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JEE (Main)

PAPER-1 (B.E./B. TECH.)

2022

COMPUTER BASED TEST (CBT)

Memory Based Questions & Solutions

Date: 25 June, 2022 (SHIFT-1) | TIME : (9.00 a.m. to 12.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: PHYSICS

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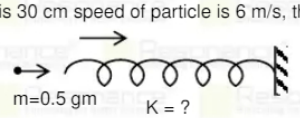
PART : PHYSICS

1. A particle of mass 0.5 kg moving with speed 12 m/s collide with free end of spring as shown in figure. When compression in spring is 30 cm speed of particle is 6 m/s, then find spring constant of spring



(1) 300 N/m (2) 400 N/m (3) 500 N/m (4) 600 N/m

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Ans. **(4)**

Sol. $\frac{1}{2}mV^2 = \frac{1}{2}m\left(\frac{V^2}{4}\right) + \frac{1}{2}k(0.3)^2$

$\frac{1}{2}m\frac{3}{4}V^2 = \frac{1}{2}k(0.9)$

$k = 600\ N/m$

2. Difference of speed of light in two medium A & B is $V_A - V_B = 2.6 \times 10^7$ m/s, Refractive index of medium B is $n_B = 1.37$, then find refractive index of medium A (Given $C = 3 \times 10^8$ m/s)

(1) 1.11 (2) 1.22 (3) 1.33 (4) 1.44

Ans. **(4)**

Sol. $V = \frac{C}{n}$

$V_B = \frac{C}{1.37} = \frac{3}{1.37} \times 10^8 = 2.1 \times 10^8$

$V_A - V_B = 2.6 \times 10^7$

$V_A = V_B + 0.26 \times 10^8$

$= 2.19 \times 10^8 + 0.26 \times 10^8$

$= 2.45 \times 10^8$

$n_A = \frac{C}{V_A} = \frac{3 \times 10^8}{2.45 \times 10^8} = 1.22$

3. A particle of 1/2 kilogram initially at rest. A force of $10\hat{i} + 5\hat{j}N$ is acting on it. Its position after 2 sec. is $a\hat{i} + b\hat{j}$, then a/b will be :

(1) 2 : 3 (2) 2 : 1 (3) 1 : 2 (4) 1 : 1

Ans. **(2)**

Sol. $\vec{a} = \frac{f}{m} = 20\hat{i} + 10\hat{j}\,m/s$

$s = \frac{1}{2} \times 20 \times 2^2\hat{i} + \frac{1}{2} \times 10 \times 2^2\hat{j}m$

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

4. Acceleration of gravity due to earth at height h = 2R from the surface of earth will be (R = radius of earth)

(1) g/4 (2) g/9 (3) g/3 (4) g/2

Ans. **(2)**

Sol. $g = \frac{GM}{(R+h)^2}$

5. A force $\vec{F} = 3\hat{i} + 4\hat{j} + 2\hat{k}\,N$ is acting on a particle at $2\hat{i} + \hat{j} - 2\hat{k}\,m$, find out torque of force about origin will be

(1) $10\hat{i} + 10\hat{j} - 5\hat{k}\,Nm$ (2) $10\hat{i} - 10\hat{j} + 5\hat{k}\,Nm$ (3) $10\hat{i} + 10\hat{j} + 5\hat{k}\,Nm$ (4) $10\hat{i} - 10\hat{j} - 5\hat{k}\,Nm$

Ans. **(2)**

Sol. $\vec{\tau} = \vec{r} \times \vec{F}$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 1 & -2 \\ 3 & 4 & 2 \end{vmatrix}$$

$= \hat{i}(2+8) - \hat{j}(4+6) + \hat{k}(8-3)$

$= 10\hat{i} - 10\hat{j} + 5\hat{k}$

6. Choose correct option for non-zero vector $\vec{A}$

(1) $\vec{A} \cdot \vec{A} = 0$ (2) $\vec{A} \cdot \vec{A} = 0$ (3) $\vec{A} \cdot \vec{A} = 1$ (4) $\vec{A} \cdot \vec{A} = 1$

(1) $\vec{A}.\vec{A} < 0$ (2) $\vec{A} \times \vec{A} = 0$ (3) $\vec{A} \times \vec{A} = 1$ (4) $\vec{A} \times \vec{A} > 1$

Ans. **(2)**

7. Angle between Two unit vector $\vec{A}$ and $\vec{B}$ is θ. Then choose correct option.

(1) $|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}| \tan\frac{\theta}{2}$ (2) $|\vec{A}-\vec{B}| = |\vec{A}+\vec{B}| \tan\frac{\theta}{2}$

