JEE EXPERT

JEE MAIN EXCLUSIVE TOPICS

(SPECIAL TEST - 01)
PHYSICS, CHEMISTRY & MATHEMATICS
Batch : 12th (X01 & X02) [19.12.2019]

Answer Key

PHYSICS

1	(A)	2	(C)	3	(A)	4	(C)	5	(A)
6	(A)	7	(D)	8	(C)	9	(D)	10	(B)
11	(C)	12	(A)	13	(A)	14	(C)	15	(C)
16	(C)	17	(C)	18	(B)	19	(A)	20	(B)
21	(C)	22	(B)	23	(B)	24	(A)	25	(A)
26	(C)	27	(A)	28	(A)	29	(D)	30	(A)

CHEMISTRY

31	(D)	32	(C)	33	(C)	34	(A)	35	(B)
36	(C)	37	(D)	38	(B)	39	(C)	40	(D)
41	(A)	42	(C)	43	(D)	44	(C)	45	(C)
46	(B)	47	(A)	48	(C)	49	(A)	50	(A)
51	(D)	52	(B)	53	(C)	54	(A)	55	(D)
56	(A)	57	(A)	58	(C)	59	(A)	60	(A)

MATHEMATICS

61	(C)	62	(A)	63	(D)	64	(C)	65	(D)
66	(D)	67	(C)	68	(C)	69	(C)	70	(C)
71	(B)	72	(B)	73	(A)	74	(B)	75	(C)
76	(A)	77	(B)	78	(A)	79	(B)	80	(D)
81	(D)	82	(C)	83	(B)	84	(C)	85	(B)
86	(C)	87	(B)	88	(A)	89	(B)	90	(A)

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Solutions

PHYSICS

1. A lift is tied ....

Sol. The tension T in the rope of the lift when it goes upward is given by

T = (m) (g + a) = 1000 (9.8 + 1.2) = 11000 N

Let r be the radius of the wire, then the maximum stress will be $\frac{T}{\pi r^2}$

Hence, $\frac{T}{\pi r^2} = 1.4\times10^8$

or

$$r^2 = \frac{T}{\pi\times1.4\times10^8} = \frac{11000}{3.14\times\left(1.4\times10^8\right)} = \frac{1}{4\times10^4}$$

Now $r = \frac{1}{2\times10^2} = \frac{1}{200} = 0.005\text{m}$

Therefore, diameter of the wire = 2r = 0.01 m.

2. The current ....

Sol. Given that,

$V_I = 0.01$ volt

$R_I = 1\text{k}\Omega = 10^3\Omega$

$$\therefore I_b = \frac{V_I}{R_I} = \frac{0.01}{1\times10^3} = 0.01\times10^{-3}\Omega = 0.01\,\text{mA}$$

Further, $I_C = \beta I_b = 50\times0.01\text{mA}$

$= 0.5$ mA $= 500\,\mu$A

3. What is the ....

Sol. $m\frac{g}{2} = mg - F_B - F_V$

$F_V + F_B = \frac{1}{2}mg$

$$6\pi\eta rv + \sigma\frac{4}{3}\pi r^3 g = \frac{1}{2}\rho\frac{4}{3}\pi r^3 g$$

$$v = \frac{r^2 g}{9\eta}(\rho - 2\sigma)$$

4. An air bubble ....

Sol. Excess pressure inside an air bubble in soap solution

$$\frac{2T}{r} = \frac{2\times2.50\times10^{-2}}{5.00\times10^{-3}} = 10\,\text{pa}$$

Total pressure inside the air bubble

$= P_0 + h\rho g + \frac{2T}{r}$

$= 1.01\times10^5 + 0.4\times1.2\times10^3\times9.8 + 10$

$= 1.06\times10^5$ Pa

5. The excess ....

Sol. $\frac{P_1}{P_2} = 4$ or $\quad P_1 = 4P_2$

$$\frac{4s}{r^1} = \frac{4\times4s}{r_2} \Rightarrow \frac{r_1}{r_2} = \frac{1}{4}$$

$$\frac{V_1}{V_2} = \frac{r_1^3}{r_2^3} = \left(\frac{1}{4}\right)^3 = \frac{1}{64}$$

