

JEE Main 2023 April 13 Shift 1 Physics Question Paper

Time Allowed :1 Hour	Maximum Marks :100	Total Questions :30
----------------------	--------------------	---------------------

General Instructions

Read the following instructions very carefully and strictly follow them:

1. The test is of 3 hours duration.
2. The question paper 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.
4. 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.

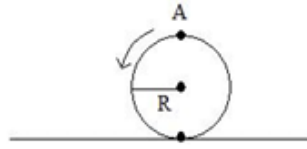
1. A body of mass (5 ± 0.5) kg is moving with a velocity of (20 ± 0.4) m/s. Its kinetic energy will be

- (A) (1000 ± 0.14) J
(B) (1000 ± 140) J
(C) (500 ± 0.14) J
(D) (500 ± 140) J

2. Two trains 'A' and 'B' of length ' l ' and ' $4l$ ' are travelling into a tunnel of length ' L ' in parallel tracks from opposite directions with velocities 108 km/h and 72 km/h, respectively. If train 'A' takes 35s less time than train 'B' to cross the tunnel then, length ' L ' of tunnel is : (Given $L = 60 l$)

- (A) 1800 m
(B) 900 m
(C) 1200 m
(D) 2700 m

3. A disc is rolling without slipping on a surface. The radius of the disc is R . At $t = 0$, the top most point on the disc is A as shown in figure. When the disc completes half of its rotation, the displacement of point A from its initial position is



- (A) $2R\sqrt{1 + 4\pi^2}$
 (B) $2R$
 (C) $R\sqrt{\pi^2 + 1}$
 (D) $R\sqrt{\pi^2 + 4}$

4. Two bodies are having kinetic energies in the ratio 16 : 9. If they have same linear momentum, the ratio of their masses respectively is :

- (A) 3 : 4
 (B) 9 : 16
 (C) 4 : 3
 (D) 16 : 9

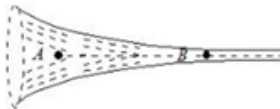
5. A bullet of 10 g leaves the barrel of gun with a velocity of 600 m/s. If the barrel of gun is 50 cm long and mass of gun is 3 kg, then value of impulse supplied to the gun will be :

- (A) 12 Ns
 (B) 3 Ns
 (C) 6 Ns
 (D) 36 Ns

6. A planet having mass $9 M_e$ and radius $4 R_e$, where M_e and R_e are mass and radius of earth respectively, has escape velocity in km/s given by : (Given escape velocity on earth $V_e = 11.2 \times 10^3$ m/s)

- (A) 67.2
 (B) 33.6
 (C) 16.8
 (D) 11.2

7.



The figure shows a liquid of given density flowing steadily in horizontal tube of varying cross-section. Cross sectional areas at A is 1.5 cm^2 , and B is 25 mm^2 , if the speed of liquid at B is 60 cm/s then $(P_A - P_B)$ is : (Given P_A and P_B are

liquid pressures at A and B points; density $\rho = 1000 \text{ kg m}^{-3}$; A and B are on the axis of tube)

- (A) 27 Pa
 - (B) 175 Pa
 - (C) 135 Pa
 - (D) 36 Pa
-

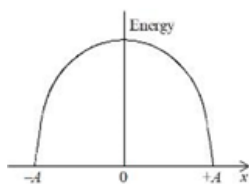
8. Under isothermal condition, the pressure of a gas is given by $P = \alpha V^{-3}$, where α is a constant and V is the volume of the gas. The bulk modulus at constant temperature is equal to

- (A) 3 P
 - (B) 2 P
 - (C) P
 - (D) P/2
-

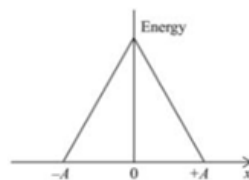
9. The rms speed of oxygen molecule in a vessel at particular temperature is $\left(1 + \frac{5}{x}\right)^{\frac{1}{2}} v$, where v is the average speed of the molecule. The value of x will be : (Take $\pi = \frac{22}{7}$)

- (A) 4
 - (B) 8
 - (C) 27
 - (D) 28
-

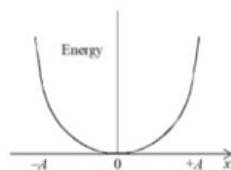
10. Which graph represents the difference between total energy and potential energy of a particle executing SHM vs it's distance from mean position ?