(3) $|\vec{A}+\vec{B}| = |\vec{A}-\vec{B}| \cos\frac{\theta}{2}$ (4) $|\vec{A}-\vec{B}| = |\vec{A}+\vec{B}| \cos\frac{\theta}{2}$

Ans. **(2)**

Sol. $|\vec{A}+\vec{B}| = \sqrt{A^2+B^2+2AB\cos\theta}$ $\quad \therefore |\vec{A}| = 1$

$|\vec{A}-\vec{B}| = \sqrt{A^2+B^2-2AB\cos\theta}$ $\quad |\vec{B}| = 1$

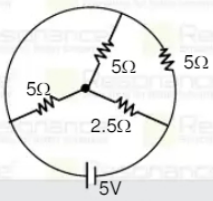
$$\frac{|\vec{A}+\vec{B}|}{|\vec{A}-\vec{B}|} = \frac{\sqrt{1^2+1^2+2\cos\theta}}{\sqrt{1^2+1^2-2\sin\theta}} = \frac{2\cos\frac{\theta}{2}}{2\sin\frac{\theta}{2}} = \cot\frac{\theta}{2}$$

8. The element in AC circuit which produce only non- watt current is –

(1) RC only (2) RLC series (3) Pure resistance (4) Pure inductance

Ans. **(4)**

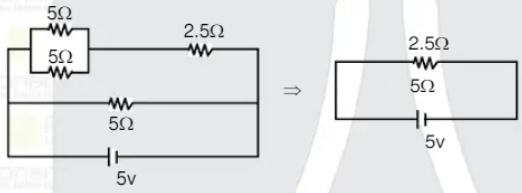
9. Find current through cell in given circuit.



(1) 5A (2) 2A (3) 4A (4) 1A

Ans. **(2)**

Sol.



$i = \frac{5}{2.5} = 2A$

10. 50 gm steam of 100° is convert in 20°C water. Then find heat released in joule during this process. (Latent heat of vaporisation 540 cal/g & specific heat of water is 1 cal./g°C)

(1) 13×10^3 J (2) 13.2×10^3 J (3) 30.2×10^4 J (4) 13×10^4 J

Ans. **(4)**

Sol. 50×540 cal + 50(1) (80) cal

= 50(540 + 80)

= 50 × 620 = 31000 cal

= 31 kcal

= 31 × 4.2

= 130.2×10^3 J

11. In which cable signal of 100 Tera Hz will be transmitted.

(1) Optical fibre (2) Twisted pair (3) coaxial cable (4) Normal cable

Ans. **(1)**

12. Intensities of two waves are I & 9I meets at points P & Q. If phase difference between two waves at point

P is $\frac{\pi}{2}$ and at point Q is π. Then ratio of intensity at P & Q is.

(1) $\frac{1}{2}$ (2) $\frac{3}{2}$ (3) $\frac{5}{2}$ (4) $\frac{4}{2}$

Ans. **(3)**

Sol. $I_P = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\frac{\pi}{2}$

$I_P = I_1 + I_2 = 10I$

$I_Q = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\pi$

$= 9I + I + 2 \times 3I(-1) = 4I$

$\frac{I_P}{I_Q} = \frac{10}{4} = \frac{5}{2}$

13. Magnetic field B due to infinite log wire at distance r if current is constant in the wire is :

(1) $B \propto r$ (2) $B \propto \frac{1}{r}$ (3) $B \propto \frac{1}{r^2}$ (4) $B \propto \frac{1}{r^3}$

Ans. **(2)**

Sol. $B = \frac{\mu_0 I}{2\pi r}$

14. A ball of radius r falling in a liquid its terminal velocity v will be :

(1) $V \propto r$ (2) $V \propto r^2$ (3) $V \propto r^3$ (4) $V \propto \frac{1}{r}$

Ans. **(2)**

Sol. $\frac{2}{9}\frac{r^2}{\eta}(\rho_o - \rho_\ell)g = v$

15. Wavelength of emitted photon to ionise Li^{++} from ground state.

(1) 101Å (2) 120Å (3) 130Å (4) 150Å

Ans. **(1)**

Sol. $\frac{1}{\lambda} = R\left(\frac{1}{\infty} - \frac{1}{1^2}\right)Z^2$

$\frac{1}{\lambda} = R(9)$

$\lambda = \frac{1}{9R} = \frac{911}{9}\text{Å} = 101\text{Å}$

16. Find out the ratio of speed of electron moving in third orbit of hydrogen and He^+ ion.

(1) $\frac{1}{2}$ (2) $\frac{3}{2}$ (3) $\frac{2}{1}$ (4) $\frac{2}{3}$

Ans. **(1)**

Sol. $V \propto \frac{z}{n}$

so $\frac{V_H}{V_{He^+}} = \frac{1/3}{2/3} = \frac{1}{2}$

17. Why photodiode used in Revers Bias because –
(1) Small change in majority charge carrier produces high value of current in reverse bias.
(2) Small change in minority charge carrier produces high value of current in reverse bias.
(3) Small change in majority charge carrier produces low value of current in reverse bias.
(4) Small change in minority charge carrier produces low value of current in reverse bias.