6. A mercury drop ....

Sol. Energy expended will be the work done against the increase in surface area i.e.

$$\Delta S = n(4\pi r^2) - 4\pi R^2$$

$$\Delta E = W = T\Delta S = T.4\pi(nr^2 - R^2)$$

But the total volume remains constant.

i.e. $\frac{4}{3}\pi R^3 = n\frac{4}{3}\pi r^3$

or $r = \frac{R}{(n)^{1/3}}$ and hence, $E = 4\pi R^2 T(n^{1/3} - 1)$

7. Water rises in ....

Sol. $L = \dfrac{h'}{\cos\phi} = \dfrac{\left(\dfrac{2T\cos\theta}{\rho g r'}\right)}{\cos\phi} = \dfrac{3h}{\cos\phi}$

8. **(C)**

9. For a faulty ....
Sol. Zero error = MSR + (n)(L.C)
= – 0.1 + (7)(0.01) = – 0.03 cm
Actual value = Measured value – Zero error
= 8.65 – (– 0.03) = 8.68 cm

10. **(B)**

11. If the length ....
Sol. $B - A = (b \pm \Delta b) - (a \pm \Delta a) = (b - a) \pm (\Delta b + \Delta a)$
= $(4.19 - 3.25) \pm (0.01 + 0.01) = 0.94 \pm 0.02$ cm

12. The vernier ....
Sol. L.C = 1 MSD – I VSD

13. A block of ....
Sol. $A = \dfrac{F_0}{\sqrt{m^2\left(\omega^2 - \omega_d^2\right)^2 + \omega_d^2 b^2}}$

In this case $\omega_d = \omega = \sqrt{\dfrac{k}{m}} = 20\text{ rad/s}$

so, $A = \dfrac{F_0}{\omega_d b} \Rightarrow b = \dfrac{F_0}{\omega_d A} = \dfrac{0.1}{20 \times 5} = 10^{-3}$

14. In a Searle's ....
Sol. Young's modulus of elasticity is given by
$Y = \dfrac{\text{stress}}{\text{strain}} = \dfrac{F/A}{\ell/L} = \dfrac{FL}{\ell A} = \dfrac{FL}{\ell\left(\dfrac{\pi d^2}{4}\right)}$

Substituting the values, we get
$y = \dfrac{50 \times 11 \times 4}{\left(1.25 \times 10^{-3}\right) \times \pi\left(5.0 \times 10^{-4}\right)^2} = 2.24 \times 10^{11}$ N/m^2

Now, $\dfrac{\Delta Y}{Y} = \dfrac{\Delta L}{L} + \dfrac{\Delta \ell}{\ell} + 2\dfrac{\Delta d}{d}$

$= \left(\dfrac{0.1}{110}\right) + \left(\dfrac{0.001}{0.125}\right) + 2\left(\dfrac{0.001}{0.05}\right) = 0.0489$

$\Delta Y = (0.0489)Y = (0.0489) \times (2.24 \times 10^{11})\ N/m^2$

$= 1.09 \times 10^{10}\ N/m^2$

15. A carnot's ....
Sol. $\text{Efficiency} = \eta = 1 - \dfrac{T_L}{T_H} = 1 - \dfrac{300}{900} = \dfrac{2}{3}$

$\therefore$ If heat rejected is E
$\Rightarrow$ heat supplied is 3E and work done is 2E

So, $2E = \dfrac{1}{2}\left(\dfrac{mR^2}{2}\right)\omega^2 \Rightarrow \omega = \sqrt{\dfrac{8E}{mR^2}}$

16. A monochromatic ....
Sol. $\dfrac{1}{2} = \dfrac{1}{2}\varepsilon_0 E_{rms}{}^2 \Rightarrow l = \dfrac{1}{2}\varepsilon_0 E_0^2$

$\dfrac{P}{4\pi r^2} = \dfrac{1}{2}\varepsilon_0 E_0^2 C \Rightarrow E_0 = \dfrac{1}{r}\sqrt{\dfrac{P}{2\pi\varepsilon_0 C}}$

and $C = \dfrac{1}{\sqrt{\mu_0\varepsilon_0}} \Rightarrow \dfrac{1}{\varepsilon_0} = \mu_0 C^2$

so, $E_0 = \dfrac{1}{r}\sqrt{\dfrac{P}{2\pi C} \times \mu_0 C^2} = \dfrac{1}{r}\sqrt{\dfrac{\mu_0 PC}{2\pi}}$

16. A simple microscope ....
Sol. $\text{R.P.} = \dfrac{2\mu\sin 30^\circ}{\lambda}$

17. A paramagnetic ....
Sol. If the temperature is decreased, the thermal vibration will be reduced. So there would not be negative effect on magnetisation.

