JEE (Main) 2020

COMPUTER BASED TEST (CBT)

Memory Based Questions & Solutions

Date: 02 September, 2020 (SHIFT-2) | TIME: (03.00 p.m. to 06.00 p.m)

Duration: 3 Hours | Max. Marks: 300

SUBJECT: PHYSICS
PART : PHYSICS

Single Choice Type (एकल विकल्पीय प्रश्न)

This section contains 20 Single choice questions. Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which Only One is correct.

इस वांछे में 20 एकल विकल्पीय प्रश्न हैं। प्रत्येक प्रश्न के 4 विकल्प (1), (2), (3) तथा (4) हैं, जिनमें से एकल एक ही है।

1. A rod is heated from 0 to 10°C its length is changed by 0.02% by what % change in mass density?
   (1) 0.02  (2) 0.04  (3) 0.06  (4) 0.08

Ans. (3)

Sol. \( \Delta l = \alpha l \Delta T \)

\( \alpha = \frac{\Delta l}{l \Delta T} = \frac{0.02}{100 \times 10^{-5}} = 2 \times 10^{-5} \)

\( \eta = 3a = 6 \times 10^{-5} \)

\( \frac{\Delta V}{V} = 4 \Delta T, \quad \frac{\Delta V}{V} = 100 = (6 \times 10^{-5} \times 10 \times 100) = 6 \times 10^{-2} \)

Volume increase by 0.06% therefore density decrease by 0.06%.

2.
Magnetic moment of the lap

1. $i\mathbf{ab}\mathbf{i} \mathbf{j}$
2. $i\mathbf{ab}(-\mathbf{j})$
3. $i\mathbf{ab}(-\mathbf{k})$
4. $i\mathbf{ab}(-\mathbf{i})$

Ans. (2)

Resonance Eduventures Ltd.

Reg. Office & Corp. Office: CG Tower, A-46 & 52, IPA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777200 | FAX No.: +91-022-39167222
To Know more : sms RESO at 56777 | Website: www.resonance.ac.in | E-mail: contact@resonance.ac.in | CIN : U807022007NLCO24029
Toll Free : 1800 258 5555 | 7840013931 | @facebook.com/resonanceedu | @twitter.com/resonanceedu | @youtube.com/resonanceedu

This solution was downloaded from Resonance JEE (MAIN) 2020 Solution portal

---

Loop ABCD

$\vec{M}_1 = \mathbf{ab}(-\mathbf{j})$

For Loop DEFA

$\vec{M}_2 = \mathbf{ab}(-\mathbf{i})$

$\vec{M} = \vec{M}_1 + \vec{M}_2 : \vec{M} = \mathbf{ab}(-\mathbf{i} - \mathbf{j})$

3. If area ($A$), time ($T$) and momentum ($P$) are assume as fundamental quantities, then dimensional formula of energy will be:

1. $A^{10}T^{-1}P^1$
2. $A^{10}T^{-1}P^2$
3. $A^{10}T^{-1}P^1$
4. $A^{-10}T^{-1}P^2$

Ans. (3)

Sol. Let dimension formula of energy will be

$E = A^p T^q P^r$

$MlT^{-1} = M_0 l^a t^b c^c$

By comparison

$p = 1$ ..... (1)

$2a + b = 2$ ..... (2)

$b - c = 2$ ..... (3)

$a = 1, b = 1/2, c = -1$

$E = A^{10} T^{-1} P^1$

4. $\hat{E}$ & $\hat{B}$ an electromagnetic wave oscillate along the direction having unit vectors $\hat{k}$ & $\hat{i} - \hat{j}$. Find unit vector along direction of propagation:

1. $\frac{\hat{i} - \hat{j}}{\sqrt{2}}$
2. $\frac{\hat{i} + \hat{j}}{\sqrt{2}}$
3. $\frac{\hat{i} + \hat{k}}{\sqrt{2}}$
4. $\frac{\hat{i} - \hat{k}}{\sqrt{2}}$

Ans. (1)