Ans. **(2)**

18. Choose correct option for relation between rms speed and most probable speed of oxygen

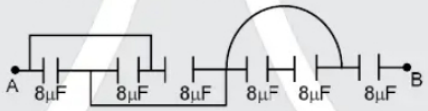
(1) $V_{rms} = \sqrt{\frac{3}{2}}\, V_{mp}$ (2) $V_{rms} = \sqrt{\frac{2}{3}}\, V_{mp}$ (3) $V_{rms} = \sqrt{\frac{1}{2}}\, V_{mp}$ (4) $V_{rms} = \sqrt{2}\, V_{mp}$

Ans. **(1)**

Sol. $v_{rms} = \sqrt{\frac{3RT}{M}}$

$v_{mp} = \sqrt{\frac{2RT}{M}}$; $\frac{V_{rms}}{V_{mp}} = \sqrt{\frac{3}{2}}$

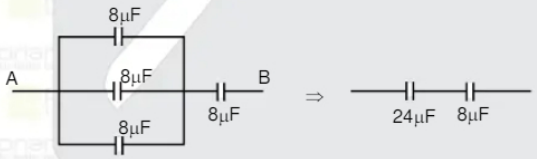
19. In given circuit, equivalent capacitance between point A & B is



(1) 4 μF (2) 2 μF (3) 6 μF (4) 8 μF

Ans. **(3)**

Sol.



$C_{AB} = \frac{24 \times 8}{24 + 8} = 6\mu F$

20. Electric field at distance L and 2 L from uniformly charged large non conducting sheet of surface charge density σ will be

(1) $\frac{\sigma}{\varepsilon_0}, \frac{\sigma}{2\varepsilon_0}$ (2) $\frac{\sigma}{2\varepsilon_0}, \frac{\sigma}{2\varepsilon_0}$ (3) $\frac{\sigma}{2\varepsilon_0}, \frac{\sigma}{\varepsilon_0}$ (4) $\frac{\sigma}{\varepsilon_0}, \frac{\sigma}{\varepsilon_0}$

Ans. **(2)**

Sol. $E = \frac{\sigma}{2\varepsilon_0}$

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21. At what minimum angle light should incident so that intensity will not transmitted in medium $\varepsilon_r = 1$, $\mu_r = 1$ if light incident from medium $\varepsilon_r = 4$, $\mu_r = 1$.

(1) 10° (2) 20° (3) 30° (4) 40°

Ans. **(3)**

Sol. $n = \sqrt{\mu_r \varepsilon_r}$

$n_{ree} = \frac{n_D}{n_r} = \frac{\sqrt{4 \times 1}}{\sqrt{1 \times 1}} = 2$

$\theta > c$

$\sin\theta > \sin c$

$\sin\theta > \frac{1}{n_{rel}}$

$\sin\theta > 1/2$

$\theta > 30°$

22. In a resistance 2A current produce 300 J heat in 15 sec. Then heat produce by 3 A current in 10 sec by same resistance is

(1) 300 J (2) 250 J (3) 450 J (4) 350 J

Ans. **(3)**

Sol. $H = i^2 Rt$

$$\frac{H_2}{H_1} = \frac{i_2^2 t_2}{i_1^2 t_1} = \frac{3^2 \times 10}{2^2 \times 15}$$

$H_2 = 450$ J

23. Electric field for a electromagnetic wave is given by $E = 45.7 \sin\omega\left(t - \frac{x}{C}\right) \frac{N}{C}$, then intensity of electromagnetic wave is ($c = 3 \times 10^8$ m/s)

(1) 2532.81 (2) 2032.81 (3) 2132.81 (4) 2232.81

Ans. **(1)**

Sol. $I = \frac{1}{2} \epsilon_o E^2 C = \frac{1}{2} \times 8.85 \times 10^{-12} \times (45.7)^2 \times 3 \times 10^8$

$= 2.77$