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	(B)	32	(A)	33	(D)	34	(A)	35	(C)
36	(C)	37	(D)	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)

JEE EXPERT

JEE MAIN EXCLUSIVE TOPICS

(SPECIAL TEST - 01)
PHYSICS, CHEMISTRY & MATHEMATICS
Batch : 12th Pass (A01 & A02) [19.12.2019]

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 – I 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. $A = \dfrac{F_0}{\sqrt{m^2\left(\omega^2 - \omega_d^2\right)^2 + \omega_d^2 b^2}}$

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

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

7. 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, $2E = \dfrac{1}{2}\left(\dfrac{mR^2}{2}\right)\omega^2 \Rightarrow \omega = \sqrt{\dfrac{8E}{mR^2}}$

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

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

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

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

9. 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

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 Aℓ, 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

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

$l_C = V_{CC}/R_C$ = 5.0V/1.0kΩ = 5.0mA

Therefore l_B =/β= 5.0 mA/250 = 20μA

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

$V_{lH} = V_{BB} = l_B R_B + V_E$ =20μA $\times$ 100kΩ + 0.8V = 2.8V

15. The current ....
Sol. Given that,

V_l = 0.01 volt

R_l = 1kΩ = $10^3\Omega$

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

Further, $l_C = \beta l_b$ = 50$\times$0.01mA

= 0.5 mA = 500μA

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, $I_E = \frac{I_C}{\alpha}$

$I_E = \frac{10}{0.9} = 11\text{mA}$

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

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.

21. What is the ....
Sol. $m\frac{g}{2} = mg - F_B - F_V$

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

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

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

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.

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

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

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

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

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

$=1.06\times 10^5$ Pa

26. In Amplitude ....

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

27. Consider an ....

Sol. Optical source frequency

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

$= 3.8\times 10^{14}$ 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

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

28. The diameter ....

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

29. A simple microscope ....

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

30. 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, $E_{transmitted} = E_{incident}\cos(60^o-45^o)$

$=2E_0\cos 15^o$

CHEMISTRY

31. 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.

33. Colloidal solution shows brownian movement. The Brownian movement does not allow the collidal 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 $=\frac{(0.3-0.125)6}{0.8}=1.31g$

37. (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.

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

$A:2<x<4$ and $2<y<4$

64. Consider the following ....

Sol. The given relation is only symmetric

65. 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

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 : $|z|^2$ ....

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

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 ....

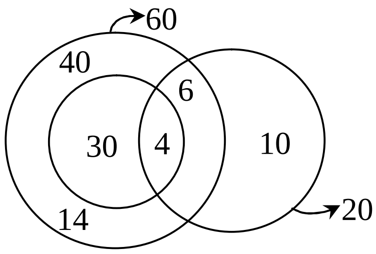
Sol. Obvious

77. Consider relation ....

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

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

Sol.



79. The relation T ....

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

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

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

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

$\Rightarrow$ transitive

80. Which of the following ....

Sol. Obvious

81. Consider relation ....

Sol. Obvious

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

Sol. (21 to 22)

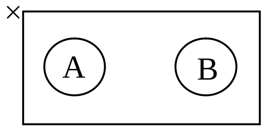
$(3, 2) \simeq (c, d) \Rightarrow 3d = 2c \Rightarrow c = \frac{3d}{2}$

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

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, ... 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. The number of ....

Sol. Total no. of relations $= 2^{4\times4} = 2^{16}$

In cartesian product we have 16 ordered pairs in which 4 are compulsory of reflexive relation, out of 12 ordered pairs.

We can take

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

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