

JEE Main 2023 Physics Question Paper Jan 31 Shift 1

Time Allowed :3 Hour	Maximum Marks :120	Total Questions :30
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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 30 questions. The maximum marks are 120.
3. The question paper consists of topics from Physics, having 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. 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

1. If 1000 droplets of water of surface tension 0.07N/m , having same radius 1mm each, combine to form a single drop. In the process the released surface energy is - (Take $\pi = \frac{22}{7}$)

- (A) $8.8 \times 10^{-5}\text{J}$
(B) $7.92 \times 10^{-6}\text{J}$
(C) $7.92 \times 10^{-4}\text{J}$
(D) $9.68 \times 10^4\text{J}$

2. The initial speed of a projectile fired from ground is u . At the highest point during its motion, the speed of projectile is $\frac{\sqrt{3}}{2}u$. The time of flight of the projectile is:

- (A) $\frac{2u}{g}$
(B) $\frac{u}{g}$
(C) $\frac{\sqrt{3}u}{g}$
(D) $\frac{u}{2g}$
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3. The amplitude of $15 \sin(1000\pi t)$ is modulated by $10 \sin(4\pi t)$ signal. The amplitude modulated signal contains frequency (ies) of

- A. 500 Hz
- B. 2 Hz
- C. 250 Hz
- D. 498 Hz
- E. 502 Hz

Choose the correct answer from the options given below:

- (A) A and B Only
- (B) B Only
- (C) A Only
- (D) A, D and E Only

4. A bar magnet with a magnetic moment 5.0 Am^2 is placed in parallel position relative to a magnetic field of 0.4 T. The amount of required work done in turning the magnet from parallel to antiparallel position relative to the direction is

- (A) 4 J
- (B) 2 J
- (C) 1 J
- (D) zero

5. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R

Assertion A: The beam of electrons show wave nature and exhibit interference and diffraction.

Reason R: Davisson Germer Experimentally verified the wave nature of electrons. In the light of the above statements, choose the most appropriate answer from the options given below:

- (A) Both A and R are correct but R is Not the correct explanation of A
- (B) Both A and R are correct and R is the correct explanation of A
- (C) A is correct but R is not correct
- (D) A is not correct but R is correct

6. At a certain depth "d" below surface of earth, value of acceleration due to gravity becomes four times that of its value at a height $3R$ above earth surface. Where R is Radius of earth (Take $R = 6400\text{km}$). The depth d is equal to

- (A) 640 km
- (B) 4800 km
- (C) 2560 km
- (D) 5260 km

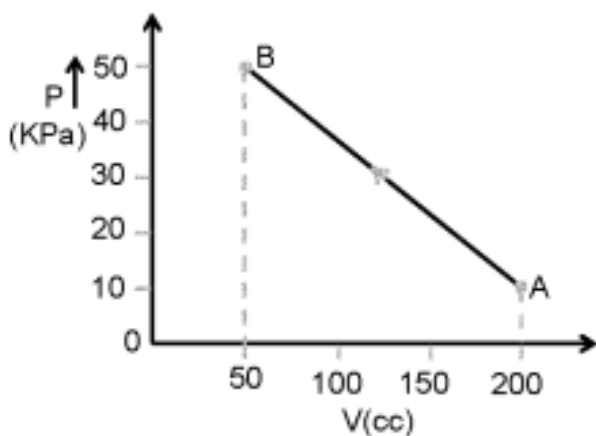
7. Spherical insulating ball and a spherical metallic ball of same size and mass are dropped from the same height. Choose the correct statement out of the following Assume negligible air friction

- (A) Time taken by them to reach the earth's surface will be independent of the properties of their materials
- (B) Metal ball will reach the earth's surface earlier than the insulating ball
- (C) Both will reach the earth's surface simultaneously
- (D) Insulating ball will reach the earth's surface earlier than the metal ball

8. If R , X_L , and X_C represent resistance, inductive reactance and capacitive reactance. Then which of the following is dimensionless :

- (A) $\frac{R}{\sqrt{X_L X_C}}$
- (B) $R \frac{X_L}{X_C}$
- (C) $R X_L X_C$
- (D) $\frac{R}{X_L X_C}$

9. The pressure of a gas changes linearly with volume from A to B as shown in figure. If no heat is supplied to or extracted from the gas then change in the internal energy of the gas will be



