

JEE EXPERT

JEE MAIN EXCLUSIVE TOPICS

(SPECIAL TEST - 01)

PHYSICS, CHEMISTRY & MATHEMATICS

Batch : 12th Pass (A01 & A02) [19.12.2019]

Answer Key

PHYSICS

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

CHEMISTRY

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

MATHEMATICS

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

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Solutions

PHYSICS

3. 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

4. The vernier

Sol. L.C = 1 MSD - 1 VSD

5. 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

6. A block of

Sol. $A = \frac{F_0}{\sqrt{m^2(\omega^2 - \omega_d^2)^2 + \omega_d^2 b^2}}$

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

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

7. A carnot's

Sol. Efficiency = $\eta = 1 - \frac{T_L}{T_H} = 1 - \frac{300}{900} = \frac{2}{3}$

\therefore If heat rejected is E

\Rightarrow heat supplied is 3E and work done is 2E

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

8. A monochromatic

Sol. $\frac{1}{2} = \frac{1}{2} \epsilon_0 E_{rms}^2 \Rightarrow 1 = \frac{1}{2} \epsilon_0 E_0^2$

$\frac{P}{4\pi r^2} = \frac{1}{2} \epsilon_0 E_0^2 C \Rightarrow E_0 = \frac{1}{r} \sqrt{\frac{P}{2\pi \epsilon_0 C}}$

and $C = \frac{1}{\sqrt{\mu_0 \epsilon_0}} \Rightarrow \frac{1}{\epsilon_0} = \mu_0 C^2$

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

9. In a Searle's

Sol. Young's modulus of elasticity is given by

$$Y = \frac{\text{stress}}{\text{strain}} = \frac{F/A}{\ell/L} = \frac{FL}{\ell A} = \frac{FL}{\ell \left(\frac{\pi d^2}{4} \right)}$$

Substituting the values, we get

$$Y = \frac{50 \times 11 \times 4}{(1.25 \times 10^{-3}) \times \pi (5.0 \times 10^{-4})^2} = 2.24 \times 10^{11}$$

N/m²

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

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

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

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

10. A paramagnetic

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

11. The following

Sol. Out of upper ABD gate = $A\bar{B}$

Output of lower AND gate = $B\bar{A}$

Output $Y = A\bar{B} + B\bar{A}$

This is Boolean expression for XOR gate.

13. A Ge specimen

Sol. When Ge specimen is doped with A ℓ , 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

$\therefore (10^{19})^2 = 10^{21} \times n_e, n_e = 10^{17} / m^3$

14. In a given

Sol. Given at saturation

$V_{CE} = 0V, V_{BE} = 0.8V$

$V_{CE} = V_{CC} - I_C R_C$

$I_C = V_{CC}/R_C = 5.0V/1.0k\Omega = 5.0mA$

Therefore $I_B = I_C/\beta = 5.0 mA/250 = 20\mu A$

The input voltage at which the transistor will go into saturation is given by

$V_{IH} = V_{BB} = I_B R_B + V_E = 20\mu A \times 100k\Omega + 0.8V = 2.8V$

15. The current

Sol. Given that,

$V_I = 0.01$ volt

$R_I = 1k\Omega = 10^3\Omega$

$\therefore I_b = \frac{V_I}{R_I} = \frac{0.01}{1 \times 10^3} = 0.01 \times 10^{-3} \Omega = 0.01 mA$

Further, $I_C = \beta I_b = 50 \times 0.01 mA$

$= 0.5 mA = 500\mu A$

16. The current gain

Sol. $\alpha = \frac{I_C}{I_E} = \frac{I_E - I_B}{I_E} \Rightarrow 0.95 = \frac{10 - I_B}{10}$

$\Rightarrow I_B = 0.5 mA$

17. 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, $I_B = I_E - I_C$

$I_B = 11 - 10 = 1 mA$

18. 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.

19. If ρ is the

Sol. Stress = weight/area = $A\ell\rho g / A = \ell\rho g$
 $\Rightarrow \sigma = \ell\rho g$

20. 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, $\frac{T}{\pi r^2} = 1.4 \times 10^8$

or

$r^2 = \frac{T}{\pi \times 1.4 \times 10^8} = \frac{11000}{3.14 \times (1.4 \times 10^8)} = \frac{1}{4 \times 10^4}$

Now $r = \frac{1}{2 \times 10^2} = \frac{1}{200} = 0.005m$

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

21. What is the

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

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

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

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

22. The excess

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

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

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

23. 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.

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

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

24. Water rises in

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

25. An air bubble

Sol. Excess pressure inside an air bubble in soap solution

$$\frac{2T}{r} = \frac{2 \times 2.50 \times 10^{-2}}{5.00 \times 10^{-3}} = 10 \text{ Pa}$$

Total pressure inside the air bubble

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

$$= 1.01 \times 10^5 + 0.4 \times 1.2 \times 10^3 \times 9.8 + 10$$

$$= 1.06 \times 10^5 \text{ Pa}$$

26. In Amplitude

Sol. Modulation index = $\frac{A_m}{A_c}$

27. Consider an

Sol. Optical source frequency

$$f = \frac{c}{\lambda} = 3 \times 10^8 / (800 \times 10^{-9})$$

$$= 3.8 \times 10^{14} \text{ Hz}$$

$$\text{Bandwidth of channel (1\% of above)} = 3.8 \times 10^{12} \text{ Hz}$$

$$\text{Number of channel} = (\text{Total bandwidth of channel}) / (\text{Bandwidth needed per channel})$$