Sol. $\hat{E} \times \hat{B} \mid \hat{C}$

$\hat{E} \times \hat{B} = \frac{1}{\sqrt{2}} \begin{vmatrix} i & j & k \\ 0 & 0 & 1 \end{vmatrix} = \frac{\hat{i} - \hat{j}}{\sqrt{2}} \Rightarrow \hat{C} = \frac{\hat{i} - \hat{j}}{\sqrt{2}}$
5. Charge \( Q \) is distributed on two concentric spheres of radius \( r \) and \( R \) respectively, if charger density of both spheres is same then electric potential at the centre will be:

\[
\begin{align*}
(1) \quad & \frac{KQ}{r} \\
(2) \quad & \frac{KQ(r + R)}{r^2 + R^2} \\
(3) \quad & \frac{KQr}{r + R} \\
(4) \quad & \frac{KQ(r^2 + r^2)}{R + r}
\end{align*}
\]

Ans. (2)

Sol.

\[
Q_1 = \sigma 4\pi r^2 \\
Q_2 = \sigma 4\pi R^2 \\
\therefore \quad Q = \sigma 4\pi (r^2 + R^2) \\
\therefore \quad \sigma = \frac{Q}{4\pi (r^2 + R^2)}
\]

\[
V_c = \frac{KQ_1}{r} + \frac{KQ_2}{R}
\]

\[
= \frac{K\sigma 4\pi r^2}{r} + \frac{K\sigma 4\pi R^2}{R}
\]

6. A capillary of radius 0.15 mm is dipped in liquid of density \( \rho = 667 \text{ kg/m}^3 \). If surface tension of liquid is \( \frac{1}{20} \text{ N/m} \), then find the height up to which liquid rises in capillary. Angle of contact between liquid and capillary tube is 60°. (\( g = 10 \text{ m/s}^2 \))

\[
(1) \quad 0.01 \text{ m} \\
(2) \quad 0.02 \text{ m} \\
(3) \quad 0.04 \text{ m} \\
(4) \quad 0.05 \text{ m}
\]

Ans. (4)

Sol.

\[
h = \frac{2T \cos \theta}{\rho g} \\
= \frac{2 \times \frac{1}{20} \times \frac{1}{2}}{667 \times 10 \times 0.15 \times 10^{-3}}
\]

\[
= \frac{20 \times 10 \times 667 \times 15}{1000}
\]

\[
= 0.05 \text{ m}
\]
7. In a given potentiometer circuit 1.02 volt is balanced at 51 cm from A. Find potential gradient of potentiometer wire AB:

\[ X = \frac{V}{L} \]

\[ x = \frac{1.02}{51} = 0.02 \text{ volt/cm} \]

8. In hydrogen atom electron jumps from \((n + 1)^{th}\) state to \(n^{th}\) state the frequency of emitted photon is directly proportional to \((n \gg 1)\)

\[ n \]

\[ \frac{1}{n} \]

\[ \frac{1}{n^2} \]

\[ \frac{1}{n^3} \]

\[ \text{Ans. (4)} \]

\[ \text{Sol. } E_n = -\frac{R \hbar c}{n^2} \]

\[ E_{n+1} = -\frac{R \hbar c}{(n+1)^2} \]

\[ \Delta E = E_{n+1} - E_n \]

\[ h\nu = R \hbar c \left[ \frac{1}{n^2} - \frac{1}{(n+1)^2} \right] \]

\[ v = R \frac{[n^2 - (n+1)^2]}{n^2(n+1)^2} \]

\[ v = R \frac{1 + 2n}{n^2(n+1)^2} \]

\[ n \gg 1 \Rightarrow \]

\[ v = R \frac{2n}{n^2(n+1)^2} \]

\[ = \frac{2Rc}{n^3} \]

\[ v \propto \frac{1}{n^3} \]

---

Resonance Eduventures Ltd.

Reg. Office & Corp. Office: CG Tower, A-46 B. S. 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005

Ph. No.: +91-744-2777777, 2777700 | FAX No.: +91-202-39167222

To Know more : sms RESO at 56777 | Website: www.resonance.ac.in | E-mail: contact@resonance.ac.in | CIN: U80302220077001 | C245029


This solution was download from Resonance JEE (MAIN) 2020 Solution portal
Which of the following is correct.