19. A Ge specimen ....
Sol. When Ge specimen is doped with $A\ell$, then concentration of acceptor atoms is also called concentration of holes.
Using formula $n_i^2 = n_e n_h$
n_i = concentration of electron hole pair = $10^{19}/m^3$
n_e = concentration of electrons
n_h = concentration of holes = 10^{21} atoms/m^3
$\therefore (10^{19})^2 = 10^{21} \times n_e, n_e = 10^{17}/m^3$

20. The following ....
Sol. Out of upper ABD gate = $A\overline{B}$
Output of lower AND gate = $B\overline{A}$

Output Y= $A\bar{B} + B\bar{A}$
This is Boolean expression for XOR gate.

21. In a given ....
Sol. Given at saturation
$V_{CE} = 0V$, $V_{BE} = 0.8V$
$V_{CE} = V_{CC} - l_C R_C$
$l_C = V_{CC}/R_C = 5.0V/1.0k\Omega = 5.0mA$

Therefore $l_B = /\beta = 5.0\ mA/250 = 20\,\mu A$
The input voltage at which the transistor will go into saturation is given by
$V_{IH} = V_{BB} = l_B R_B + V_E = 20\,\mu A \times 100k\Omega + 0.8V = 2.8V$

22. The current gain ....
Sol. $\alpha = \frac{I_C}{I_E} = \frac{I_E - I_B}{I_E} \Rightarrow 0.95 = \frac{10 - I_B}{10}$
$\Rightarrow I_B = 0.5\ mA$

23. In an npn ....
Sol. Collector current,
$I_c = 10\ mA\ ;\ \alpha = \frac{90}{100} = 0.9$
$\alpha = \frac{I_C}{I_E} \Rightarrow$ Emitter current, $I_E = \frac{I_C}{\alpha}$
$I_E = \frac{10}{0.9} = 11mA$
Base current, $I_B = I_E - I_C$
$I_E = \frac{10}{0.9}\ 11mA$
Base current, $I_B = I_E - I_C$
$I_B = 11 - 10 = 1\ mA$

24. Consider an ....
Sol. Optical source frequency
$f = \frac{c}{\lambda} = 3\times10^{8}/(800\times10^{-9})$
$= 3.8\times10^{14}$ Hz
Bandwidth of channel (1% of above) = 3.8×10^{12} Hz
Number of channel =(Total bandwidth of channel)/ (Bandwidth needed per channel)
Number of channels for audio signal
$= (3.8\times10^{12})/(8\times10^{3}) = 4.8\times10^{8}$

25. The diameter ....
Sol. $d\theta = \frac{1.22\lambda}{a}$

27. Linearly polarised ....
Sol. In incident light, $\frac{E_z}{E_y} = \sqrt{3} \Rightarrow \vec{E}$
is at angle 60^o from y-axis
whereas transmission axis (y = z) is at 45^o from y-axis
So, $E_{transmitted} = E_{incident} \cos(60^o - 45^o)$
$= 2E_0 \cos 15^o$

28. In Amplitude ....
Sol. Modulation index $= \frac{Am}{Ac}$

29. Following diagram ....
Sol. We know that combination of AND gate and NOT gate is known as NAND gate since the given symbol contains AND gate and NOT, therefore it is a NAND gate.

30. If ρ is the ....
Sol. Stress = weight/area = $A\ell\rho g$ /A = $\ell\rho g$
$\Rightarrow \sigma = \ell\rho g$

CHEMISTRY

31. (1) $\Delta G = \Delta H - T\Delta S < O$ as $\Delta S < O$ so ΔH has to be negative.
(2) micelles formation will take place above T_k and above CMC.
(4) Fe^{3+} ions will have greater flocculatibility power so smaller flocculating value.

