

08/04/2023

Evening



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Memory Based Answers & Solutions

Time : 3 hrs.

for

M.M. : 300

JEE (Main)-2023 (Online) Phase-2

(Physics, Chemistry and Mathematics)

IMPORTANT INSTRUCTIONS:

- (1) The test is of **3 hours** duration.
- (2) The Test Booklet consists of 90 questions. The maximum marks are 300.
- (3) There are **three** parts in the question paper consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each part (subject) has two sections.
 - (i) **Section-A:** This section contains 20 multiple choice questions which have only one correct answer. Each question carries **4 marks** for correct answer and **-1 mark** for wrong answer.
 - (ii) **Section-B:** This section contains 10 questions. In Section-B, attempt any **five questions out of 10**. The answer to each of the questions is a numerical value. Each question carries **4 marks** for correct answer and **-1 mark** for wrong answer. For Section-B, the answer should be rounded off to the nearest integer.

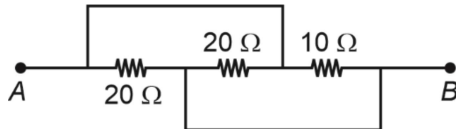
PHYSICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

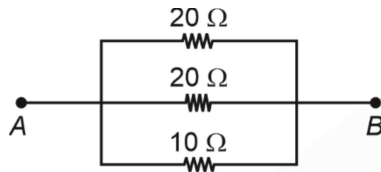
1. The effective resistance in the following circuit across terminal A and B is equal to



- (1) 5 Ω
- (2) 10 Ω
- (3) 20 Ω
- (4) 40 Ω

Answer (1)

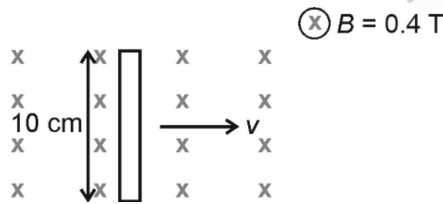
Sol. Equivalent circuit



$$\frac{1}{R} = \frac{1}{10} + \frac{1}{20} + \frac{1}{20}$$

$$\Rightarrow R = 5 \Omega$$

2. If the emf generated in the moving rod in uniform magnetic field B is 0.08 V, then find the speed (v) of the rod.



- (1) 1 m/s
- (2) 2 m/s
- (3) 3 m/s
- (4) 4 m/s

Answer (2)

Sol. $\varepsilon = Blv$

$$v = \frac{\varepsilon}{Bl} = \frac{0.08 \times 100}{0.4 \times 10} = 2 \text{ m/s}$$

3. Which of the following expressions give the value of acceleration due to gravity (g') at the altitude h above the surface of earth. (R : radius of earth, g : acceleration due to gravity at surface of earth)

- (1) $g' = g \frac{h^2}{R^2}$
- (2) $g' = \frac{gR^2}{(R+h)^2}$
- (3) $g' = g \left(1 - \frac{h}{R}\right)$
- (4) $g' = g \left(1 - \frac{h^2}{R^2}\right)$

Answer (2)

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

$$g' = \frac{gR^2}{(R+h)^2}$$

4. Find the distance from a point charge of magnitude 5×10^{-9} C, where the electric potential is 50 V

- (1) 90 cm
- (2) 70 cm
- (3) 60 cm
- (4) 50 cm

Answer (1)

Sol. $V = \frac{kQ}{r}$

$$50 = \frac{9 \times 10^9 \times 5 \times 10^{-9}}{r}$$

$$r = 0.9 \text{ m}$$

5. Match column I with column II and choose the correct option.

	Column I		Column II
I.	Torque	a.	M^0LT^{-2}
II.	Stress	b.	$ML^{-1}T^{-1}$
III.	Coefficient of viscosity	c.	$ML^{-1}T^{-2}$
IV.	Gravitational potential gradient	d.	ML^2T^{-2}

- (1) I → a, II → c, III → b, IV → d
- (2) I → d, II → b, III → c, IV → a
- (3) I → d, II → c, III → b, IV → a
- (4) I → a, II → c, III → d, IV → b

Answer (3)

Sol. Torque = $r \times F = ML^2T^{-2}$

$$\text{Stress} = \frac{F}{A} = ML^{-1}T^{-2}$$

$$\text{Coefficient of viscosity} = ML^{-1}T^{-1}$$

$$\text{Gravitational potential gradient} = M^0LT^{-2}$$

6. Which of the following is the highest energy electromagnetic wave?
 (1) X-rays (2) Infra Red
 (3) Microwaves (4) Radiowave

Answer (1)

Sol. Since out of the given options, X-rays have the highest frequency.

