11/04/2023
Evening

Corporate Office : Aakash Tower, 8, Pusa Road, New Delhi-110005 | Ph.: 011-47623456

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. Density (ρ) of a body depends on the force applied (F), its speed (v) and time of motion (t) by the relation $\rho = KF^a v^b t^c$, where K is a dimensionless constant. Then
   (1) $a = 1, b = -4, c = -2$
   (2) $a = 2, b = -4, c = -1$
   (3) $a = -1, b = -4, c = 2$
   (4) $a = 1, b = 4, c = -2$

Answer (1)

Sol. $[ML^{-3}] = [MLT^{-2}]^a[LT^{-1}]^b[T]^c$
$= [M^aL^{a+b}T^{-2a-b+c}]$
$a = 1,$
$a + b = -3,$
$\Rightarrow b = -4,$
also $-2a - b + c = 0$
$c = -2$

2. In which of the following process, the internal energy of gas remains constant.
   (1) Isothermal (2) Isochoric
   (3) Isobaric (4) Adiabatic

Answer (1)

Sol. T = constant $\Rightarrow U$ = constant

3. A particle is projected at an angle of 30° with ground with speed 40 m/s. The speed of particle after two seconds is (use $g = 10$ m/s^2)
   (1) $20\sqrt{2}$ m/s (2) $20\sqrt{3}$ m/s
   (3) 20 m/s (4) $10\sqrt{3}$ m/s

Answer (2)

Sol. At $t = 2$ particle is at maximum height moving with 40cos30° m/s.

4. Potential at the surface of a uniformly charged non-conducting sphere is V. Then the potential at its centre is
   (1) 0 (2) $\frac{V}{2}$
   (3) $2V$ (4) $\frac{3V}{2}$

Answer (4)

Sol. $V = \frac{KQ}{2R^3}\left(3R^2 - r^2\right)$ at $r = R \Rightarrow V = \left(\frac{KQ}{R}\right)$

at $r = 0$, $V_0 = \frac{3KQ}{2R} = \left(\frac{3V}{2}\right)$

5. If $\vec{A} = 2\hat{i} + 3\hat{j} + 2\hat{k}$ and $\vec{A} - \vec{B} = 2\hat{j}$, then find $|\vec{B}|$.
   (1) 3 (2) $3\sqrt{3}$
   (3) 2 (4) $\sqrt{3}$

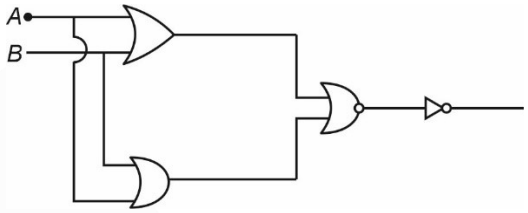
Answer (1)

Sol. $\left(2\hat{i} + 3\hat{j} + 2\hat{k}\right) - \vec{B} = 2\hat{j}$

$\Rightarrow \vec{B} = 2\hat{i} + \hat{j} + 2\hat{k}$

$\Rightarrow |\vec{B}| = 3$

6. The resultant gate is

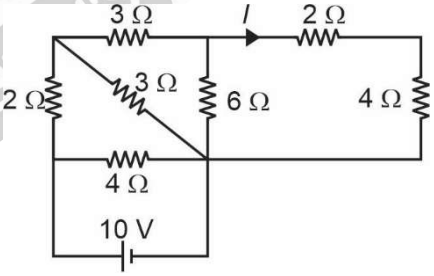


   (1) NAND (2) NOR
   (3) OR (4) AND

Answer (4)

Sol. (A+B) (A·B) = (A·AB) + A·(AB)
= AB + AB
= (AB)

7. For the given circuit diagram, find the current I.



   (1) $\frac{5}{16}$ A (2) $\frac{5}{48}$ A
   (3) $\frac{5}{12}$ A (4) $\frac{1}{16}$ A

Answer (3)

Sol. $i_{battery} = \frac{10}{2} = 5$ A

$I = i_{battery} \times \frac{1}{2} \times \frac{1}{3} \times \frac{1}{2} = \frac{5}{12}$ A