(1) A & C
(2) A, C, D
(3) A, B, D
(4) C, D

(3)

**Sol.** From graph equation of SHM.

\[ x = A \cos \omega t \]

(i) at \( t = \frac{T}{4} \) particle at mean position

\[ a = 0 \]
\[ F = 0 \]

(ii) at \( t = \frac{3T}{4} \) particle again at mean position so velocity is maximum

(iii) at \( t = \frac{T}{4} \), particle is at mean position.

\[ a = 0 \]

(iv) \[ KE = PE \]

\[ \frac{1}{2}k(x^2 - x^2) = \frac{1}{2}kx^2 \]
\[ A^2 = 2x^2 \]
\[ x = \frac{A}{\sqrt{2}} \]

\[ \frac{A}{\sqrt{2}} = A \cos \omega t \]

\[ t = \frac{T}{8} \]

\[ \therefore \] A, B and D are correct.

10. A closed box contains an ideal gas if temperature of gas increased which:

(A) Mean free path remain same
(B) Mean free path decreases
(C) Relaxation time decreases
(D) Relaxation time remain same.

Which of the following is correct

(1) B & D
(2) A & C
(3) A & D
(4) B & C

Resonance Eduventures Ltd.

Reg. Office & Corp. Office: CG Tower, A-46 & 52, IPIA, Phase-2, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-744-2777777, 2777700 | FAX No.: +91-029-39167222
To Know more : sms RESO 15667 | Website: www.resonance.ac.in | E-mail: contact@resonance.ac.in | DIN : U803028/2007/T/10426029
Toll Free : 1800 238 5555 | 7344001933 | transcoursetutor@resonance.co.in | warrior@resonance.co.in | www.polestar.com/resonance @ ed.resonance.co.in

This solution was downloaded from Resonance JEE (MAIN) 2020 Solution portal PAGE # 5

Ans. (2)

**Sol.** As we know mean free path

\[ \lambda = \frac{1}{\sqrt{2} \left( \frac{N}{V} \right)^{1/3} d^2} \]

\( N \) = no. of molecule
\( V \) = volume of container
\( d \) = diameter of molecule

So mean free path remains same.

As temperature increases no. of collision increases so relaxation time decrease.

11. \( R_1 = R_2 = R_3 = R_4 = 2\Omega \). Find voltage across capacitor at steady state

**Ans.** (4)

**Sol.**
11. \[ i = \frac{10}{4} = \frac{10-3}{10} = 3 \text{Amp} \]

\[ i_1 = 2 \text{A} \quad i_2 = 1 \text{A} \]

\[ V_{eq} = 1 \times 2 + 3 \times 2 = 8 \text{V} \]

12. Two discs having moment of inertias \( I_1 \) and \( I_2 \) and angular velocities \( \omega_1 \) and \( \omega_2 \) are placed coaxially find total kinetic energy when they rotate with same angular velocity.

\( I_1 = 0.10 \text{ (kgm}^2\text{)} \)

\( I_2 = 0.20 \text{ (kgm}^2\text{)} \)

\( \omega_1 = 10 \text{ Rad/sec} \)

\( \omega_2 = 5 \text{ Rad/sec} \)

\( (1) \) 0 J

\( (2) \) 5 J

\( (3) \) 10 J

\( (4) \) 20/3 J

Ans. (4)

Sol.

---

13. A particle having mass \( m \) & charge \( +q \) is projected horizontally from point O. Charge correct from.

\[ \omega = \frac{I_1 \omega_1 + I_2 \omega_2}{I_1 + I_2} = \frac{20}{3} \]

Final K.E.

\[ K_f = \frac{1}{2} k_0^2 + \frac{1}{2} k_0^2 \]

\[ = \frac{1}{2} (0.1 + 0.2) \times \left( \frac{20}{3} \right)^2 \]

\[ \Rightarrow k_f = \frac{20}{3} \]

---

Ans. (3)