⇒ Option (1) is correct

7. A Carnot engine working between 27°C and 127° performs 2 kJ of work. The amount of heat energy rejected is equal to

- (1) 4 kJ (2) 6 kJ
 (3) 8 kJ (4) 12 kJ

Answer (2)

Sol. $2 \text{ kJ} = x \left(1 - \frac{300}{400}\right)$

$$2 \text{ kJ} = \frac{x}{4}$$

⇒ $x = 8 \text{ kJ}$

⇒ Heat lost = 6 kJ

8. **Statement-I:** Electromagnets are made of soft iron.

Statement-II: Soft iron has lower permeability and high retentivity.

Choose the correct option related to statements.

- (1) Statement-I is true and statement-II is true
 (2) Statement-I is true and statement-II is false
 (3) Statement-I is false and statement-II is true
 (4) Statement-I is false and statement-II is false

Answer (2)

Sol. Soft iron has low retentivity and high permeability.

9. If a satellite is orbiting the earth at a height h has angular momentum ' L '. Then, the same satellite at a height 10 times ' h ' will have angular momentum equal to

- (1) $\sqrt{10} L$ (2) $\sqrt{5} L$
 (3) $3L$ (4) $\sqrt{20} L$

Answer (1)

Sol. ∴ $\frac{mv^2}{r} = \frac{GMm}{r^2}$

⇒ $m^2 v^2 r^2 = GMmr$

$L^2 \propto r$

∴ $\frac{L_1}{L_2} = \sqrt{\frac{h}{10h}}$

⇒ $L_2 = \sqrt{10} L$

10. Consider 2 statements:

Statement 1: We can get displacement from acceleration-time graph.

Statement 2: We can get acceleration from velocity-time graph.

Then

- (1) Both statements are true
 (2) Both statements are false
 (3) Statement 1 is true and statement 2 is false
 (4) Statement 1 is false and statement 2 is true

Answer (4)

Sol. To get displacement from acceleration-time graph, we will need 1 initial value (for velocity).

Also, $a = \frac{dv}{dt}$

⇒ Slope will give a .

11. A projectile launched on a horizontal surface follows a trajectory given by $y = x - \frac{x^2}{20}$ where y -axis is in vertical upward direction. Maximum height attained by projectile is (All units are in SI)

- (1) 10 m (2) 5 m
 (3) 20 m (4) 40 m

Answer (2)

Sol. $y = x - \frac{x^2}{20}$

at maximum height $\frac{dy}{dx} = 0$

⇒ $x = 10 \text{ m}$

at $x = 10 \text{ m}$, $y = 10 - 5 = 5 \text{ m}$

12. An antenna of length l emits radiation of wavelength λ . The power emitted by the antenna is proportional to:

- (1) $\left(\frac{l}{\lambda}\right)^2$ (2) $\frac{l}{\lambda}$
 (3) $\frac{\lambda}{l}$ (4) $\frac{1}{l\lambda}$

Answer (1)

Sol. Since $P \propto \left(\frac{l}{\lambda}\right)^2$

⇒ Option (1) is correct.

13. In a radioactive process, $\frac{1}{8}$ th of the initial amount of the element is decayed. If in 5 days further, 8×10^{-3} kg of the element decayed, find the original amount of element.

- (1) 128 grams (2) 64 grams
 (3) 256 grams (4) 32 grams

Answer (2)

Sol. $\frac{1}{8} = \frac{1}{2^3}$

\Rightarrow 3 half lives = 3 days

$\Rightarrow \frac{b}{2} = 1$ day

Let m: initial mass

$\Rightarrow \frac{m}{8} - \frac{m}{8 \times 32} = 8$ grams

$\Rightarrow m = \frac{64 \times 32}{32 - 1} \approx 65$ g.

14. Find the change in energy stored in a capacitor of 600 pF capacitance charged at 50 V, once connected with another 600 pF uncharged capacitor.

- (1) 0.56 μ J (2) 0.4 μ J
 (3) 0.86 μ J (4) 0.32 μ J

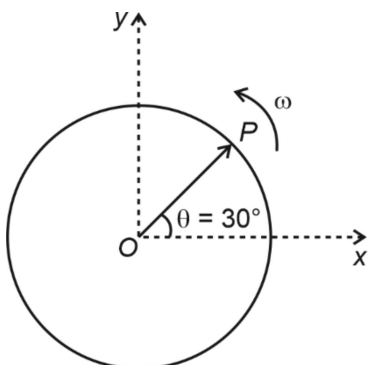
Answer (1)

Sol. $U_i = \frac{1}{2}Cv^2$, $U_f = \frac{1}{2}C\left(\frac{v}{2}\right)^2$

$\Delta U = \frac{3}{8}Cv^2$

$= \frac{3}{8} \times 600 \times 10^{-12} \times (50)^2$

15. Phasor of a particle performing SHM is as shown in the diagram. The SHM has angular frequency ω and at $t = 0$ the phasor lies along OP. At any time t further the projection of phasor along y-axis is given by



- (1) $R \sin\left(\omega t + \frac{\pi}{6}\right)$ (2) $R \cos\left(\omega t + \frac{\pi}{6}\right)$
 (3) $R \sin\left(\omega t - \frac{\pi}{6}\right)$ (4) $R \cos\left(\omega t - \frac{\pi}{6}\right)$

Answer (1)

Sol. θ at any time t

$= \omega t = 30^\circ$

$\Rightarrow y_{\text{projection}} = R \sin \theta$

$= R \sin\left(\omega t + \frac{\pi}{6}\right)$

16.
17.
18.
19.
20.