8. If a nucleus is divided in ratio of $1 : 2^{1/3}$, then find ratio of velocity of the parts is
   (1) 2 (2) $2^{1/3}$
   (3) $2^{2/3}$ (4) $2^{-1/3}$

Answer (2)

Sol. From conservation of momentum,

$$m_0\vec{v}_1 + 2^{1/3} m_0\vec{v}_2 = 0$$

$$\Rightarrow \left|\frac{\vec{v}_1}{\vec{v}_2}\right| = 2^{1/3}$$

9. If electric field $\left(\vec{E}\right)$ at an instant is $6.6\hat{j}$ N/C and the EM wave is propagating along positive *x*-direction then $\vec{B}$ at that instant is given by

(1) $2.2\times10^{-8}\hat{k}$ T (2) $-2.2\times10^{-8}\hat{k}$ T

(3) $-0.5\times10^{-8}\hat{k}$ T (4) $19.8\times10^{8}\hat{k}$ T

Answer (1)

Sol. $\left|\vec{E}\right| = C\left|\vec{B}\right|$

$$\left|\vec{B}\right| = \frac{6.6}{3\times10^8} = 2.2\times10^{-8}\ \text{T}$$

Also $\hat{E}\times\hat{B} = \hat{C}$

10. Find average speed of N_2 at 27°C.

(1) 476 m/s (2) 470 m/s

(3) 480 m/s (4) 490 m/s

Answer (1)

Sol. $\bar{v} = \sqrt{\frac{8RT}{\pi M}} = \sqrt{\frac{8\times8.314\times300}{3.14\times28\times10^{-3}}} = 476$ m/s

11. A charge particle is projected inside along the axis of long solenoid, then

(a) Path will be straight line

(b) There is no effect of magnetic field on charge

(c) Path will be parabolic

(d) Path will be circular

(1) a, d (2) a, b

(3) b, d (4) a, b, d

Answer (2)

Sol. $\vec{F} = q\vec{v}\times\vec{B} = 0$

12. Six identical small liquid drops are mixed together to form a bigger drop. The terminal velocity of bigger drop if terminal velocity of small drop is 10 m/s, will be

(1) $10\times(6)^{\frac{1}{3}}$ m/s (2) $10\times(6)^{\frac{2}{3}}$ m/s

(3) $5\times(3)^{\frac{2}{3}}$ m/s (4) $10\times(6)^3$ m/s

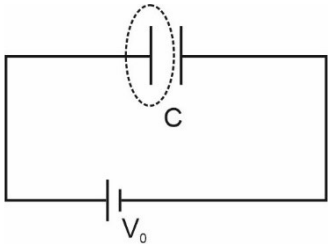
Answer (2)

Sol. $R = 6^{1/3}r$

Also, $\frac{v_b}{v_s} = \frac{R^2}{r^2}$ ($\because v_T \propto$ (Radius)^2)

$V_b = 10\times(6)^{2/3}$

13. A parallel plate capacitor C connected with a battery of voltage V_0. A close gaussian surface is shown by dotted boundary as shown. The electric flux through the surface is



(1) $\frac{2CV}{\epsilon_0}$ (2) $\frac{CV_0}{\epsilon_0}$

(3) $\frac{CV_0}{2\epsilon_0}$ (4) $\frac{3CV}{2\epsilon_0}$

Answer (1)

Sol. $\phi = \frac{Q}{\epsilon_0} = \frac{CV_0}{\epsilon_0}$

14. A satellite is moving around earth surface. How much minimum speed should be increased so that it escapes from earth surface? (g = acceleration due to gravity, R = radius of earth)

(1) $2\sqrt{gR}$ (2) $\left(\sqrt{2}-1\right)\sqrt{gR}$

(3) $\sqrt{\frac{gR}{2}}$ (4) $\left(\sqrt{3}-1\right)\sqrt{gR}$

Answer (2)

Sol. $v_{\text{circular}} = \sqrt{\frac{GM}{R}} = \sqrt{gR}$; $\Delta v = \left(\sqrt{2}-1\right)\sqrt{gR}$

$$v_{\text{escape}} = \sqrt{\frac{2GM}{R}} = \sqrt{2gR}$$

15. **A :** Moving magnet in conducting pipe slows down.