38. The phenomenon of scattering of light from the surface of collidal particles is called tyndall effect. The minimum conc. required for micelle formation is called critical micelle concentration.
For soap solution above CMC tyndall effect is observed.

39. Higher the gold number, lesser will be the protective power of colloid.

40. Colloidal solution shows brownian movement. The Brownian movement does not allow the collidal particles to settle down to gravity & thus responsible for their stability.

41. Easily liquefiable gases like CO_2 are adsorbed to a greater extent than gases like O_2, N_2 and H_2

42. Mass adsorbed $= \frac{100(0.3-0.125)60}{1000}$

$= (0.3-0.125)6$

Mass adsorbed per gram of charcoal $= \frac{(0.3-0.125)6}{0.8} = 1.31\text{g}$

MATHEMATICS

61. If 'R' is an equivalence ....

$\forall a \in A, (a,a) \in R \Rightarrow (a,a) \in R^{-1}$

$[(a,b) \in R \Rightarrow (b,a) \in R]$

$\Rightarrow \{(a,b) \in R^{-1}\} \wedge \{(b,a) \in R^{-1}\}$

$[(a,b) \in R \wedge (b,c) \in R] \to (a,c) \in R$

$[(c,b) \in R^{-1} \wedge (b,a) \in R^{-1}] \to (c,a) \in R^{-1}$

$\therefore$ It is an equivalence relation

62. Find cardinal number ....

Sol. Let A be the set of positive integers not exceeding 1000 that are divisible by 7 and $B \to$ divisible by 11

$n(A \cup B) = n(A) + n(B) - n(A \cap B)$

$= \left[\frac{1000}{7}\right] + \left[\frac{1000}{11}\right] - \left[\frac{1000}{77}\right] = 142 + 90 - 12 = 220$

63. Let $P = \left\{\theta : \sin^2\theta + \cos^4\theta = \frac{1-\sin\theta}{\cos\theta}\right\}$............

Sol. $\sin^2\theta + \cos^4\theta = \cos^2\theta + \sin^4\theta$ and

$\frac{1-\sin\theta}{\cos\theta} = \cot\left(\frac{\pi}{4} + \frac{\theta}{2}\right)$

64. In a survey of ....

Sol. $n(M' \cap C' \cap P') = n(\cup) - n(M \cap P \cap C)$

$\Rightarrow n(M \cup P \cup C) = 450$

$n(M \cap P \cap C) = 20$

who liked exactly one = 95 + 40 + 190 = 325

65. Which of the following ....

Sol. Obvious

66. The relation R ....

Sol. Obvious

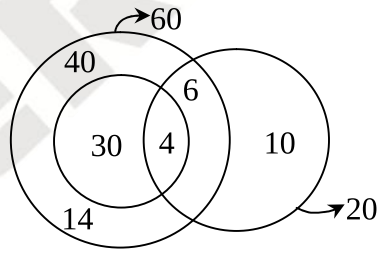
67. Number of elements ....

Sol. $P = \frac{2n^5 + 3n^4 + 4n^3 + 4n^2 + 6}{n}$ is integer

$\Rightarrow$ n = 1, 2, 3, 6

68. If A, B, C are 3 ....

Sol.



69. Which of the following ....

Sol. Obvious

70. The relation T ....

Sol. $a \geq a^{\frac{2}{3}} \Rightarrow a^3 \geq a^2$ not true for $\bar{Z}$ so not reflexive

$27 \geq 8^{\frac{2}{3}}$ but $8 \not\geq 27^{\frac{2}{3}}$ so not symmetric

$a \geq b^{\frac{2}{3}}$ and $b^3\ C^{\frac{2}{3}}$ $(\therefore a \geq 0, b \geq 0)$

$\Rightarrow a \geq (C^{\frac{2}{3}})^2 \Rightarrow a^3\ C^{\frac{2}{3}}$

$\left(\because (C^{\frac{2}{3}})^2 \geq C^{\frac{2}{3}}\right)$

$\Rightarrow$ transitive

71. Consider relation ....

Sol. (a, b) is not related to (a, b) as LCM(a, a)$\neq$ LCM(b, b)