Number of channels for audio signal

$$= (3.8 \times 10^{12}) / (8 \times 10^3) = 4.8 \times 10^8$$

28. The diameter

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

29. A simple microscope

Sol. $R.P. = \frac{2\mu \sin 30^\circ}{\lambda}$

30. Linearly polarised

Sol. In incident light, $\frac{E_z}{E_y} = \sqrt{3} \Rightarrow \vec{E}$

is at angle 60° from y-axis

whereas transmission axis ($y = z$) is at 45° from y-axis

$$\text{So, } E_{\text{transmitted}} = E_{\text{incident}} \cos(60^\circ - 45^\circ) \\ = 2E_0 \cos 15^\circ$$

CHEMISTRY

31. The phenomenon of scattering of light from the surface of colloidal 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.

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

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

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

36. Mass adsorbed = $\frac{100(0.3 - 0.125)60}{1000}$
 $= (0.3 - 0.125)6$
 Mass adsorbed per gram of charcoal
 $= \frac{(0.3 - 0.125)6}{0.8} = 1.31 \text{ g}$

37. (1) $\Delta G = \Delta H - T\Delta S < 0$ as $\Delta S < 0$ 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 flocculability power so smaller flocculating value.

MATHEMATICS

61. The number of

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

$R_2 = (a, b), (b, a), (a, a), (b, b), (c, c)$

$R_3 = (a, c), (c, a), (a, a), (c, c), (b, b)$

$R_4 = (b, c), (c, b), (b, b), (c, c), (a, a)$

$R_5 = \{(a, a), (b, b), (c, c), (a, b), (b, a), (a, c), (c, a)\}$

$(b, c), (c, b)\}$

62. Let A and B be

Sol. ${}^6C_3 + {}^6C_4 + {}^6C_5 + {}^6C_6 = 2^6 - {}^6C_0 - {}^6C_1 - {}^6C_2$
 $= 64 - 1 - 6 - 15 = 64 - 22 = 42$

63. Let A and B be

Sol. $B: \frac{(x-4)^2}{9} + \frac{(y-3)^2}{4} \leq 1$

$A: 2 < x < 4 \text{ and } 2 < y < 4$

64. Consider the following

Sol. The given relation is only symmetric

65. Let $A = \{(x, y) : \dots\}$

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

66. 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 $(1, 3) \notin R \cup S$

67. Let $A = \{z : |z|^2 \dots\}$

Sol. The given equation are the equations of two circles touching, each other externally.

68. Consider relations

Sol. R_1 is reflexive, not symmetric and transitive

R_2 is not reflexive, symmetric and not transitive

69. The intersection of

Sol. Obvious

70. If 'R' is an equivalence

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

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

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

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

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

\therefore It is an equivalence relation

71. 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

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

72. 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 = $95 + 40 + 190 = 325$

73. Number of elements

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

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

74. Find cardinal number

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

$$n(A \cup B) = n(A) + n(B) - n(A \cap B) \\ = \left[\frac{1000}{7} \right] + \left[\frac{1000}{11} \right] - \left[\frac{1000}{77} \right] = 142 + 90 - 12 = 220$$

75. The relation R

Sol. Obvious

76. Which of the following

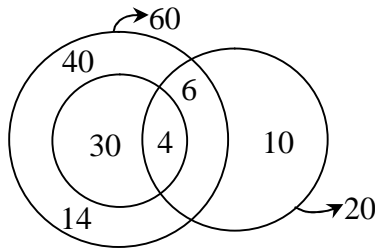
Sol. Obvious

77. Consider relation

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

78. If A, B, C are 3

Sol.



79. The relation T

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

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

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

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

\Rightarrow transitive

80. Which of the following

Sol. Obvious

81. Consider relation

Sol. Obvious

82. Let $A = \{2, 3, 4, \dots, 17, 18\}$

Sol. (21 to 22)

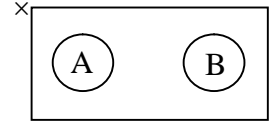
$$(3, 2) = (c, d) \Rightarrow 3d = 2c \Rightarrow c = \frac{3d}{2}$$

$$\Rightarrow d = 2, 4, 6, 8, 10, 12$$

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 atleast one of a_1, a_2, \dots, a_r and all of $a_{s+1}, a_{s+2}, \dots, a_n$ are obtained, once each, as the unions of $\{a_{s+1}, a_{s+2}, \dots, a_n\}$ with the subsets of $\{a_1, a_2, \dots, a_s\}$ which contains atleast one of $a_1, a_2, a_3, \dots, a_r$ from the subsets of $\{a_1, a_2, \dots, a_s\}$ which contains atleast

$$= 2^{s-r} (2^r - 1)$$

85. Relation \otimes is defined

Sol. Obvious

86. 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

$${}^{12}C_0 + {}^{12}C_1 + {}^{12}C_2 + \dots + {}^{12}C_{12} = 2^{12}$$

87. Consider relation

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

88. If an examination

Sol. Only failed in physics $= 37\% - 19\% = 18\%$
 $=$ alone pass in maths. let total $= x$
 $x = 1700$

89. Relation C is defined

Sol. Obvious

90. Consider the two

Sol. Obvious