- (A) 6 J
- (B) -4.5 J
- (C) zero
- (D) 4.5 J

10. The correct relation between $\gamma = \frac{C_v}{C_p}$ and temperature T is :

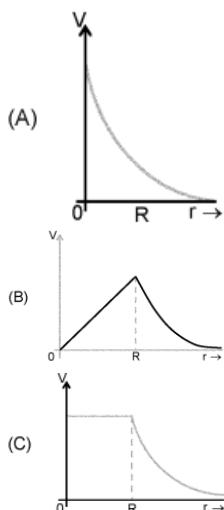
Wait, there's a typo in the question. It should be $\gamma = \frac{C_p}{C_v}$. Let's assume that. The correct relation between $\gamma = \frac{C_p}{C_v}$ and temperature T is :

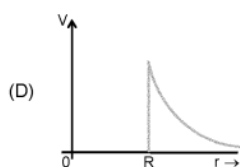
- (A) $\gamma \propto \frac{1}{\sqrt{T}}$
- (B) $\gamma \propto T$
- (C) $\gamma \propto \frac{1}{T}$
- (D) $\gamma \propto T^0$

11. If a source of electromagnetic radiation having power 15kW produces 10^{16} photons per second, the radiation belongs to a part of spectrum is. (Take Planck constant $h = 6 \times 10^{-34}$ Js)

- (A) Radio waves
- (B) Micro waves
- (C) Gamma rays
- (D) Ultraviolet rays

12. Which of the following correctly represents the variation of electric potential (V) of a charged spherical conductor of radius (R) with radial distance (r) from the centre ?





13. The effect of increase in temperature on the number of electrons in conduction band (n_e) and resistance of a semiconductor will be as :

- (A) n_e decreases, resistance increases
- (B) Both n_e and resistance increase
- (C) Both n_e and resistance decrease
- (D) n_e increases, resistance decreases

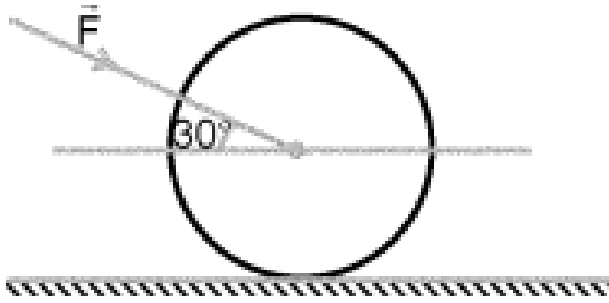
14. A free neutron decays into a proton but a free proton does not decay into neutron. This is because

- (A) neutron is an uncharged particle
- (B) proton is a charged particle
- (C) neutron is a composite particle made of a proton and an electron
- (D) neutron has larger rest mass than proton

15. Two polaroids A and B are placed in such a way that the pass-axis of polaroids are perpendicular to each other. Now, another polaroid C is placed between A and B bisecting angle between them. If intensity of unpolarized light is I_0 then intensity of transmitted light after passing through polaroid B will be :

- (A) $\frac{I_0}{4}$
- (B) $\frac{I_0}{2}$
- (C) zero
- (D) $\frac{I_0}{8}$

16. As shown in figure, a 70kg garden roller is pushed with a force of $F = 200\text{N}$ at and angle of 30° with horizontal. The normal reaction on the roller is (Given $g = 10 \text{ ms}^{-2}$)



- (A) $200\sqrt{3}\text{N}$
- (B) $800\sqrt{2}\text{N}$
- (C) 800 N
- (D) 8000 N

17. A rod with circular cross-section area 2cm^2 and length 40cm is wound uniformly with 400 turns of an insulated wire. If a current of 0.4 A flows in the wire windings, the total magnetic flux produced inside windings is $4 \times 10^{-6}\text{ Wb}$. The relative permeability of the rod is (Given: Permeability of vacuum $\mu_0 = 4\pi \times 10^{-7}\text{ NA}^{-2}$)

- (A) 12.5
- (B) $\frac{32}{5}$
- (C) $\frac{5}{16}$
- (D) 125

18. The drift velocity of electrons for a conductor connected in an electrical circuit is V_d . The conductor is now replaced by another conductor with same material and same length but double the area of cross section. The applied voltage remains same. The new drift velocity of the electrons will be

- (A) $2V_d$
- (B) $V_d/2$
- (C) V_d
- (D) $V_d/4$

19. 100 balls each of mass m moving with speed v simultaneously strike a wall normally and reflected back with same speed. In time t s. The total force exerted by the balls on the wall is