72. The number of ....

Sol. R_1 = {(a, a), (b, b), (c, c)}

R_2 = (a, b), (b, a), (a, a), (b, b), (c, c)
R_3 = (a, c), (c, a), (a, a), (c, c), (b, b)
R_4 = (b, c), (c, b), (b, b), (c, c), (a, a)
R_5 = {(a, a), (b, b), (c, c), (a, b), (b, a), (a, c), (c, a)
(b, c), (c, b)}

73. Let R and S be ....
Sol. Let A = {1, 2, 3}
R = {(1, 1), (1, 2)}
S = {(2, 2), (2, 3)} be transitive relations on A.
Then $R \cup S$ = {(1, 1), (1, 2), (2, 2), (2, 3)}
Which shows that $R \cup S$ is not transitive
Since (1, 2) $\in R \cup S$ and (2, 3) $\in R \cup S$ but (1, 3) $\notin R \cup S$

74. Consider relation ....
Sol. Obvious

75. Let A = {2, 3, 4 ....., 17, 18} ....
Sol. (21 to 22)
$$(3,2) \simeq (c,d) \Rightarrow 3d = 2c \Rightarrow c = \frac{3d}{2}$$
$\Rightarrow$ d = 2, 4, 6, 8, 10, 12

76. Let A and B be ....
Sol. $^6C_3 + {}^6C_4 + {}^6C_5 + {}^6C_6 = 2^6 - {}^6C_0 - {}^6C_1 - {}^6C_2$
$= 64 - 1 - 6 - 15 = 64 - 22 = 42$

77. Let A = {z : $|z|^2$ ....
Sol. The given equation are the equations of two circles touching, each other extremally.

78. Let A and B be ....
Sol. $B : \frac{(x-4)^2}{9} + \frac{(y-3)^2}{4} \le 1$
$A : 2 < x < 4$ and $2 < y < 4$

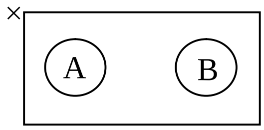
79. Consider the following ....
Sol. The given relation is only symmetric

80. Let A = {(x, y) : ....
Sol. APA $\Rightarrow$ reflexive
area (A – B) = 0 and area (B – A) = $4\pi - \pi = 3\pi$
$\Rightarrow (A, B) \notin P \Rightarrow$ symmetric and transitive

81. Consider relations ....
Sol. R_1 is reflexive, not symmetric and transitive
R_2 is not reflexive, symmetric and not transitive

82. The intersection of ....
Sol. Obvious

83. Let A and B be ....
Sol. $(A \cap B = \phi)$
$\Rightarrow A \subset (X - B)$



84. Let A consist of ....
Sol. The subsets of A which contain atteast one of a_1, a_2, ... a_r and all of a_{s+1}, a_{s+2} ..... a_n are obtained, once each, as the unions of $\{a_{s+1}, a_{s+2} ..... a_n\}$ with the subsets of {a_1, a_2, ... a_s} which contains atleast one of a_1, a_2, a_3, ... a_r from the subsets of $\{a_1, a_2, ... a_s\}$ which contains atleast
$= 2^{s-r}(2^r - 1)$

85. Relation $\otimes$ is defined ....
Sol. Obvious

86. Relation C is defined ....
Sol. Obvious

87. The number of ....
Sol. Total no. of relations $= 2^{4 \times 4} = 2^{16}$
In cartesian product we have 16 ordered pairs in which 4 are compulsory of reflexive relation, out of 12 ordered pairs.
We can take
$^{12}C_0 + {}^{12}C_1 + {}^{12}C_2 + ... + {}^{12}C_{12} = 2^{12}$

88. Consider the two ....
Sol. Obvious

89. Consider relation ....
Sol. (a, b) $\in$ T and (b, a) $\in$ T but (a, a) $\notin$ T so not transitive

90. If an examination ....
Sol. Only failed in physics = 37% – 19% = 18% = alone pass in maths. let total = x
x = 1700