{i=1}^{20}(2x_i - 2\overline{x})^2$

$= \frac{1}{20} \times 4\sum_{i=1}^{20}(x_i - \overline{x})^2 = \frac{1}{20} \times 4 \times 100 = 20$

**68. Ans. (3)**

$b_1 + b_2 = 1 \Rightarrow b_1(1+r) = 1 \Rightarrow b_1 = \frac{1}{1+r}$

$\sum_{k=1}^{\infty} b_k = \frac{1}{(1+r)(1-r)} = \frac{1}{1-r^2} = 2 \Rightarrow r = \frac{-\sqrt{2}}{2}$

$b_1 = \frac{1}{1+r} = \frac{1}{1-\frac{\sqrt{2}}{2}} = (2+\sqrt{2})$

**69. Ans. (1)**

$50, a_1, a_2, \ldots, a_n, 100$ are in A.P.

$a_2 = 50 + 2d$; where $d = \frac{50}{n+1}$

$a_2 = \left(50 + \frac{100}{n+1}\right) = \frac{50n+150}{n+1} = \frac{50(n+3)}{(n+1)}$

$50, h_1, h_2, \ldots\ldots, h_n, 100$ are in H.P.

$\frac{1}{h_{n-1}} = \frac{1}{50} + (n-1)d'$;

where $d' = \frac{\left(\frac{1}{100} - \frac{1}{50}\right)}{n+1} = \frac{-1}{100(n+1)}$

**70.** **Ans. (3)**

Do yourself

**71.** We have $7^2 = 49 = 50 - 1$

Now, $7^{300} = (7^2)^{150} = (50-1)^{150}$

$$= {}^{150}C_0(50)^{150}(-1)^0 + {}^{150}C_1(50)^{149}(-1)^1 + \ldots\ldots + {}^{150}C_{150}(50)^0(-1)^{150}$$

Thus the last digits of $7^{300}$ are ${}^{150}C_{150}.1.1$ *i.e.,* 1.

**72.** Here $\frac{{}^nC_{r-1}}{{}^nC_r} = \frac{36}{84}$ and $\frac{{}^nC_r}{{}^nC_{r+1}} = \frac{84}{126}$.

$\Rightarrow 3n - 10r = -3$ and $4n - 10r = 6$

On solving, we get $n = 9$, $r = 3$.

**73.** **1**

**74.** **3**

**75.** Here two cases arise viz.

**Case I :** $x^2 + 4x + 3 > 0$

This gives $x^2 + 4x + 3 + 2x + 5 = 0$

$\Rightarrow x^2 + 6x + 8 = 0 \Rightarrow (x+2)(x+4) = 0 \Rightarrow x = -2, -4$

$x = -2$ is not satisfying the condition $x^2 + 4x + 3 > 0$, so $x = -4$ is the only solution of the given equation.

**Case II :** $x^2 + 4x + 3 < 0$

This gives $-(x^2 + 4x + 3) + 2x + 5 = 0$

$\Rightarrow -x^2 - 2x + 2 = 0 \Rightarrow x^2 + 2x - 2 = 0$

$\Rightarrow (x + 1 + \sqrt{3})(x + 1 - \sqrt{3}) = 0$

$\Rightarrow x = -1 + \sqrt{3}, -1 - \sqrt{3}$

Hence $x = -(1 + \sqrt{3})$ satisfy the given condition $x^2 + 4x + 3 < 0$, while $x = -1 + \sqrt{3}$ is not satisfying the condition. Thus number of real solutions are two.