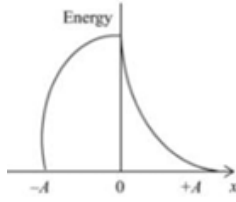
(A)



(B)



(C)



(D)

11. The ratio of powers of two motors is $\frac{3\sqrt{x}}{\sqrt{x+1}}$, that are capable of raising 300 kg water in 5 minutes and 50 kg water in 2 minutes respectively from a well of 100 m deep. The value of x will be

- (A) 2
- (B) 4
- (C) 16
- (D) 24

12. Which of the following Maxwell's equation is valid for time varying conditions but not valid for static conditions :

- (A) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$
- (B) $\oint \vec{E} \cdot d\vec{l} = -\frac{\partial \Phi_B}{\partial t}$
- (C) $\oint \vec{D} \cdot d\vec{A} = Q$
- (D) $\oint \vec{E} \cdot d\vec{l} = 0$

13. The source of time varying magnetic field may be

- (A) a permanent magnet
- (B) an electric field changing linearly with time
- (C) direct current
- (D) a decelerating charge particle
- (E) an antenna fed with a digital signal

Choose the correct answer from the options given below:

- (A) (A) only
- (B) (D) only
- (C) (C) and (E) only
- (D) (B) and (D) only

14. A vessel of depth 'd' is half filled with oil of refractive index n_1 and the other half is filled with water of refractive index n_2 . The apparent depth of this vessel when viewed from above will be-

- (A) $\frac{dn_1 n_2}{2(n_1 + n_2)}$
- (B) $\frac{dn_1 n_2}{(n_1 + n_2)}$

- (C) $\frac{2d(n_1+n_2)}{n_1n_2}$
 (D) $\frac{d(n_1+n_2)}{2n_1n_2}$

15. The difference between threshold wavelengths for two metal surfaces A and B having work function $\Phi_A = 9 \text{ eV}$ and $\Phi_B = 4.5 \text{ eV}$ in nm is: {Given, $hc = 1242 \text{ eV nm}$ }

- (A) 264
 (B) 540
 (C) 276
 (D) 138

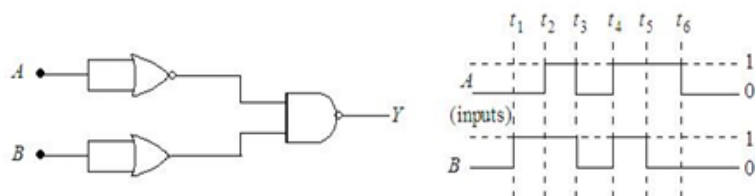
16. In the given nuclear reaction, the approximate amount of energy released will be: ${}_{92}^{238}\text{A} \rightarrow {}_{90}^{234}\text{B} + {}_2^4\text{D} + \text{Q}$

Given, mass of ${}_{92}^{238}\text{A} = 238.05079 \times 931.5 \text{ MeV}/c^2$, mass of

${}_{90}^{234}\text{B} = 234.04363 \times 931.5 \text{ MeV}/c^2$, mass of ${}_2^4\text{D} = 4.00260 \times 931.5 \text{ MeV}/c^2$

- (A) 3.82 MeV
 (B) 4.25 MeV
 (C) 5.9 MeV
 (D) 2.12 MeV

17. For the following circuit and given inputs A and B, choose the correct option for output 'Y'



- (A)
- (B)
- (C)
- (D)

18. Match List - I with List - II

List - I	List - II
(Layer of atmosphere)	(Approximate height over earth's surface)
(A) F_1 - Layer	(I) 10 km
(B) D - Layer	(II) 170 - 190 km
(C) Troposphere	(III) 100 km
(D) E - layer	(IV) 65 - 75 km

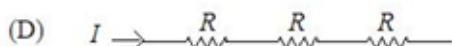
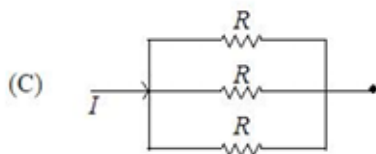
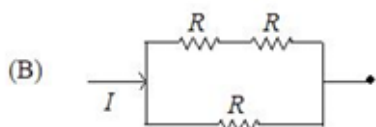
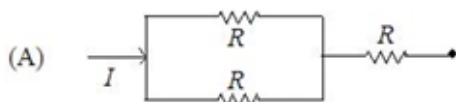
Choose the correct answer from the options given below:

- (A) A-II, B-IV, C-III, D-I
 (B) A-III, B-IV, C-I, D-II
 (C) A-II, B-IV, C-I, D-III
 (D) A-II, B-I, C-IV, D-III

19. Two charges each of magnitude 0.01 C and separated by a distance of 0.4 mm constitute an electric dipole. If the dipole is placed in an uniform electric field ' $\vec{E}$ ' of 10 dyne/C making 30° angle with $\vec{E}$, the magnitude of torque acting on dipole is:

- (A) 1.0×10^{-8} Nm
 (B) 2.0×10^{-10} Nm
 (C) 4.0×10^{-10} Nm
 (D) 1.5×10^{-9} Nm

20. Different combination of 3 resistors of equal resistance R are shown in the figures. The increasing order for power dissipation is:

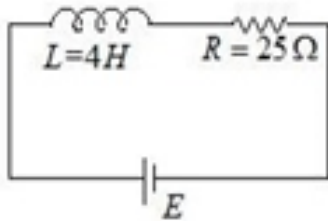


- (A) $P_A < P_B < P_C < P_D$
 (B) $P_C < P_B < P_A < P_D$
 (C) $P_C < P_D < P_A < P_B$
 (D) $P_B < P_C < P_D < P_A$

21. The radius of 2nd orbit of He^+ of Bohr's model is r_1 and that of fourth orbit of Be^{3+} is represented as r_2 . Now the ratio $\frac{r_2}{r_1}$ is $x : 1$. The value of x is _____

22. A fish rising vertically upward with a uniform velocity of 8 ms^{-1} , observes that a bird is diving vertically downward towards the fish with the velocity of 12 ms^{-1} . If the refractive index of water is $\frac{4}{3}$, then the actual velocity of the diving bird to pick the fish, will be _____ ms^{-1} .

23. In the given figure, an inductor and a resistor are connected in series with a battery of emf E volt. $\frac{E^a}{2b} \text{ J/s}$ represents the maximum rate at which the energy is stored in the magnetic field (inductor). The numerical value of $\frac{b}{a}$ will be _____



24. A thin infinite sheet charge and an infinite line charge of respective charge densities $+\sigma$ and $+\lambda$ are placed parallel at 5 m distance from each other. Points 'P' and 'Q' are at $\frac{3}{\pi} \text{ m}$ and $\frac{4}{\pi} \text{ m}$ perpendicular distances from line charge towards sheet charge, respectively. ' E_P ' and ' E_Q ' are the magnitudes of resultant electric field intensities at point 'P' and 'Q', respectively. If $\frac{E_P}{E_Q} = \frac{4}{a}$ for $2|\sigma| = |\lambda|$, then the value of a is _____

25. The elastic potential energy stored in a steel wire of length 20 m stretched through 2 cm is 80 J. The cross sectional area of the wire is _____ mm^2 .
(Given, $y = 2.0 \times 10^{11} \text{ Nm}^{-2}$)

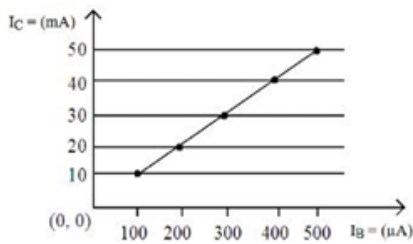
26. A solid sphere is rolling on a horizontal plane without slipping. If the ratio of angular momentum about axis of rotation of the sphere to the total energy of moving sphere is $\pi : 22$ then, the value of its angular speed will be _____ rad/s .

27. At a given point of time the value of displacement of a simple harmonic oscillator is given as $y = A \cos(30^\circ)$. If amplitude is 40 cm and kinetic energy at

that time is 200 J, the value of force constant is $1.0 \times 10^x \text{ Nm}^{-1}$. The value of x is _____

28. When a resistance of 5Ω is shunted with a moving coil galvanometer, it shows a full scale deflection for a current of 250 mA, however when 1050Ω resistance is connected with it in series, it gives full scale deflection for 25 volt. The resistance of galvanometer is _____ Ω .

29. From the given transfer characteristic of a transistor in CE configuration, the value of power gain of this configuration is 10^x , for $R_B = 10 \text{ k}\Omega$, and $R_C = 1 \text{ k}\Omega$. The value of x is _____



30. A potential V_0 is applied across a uniform wire of resistance R . The power dissipation is P_1 . The wire is then cut into two equal halves and a potential of V_0 is applied across the length of each half. The total power dissipation across two wires is P_2 . The ratio $P_2 : P_1$ is $\sqrt{x} : 1$. The value of x is _____