R : Because eddy current is formed.

(1) A is correct, R is wrong

(2) A and R both are wrong

(3) A and R both are correct

(4) A is wrong, R is correct

Answer (3)

Sol. Moving magnet in conducting pipe causes change in flux and hence induced emf. This emf causes eddy current in conducting pipe in such a way that it tries to oppose the change in flux, therefore magnet slows down.

16. A source of sound is moving away from a stationary observer with constant velocity 40 m/s. Find frequency heard by observer, if original frequency of source is 400 Hz and speed of sound in air is 360 m/s

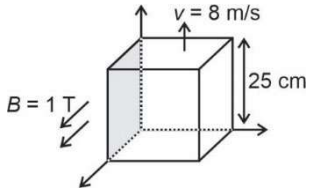
(1) 330 Hz (2) 320 Hz

(3) 360 Hz (4) 280 Hz

Answer (3)

Sol. $f = 400\left(\frac{360}{360+40}\right) = 360$ Hz

17. Find emf induces across the faces of given cube.



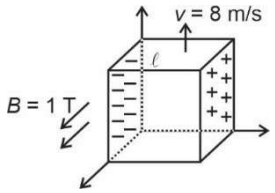
(1) 2*V* (2) 4*V*
(3) 8*V* (4) 6*V*

Answer (1)

Sol. $\varepsilon_{ind} = Bv\ell$

$\varepsilon_{ind} = 1(8)(0.25)$

$\varepsilon_{ind} = 2$ volt



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 is rotating with kinetic energy *E*. If angular velocity of body is increased to three times of initial angular velocity then kinetic energy becomes *nE*. Find *n*.

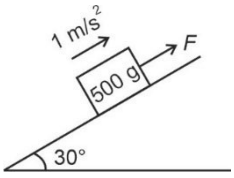
Answer (9)

Sol. K.E. = $\frac{1}{2}I\omega^2 = E$

$E_f = \frac{1}{2}I(3\omega)^2 = 9\times\left(\frac{1}{2}I\omega^2\right)$

$E_f = 9E$

22. Find power delivered by *F* at *t* = 10 s. Body start from rest.



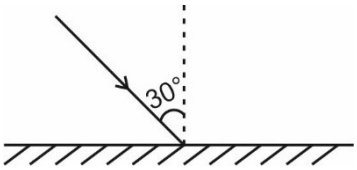
Answer (30)

Sol. $F - 0.5\ g\sin30° = 0.5\ a \Rightarrow F = 0.5 + 2.5 = 3$ N

$v_{10} = u + at \Rightarrow v_{10} = 0 + 1(10) = 10$ m/s

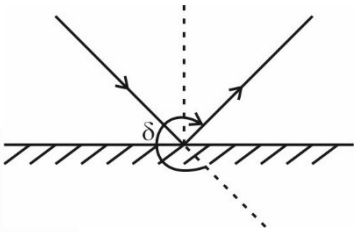
$P_{10} = Fv = 30$ w

23. A ray of light is incident on a plane mirror as shown in figure. Find the deviation of ray (in degree and clockwise direction).



Answer (240)

Sol. $\delta = 180° + 60° = 240°$ (clockwise)



24. Proton and electrons have equal kinetic energy, the ratio of de Broglie wavelength of proton and electron is $\frac{1}{x}$. Find *x*. (Mass of proton = 1849 times mass of electron)

Answer (43)

Sol. $P = \sqrt{2Km}$

$\lambda = \frac{h}{P}$

$\frac{\lambda_p}{\lambda_e} = \frac{P_e}{P_p} = \sqrt{\frac{2Km_e}{2Km_p}} = \sqrt{\frac{m_e}{m_p}} = \sqrt{\frac{1}{1849}} = \frac{1}{43}$

25. Energy of hydrogen in ground state is –13.6 eV. The energy of He^+ in first exited state is –13.6*x*. Find the value of *x*.

Answer (1)

Sol. For He^+

$E = \frac{-13.6Z^2}{2^2} = \frac{-13.6\times4}{4} = -13.6$ eV

26.

27.

28.

29.

30.