Sol.
14. In YDSE when \( \lambda = 700 \text{ nm} \) then total number of figure b/w O & P is 16. When \( \lambda = 400 \text{ nm} \) then total number of figure b/w O & P is

\[
\begin{align*}
&\text{(1) 14} \\
&\text{(2) 28} \\
&\text{(3) 7} \\
&\text{(4) 12}
\end{align*}
\]

\[
\text{Ans.} \quad (2) \quad \text{Sol.} \quad y = \frac{m_1 \Delta x_1}{d} = \frac{m_2 \Delta x_2}{d}
\]

\[
\frac{m_2}{m_1} = \frac{\lambda_1}{\lambda_2} \Rightarrow m_2 = \frac{700}{400} \times 16 = 28
\]

15. Acceleration due to gravity as same at height h from surface and at the depth h from the surface, then find the value of h.

\[
\begin{align*}
&\text{(1) } \sqrt{\frac{R}{2}} - \frac{R}{2} \\
&\text{(2) } \sqrt{\frac{5R}{2}} - 1 \\
&\text{(3) } \frac{R}{\sqrt{2}} \\
&\text{(4) } \frac{\sqrt{5R} + R}{2}
\end{align*}
\]

\[
\text{Ans.} \quad (2) \quad \text{Sol.} \quad \frac{GM}{(R + h)^2} = \frac{GM}{R^2} \Rightarrow R^2 = (R + h)^2 (R - h) \\
= (R^2 + h^2 + 2Rh)(R - h) \\
= R^2 + h^2 + 2Rh^2 - R^2h - h^3 - 2h^2R \\
= h^2 + h^2(2R - R) - R^2h = 0 \\
h^2 + h^2 - R^2h = 0 \\
h^2 + h^2 - R^2 = 0 \\
h = \frac{R \pm \sqrt{R^2 + 4(1)R^2}}{2} \\
= \frac{-R + \sqrt{5R}}{2} \\
= \frac{(\sqrt{5} - 1)R}{2}
\]
16. Efficiency of cyclic process is 50% if heat $Q_1 = 1915 J$, $Q_2 = 40 J$, $Q_3 = 125 J$, then $Q_4$ is unknown then find the value of $Q_4$.

Sol. $\eta = \frac{W}{2Q}$

(1) $1080$

(2) $-980 J$

(3) $-1080$

(4) $-1280 J$

$\Rightarrow \frac{1915 - 40 + 125 + Q_4}{Q_1 + Q_2}$

$\Rightarrow \frac{1915 + 125}{Q_1 + Q_2}$

$\Rightarrow Q_4 = 1020 - 2000$

$\Rightarrow Q_4 = -980 J$

17. (A, B) is (0, 0), (0, 1), (1, 0), (1, 1) then put at x will be

(1) (0, 0, 0, 0)

(2) (1, 1, 0, 0)

(3) (1, 0, 1, 0)

(4) (1, 1, 1, 1)

Ans. (1)

Sol.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

:. Option (ii) is the Answer

18. Impedance of $L - R$ Circuit is 100 $\Omega$ and phase difference between source voltage and source current is 45$^\circ$ of frequency of source 1000 Hz then find Inductance of coil.

(1) $25\sqrt{2}$ mH

(2) $\frac{50\sqrt{2}}{\pi}$ mH

(3) $\frac{25\sqrt{2}}{\pi}$ mH

(4) $\frac{20\sqrt{2}}{\pi}$ mH

Ans. (3)

Sol. $\tan(\phi) = \frac{X_L}{R}$

Resonance Eduventures Ltd.
Reg. Office & Corp. Office: CG Tower, A-46 & 52, IPA, Near City Mall, Jhalawar Road, Kota (Raj.) - 324005
Ph. No.: +91-7447777777, 777720 | FAX No.: +91-022-39167222
To Know more: www.ressco.in | Website: www.resonance.ac.in | E-mail: contact@resonance.ac.in | CNIC: H030502S | C200781C024029