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g., 06.25, 07.00, -00.33, -00.30, 30.27, -27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

21. A body of mass 5 kg has the linear momentum of 100 kg ms⁻¹ and acted upon by the force of 2 N for 2 seconds, then change in kinetic energy in Joule is

Answer (81.60)

Sol. $F \times t = \Delta P$

$\Rightarrow 2 \times 2 = P_f - 100$

$P_f = 104$ kg ms⁻¹

$\Delta K = \frac{P_f^2}{2m} - \frac{P_i^2}{2m} = \frac{1}{2 \times 5} \times (104^2 - 100^2)$

$= \frac{1}{10} \times 4 \times 204 = 81.6$ J

22. In a YDSE experiment, fringe width is 2 mm when wavelength of light used is $\lambda = 400$ nm. Find the fringe width (in mm) when wavelength is 600 nm.

Answer (3)

Sol. $\beta = \frac{\lambda D}{d}$

$$\Rightarrow \frac{\beta'}{\beta} = \frac{600}{400} = 1.5$$

$$\Rightarrow \beta' = 3 \text{ mm}$$

23. A block moving with speed 1 m/s comes to rest after moving for 20 cm over a rough surface. The coefficient of friction between the block and surface is ___

Answer (00.25)

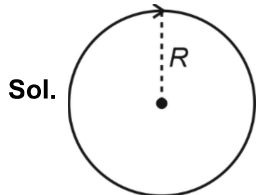
Sol. $\therefore v^2 - u^2 = 2as$

$$0^2 - 1^2 = 2(-\mu g) \frac{20}{100}$$

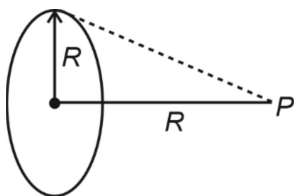
$$\mu = \frac{1}{4} = 0.25$$

24. The ratio of magnetic field due to coil at centre and at a distance of R from the centre on the axis passing through the centre and perpendicular to the plane of ring is $\sqrt{x} : 1$ (R is the radius of coil), find the value of x .

Answer (8)



$$B_C = \left(\frac{\mu_0 i}{2R} \right)$$

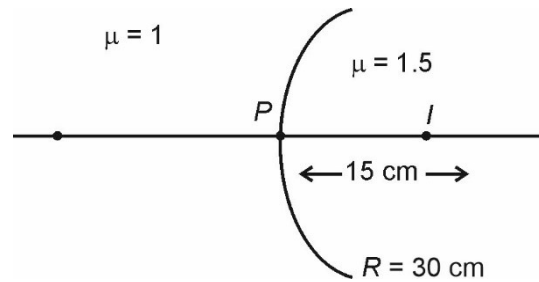


$$B_P = \frac{\mu_0}{4\pi} \times \frac{2 \times i \times \pi R^2}{(R^2 + R^2)^{3/2}}$$

$$= \frac{\mu_0}{2R} \frac{i}{2\sqrt{2}} = \left(\frac{\mu_0 i}{4\sqrt{2}R} \right)$$

$$\frac{B_C}{B_P} = \frac{4\sqrt{2}}{2} = \sqrt{8} : 1$$

25. In the given diagram image forms at a distance of 15 cm inside the



medium of refractive index 1.5. Find the object distance (in cm) from point P .

Answer (12.00)

Sol. $\frac{1.5}{15} - \frac{1}{u} = \left(\frac{1.5 - 1}{30} \right) = \frac{0.5}{30} = \frac{1}{60}$

$$\frac{1}{10} - \frac{1}{u} = \frac{1}{60} \Rightarrow \frac{1}{10} - \frac{1}{60} = \frac{1}{u}$$

$$\frac{1}{u} = \frac{5}{60} \Rightarrow u = \frac{60}{5} = 12 \text{ cm}$$

26. Ratio of wavelengths of photons corresponding to first and second line of Balmer series in an emission spectrum is given by $\frac{x}{20}$ for a hydrogen like species. Value of x is equal to

Answer (27)

Sol. $\frac{1}{\lambda_1} = -R \left(\frac{1}{9} - \frac{1}{4} \right)$

$$\frac{1}{\lambda_2} = -R \left(\frac{1}{16} - \frac{1}{4} \right)$$

$$\Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{36}{5} \times \frac{3}{16} = \frac{27}{20}$$

$$\Rightarrow x = 27$$

27.

28.

29.

30.