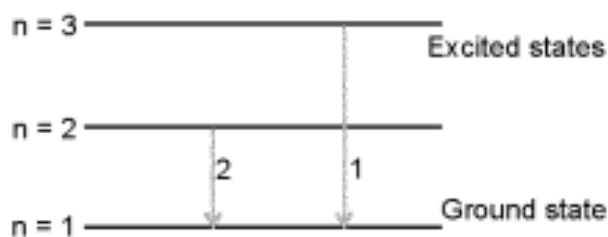
- (A) $\frac{mv}{100t}$
 - (B) $\frac{100mv}{t}$
 - (C) $200mvt$
 - (D) $\frac{200mv}{t}$
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20. The maximum potential energy of a block executing simple harmonic motion is 25J. A is amplitude of oscillation. At $A/2$, the kinetic energy of the block is

- (A) 18.75 J
 - (B) 9.75 J
 - (C) 12.5 J
 - (D) 37.5 J
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Physics Section - B

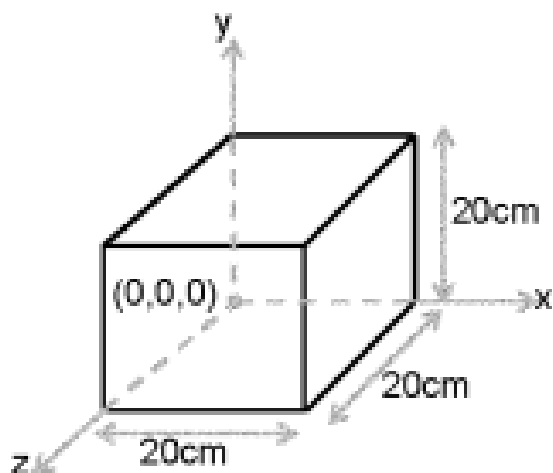
21. For hydrogen atom, λ_1 and λ_2 are the wavelengths corresponding to the transitions 1 and 2 respectively as shown in figure. The ratio of λ_1 and λ_2 is $\frac{x}{32}$. The value of x is



22. A lift of mass $M = 500$ kg is descending with speed of 2 ms^{-1} . Its supporting cable begins to slip thus allowing it to fall with a constant acceleration of 2ms^{-2} . The kinetic energy of the lift at the end of fall through to a distance of 6m will be kJ.

23. A solid sphere of mass 1 kg rolls without slipping on a plane surface. Its kinetic energy is $7 \times 10^{-3} \text{ J}$. The speed of the centre of mass of the sphere is _____ cm s^{-1} .

24. Expression from an electric field is given by $\vec{E} = 4000x^2 \hat{i} \frac{\text{V}}{\text{m}}$. The electric flux through the cube of side 20cm when placed in electric field (as shown in the figure) is V cm.



25. An inductor of 0.5 mH , a capacitor of $20 \mu\text{F}$ and resistance of 20Ω are connected in series with a 220 V ac source. If the current is in phase with the emf, the amplitude of current of the circuit is $\sqrt{x} \text{ A}$. The value of x is –

26. In a medium the speed of light wave decreases to 0.2 times to its speed in free space. The ratio of relative permittivity to the refractive index of the medium is $x : 1$. The value of x is _____. (Given speed of light in free space $= 3 \times 10^8 \text{ ms}^{-1}$ and for the given medium $\mu_r = 1$)

27. A thin rod having a length of 1 m and area of cross-section $3 \times 10^{-6} \text{ m}^2$ is suspended vertically from one end. The rod is cooled from 210°C to 160°C . After cooling, a mass M is attached at the lower end of the rod such that the length of rod again becomes 1 m . Young's modulus and coefficient of linear expansion of the rod are $2 \times 10^{11} \text{ N m}^{-2}$ and $2 \times 10^{-5} \text{ K}^{-1}$, respectively. The value of M is _____. (Take $g = 10 \text{ ms}^{-2}$)

28. Two identical cells, when connected either in parallel or in series gives same current in an external resistance 5Ω . The internal resistance of each cell will be _____ Ω .

29. The speed of a swimmer is 4 km h^{-1} in still water. If the swimmer makes his strokes normal to the flow of river of width 1 km , he reaches a point 750 m down the stream on the opposite bank. The speed of the river water is _____ km h^{-1} .

30. In the figure given below, a block of mass $M = 490\text{ g}$ placed on a frictionless table is connected with two springs having same spring constant ($K = 2\text{ N m}^{-1}$). If the block is horizontally displaced through 'X' m then the number of complete oscillations it will make in 14π seconds will be _____