This solution was downloaded from Resonance JEE (MAIN) 2020 Solution portal PAGE # 9

\[ x_L = R = 100 = \sqrt{x_L^2 + R^2} \]

\[ 100 = \sqrt{R^2 + R^2} \]

\[ \sqrt{2R} = 100 \]

\[ R = 50\sqrt{2} \]

\[ \therefore x_L = 50\sqrt{2} \]

\[ L = 50\sqrt{2} \]

\[ L = \frac{50\sqrt{2}}{2 \pi \times 1000} = \frac{25\sqrt{2}}{\pi} \text{ mH} \]

19. A square of side $\frac{a}{2}$ is removed from a disc having radius a. Find centre of mass of remaining portion.
20. A particle is projected with velocity \( v \) for point \( O \) of particle makes 10 revolutions before coming out. Find \( \ell \).

\[ X_0 = \frac{A_x - Ax}{A - A_l} = \frac{-a^2 \times 0 - \frac{a^2}{4}}{\frac{a^2}{4}} \]

\[ = -\frac{a}{8 \pi - 2} \]

**Sol.**

\( \ell = 10 \times \text{pitch} \)

\[ = 10 \times v \cos 60^\circ \times \frac{2m}{qB} \]

\[ \ell = \frac{20m v}{qB} \]

**Numerical Value Type (संख्यात्मक प्रकार)**

This section contains 5 Numerical value type questions.

21. Young modulus of a string of length 1m and density 900 kg/m\(^3\) is \( 9 \times 10^8 \) N/m\(^2\). Find minimum resonance frequency (in Hz) can be produced in the string if strain in the string is \( 4.9 \times 10^{-5} \).

**Ans.** 35.00 Hz

**Sol.** Fundamental frequency in the string

\[ f = \frac{1}{2L} \times \frac{1}{\sqrt{\mu}} \times \frac{1}{4} \sqrt{\frac{Y}{\rho}} \]
22. Light incident on a sphere of refractive index $\sqrt{3}$ placed in air as shown in figure. Find the angle ($\theta$) in degree between emergent ray and reflected ray.

**Ans.** $\theta = 90^\circ$

**Sol.**

Apply Snell's law at $S_1$:

$1 \sin 60^\circ = \sqrt{3} \sin r$

$\sin r = \frac{1}{2}$

$r = 30^\circ$

from geometry

$r' = 30^\circ$

Again apply Snell's law on $S_2$

$\sqrt{3} \sin r'' = 1 \sin e$

$\frac{\sqrt{3}}{2} = \sin e$

\[ e = 60^\circ \]

from geometry

$r'' + \theta + e = 180^\circ$

$\theta = 90^\circ$
23. A capacitor of capacity $2Q_0 F$ is charged up to 50V and disconnected from cell. Now this charged capacitor is connected to another capacitor of capacitance $C$. If final common potential is 20V then find the capacitance $C$.

Ans. 30.00

Sol. $V = \frac{C_1V_1 + C_2V_2}{C_1 + C_2}$

$20 = \frac{20 \times 50 + 0}{20 + C}$

$400 + 20C = 1000$

$20C = 600$

$C = 30 \mu F$
Announcing

Rank Booster
Part-2

An Exhaustive Online Preparation Course of 3 Weeks for JEE (Advanced) 2020

Course Features

- New specially designed 18 Advanced Worksheets
- Online Live Discussion class (6 per week) each of 1.5 hours for Advanced worksheets
- Exclusive Unit wise Work Sheets covering tough & important concepts
- Revision DPPs for more practice on daily basis
- Medium of Teaching and Content would be only English
- Gyan Sutra booklet: Specially designed package for quick revision of P, C & M

Course Brief

The Rank Booster Part-2 course is recommended for students aiming a top rank in JEE (Advanced) 2020. The course structure is tailored to better the chances through rigorous practice of 18 Advanced Worksheets and their exhaustive conceptual discussion. Also, unit wise worksheets for self practice to strengthen tough and important concepts.

Boosting Aspirations to Reality

Course Starts
07 Sept.

Course Duration
3 Weeks

Course Mode
Online

Course Fee
(Excl. of 4% GST)
₹5000/-

Limited Seats

Register on
www.resonance.ac.in

Toll Free: 1800 258 5555
7023003307, 7728890101 | 7340010333