JEE Main 2023 25 Jan Shift 2 Physics Question Paper

Time Allowed :60 minutes	Maximum Marks :100	Total questions :30

SECTION-A

1. Match List I with List II:

List I	List II
A. Young's Modulus (Y)	I. $[ML^{-1}T^{-1}]$
B. Co-efficient of Viscosity (η)	II. $[ML^2T^{-1}]$
C. Planck's Constant (h)	III. $[ML^{-1}T^{-2}]$
D. Work Function (Φ)	IV. $[ML^2T^{-2}]$

Choose the correct answer from the options given below:

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

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

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

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

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2. According to the law of equipartition of energy, the molar specific heat of a diatomic gas at constant volume where the molecule has one additional vibrational mode is:

(1) $\frac{9}{2}R$

(2) $\frac{5}{2}R$

(3) $\frac{3}{2}R$

(4) $\frac{7}{2}R$

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3. The light rays from an object have been reflected towards an observer from a standard flat mirror. The image observed by the observer is:

A. Real

B. Erect

C. Smaller in size than the object

D. Laterally inverted

Choose the most appropriate answer from the options given below:

(1) B and D only

(2) B and C only

(3) A and D only

(4) A, C, and D only

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4. For a moving coil galvanometer, the deflection in the coil is 0.05 rad when a current of 10 mA is passed through it. If the torsional constant of the suspension wire is 4.0×10^{-5} Nm/rad, the magnetic field is 0.01 T, and the number of turns in the coil is 200, the area of each turn (in cm^2) is:

(1) 2.0

(2) 1.0

(3) 1.5

(4) 0.5

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5. The graph between two temperature scales P and Q is shown in the figure. Between the upper fixed point and lower fixed point, there are 150 equal divisions of scale P and 100 divisions on scale Q. The relationship for conversion between the two scales is given by:
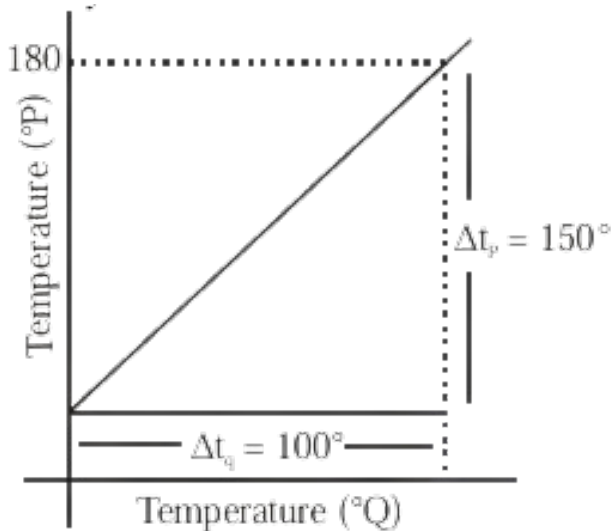
(1) $t_q/150 = \frac{t_p-180}{100}$

(2) $t_q/100 = \frac{t_p-30}{150}$

(3) $t_p/180 = \frac{t_Q-40}{100}$

(4) $t_p/100 = \frac{t_Q-180}{150}$

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6. Match List I with List II:

A.	Gauss's Law in Electrostatics	I.	$\oint \vec{E}.d\vec{l} = -\dfrac{d\phi_B}{dt}$
B.	Faraday's Law	II.	$\oint \vec{B}.d\vec{A} = 0$
C.	Gauss's Law in Magnetism	III.	$\oint \vec{B}.d\vec{l} = \mu_0 i_C + \mu_0 \in_0 \dfrac{d\phi_E}{dt}$
D.	Ampere-Maxwell Law	IV.	$\oint \vec{E}.d\vec{s} = \dfrac{q}{\in_0}$

Choose the correct answer from the options given below:

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

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

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

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

7. Statement I: When a Si sample is doped with Boron, it becomes P type and when doped by Arsenic it becomes N-type semi conductor such that P-type has excess holes and N-type has excess electrons.

Statement II: When such P-type and N-type semi-conductors, are fused to make a junction, a current will automatically flow which can be detected with an externally connected ammeter.

In the light of above statements, choose the most appropriate answer from the options given below.

(1) Both Statement I and statement II are incorrect

(2) Statement I is incorrect but statement II is correct.

(3) Both Statement I and statement II are correct

(4) Statement I is correct but statement II is incorrect

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8. Consider a block kept on an inclined plane (inclined at 45°) as shown in the figure.

If the force required to just push it up the incline is 2 times the force required to just prevent it from sliding down, the coefficient of friction between the block and inclined plane (μ) is equal to
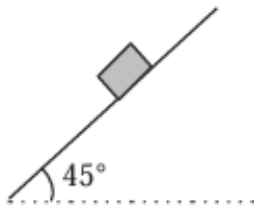
(1) 0.33

(2) 0.60

(3) 0.25

(4) 0.50

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9. A point charge of 10 μC is placed at the origin. At what location on the X-axis should a point charge of 40μC be placed so that the net electric field is zero at x = 2 cm on the X-axis ?

(1) $x = 6\,\text{cm}$

(2) $x = 4\,\text{cm}$

(3) $x = 8\,\text{cm}$

(4) $x = -4\,\text{cm}$

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10. The energy levels of an atom is shown in figure. Which one of these transitions will result in the emission of a photon of wavelength 124.1 nm?

Given (h = 6.626×10^{-34}) JS
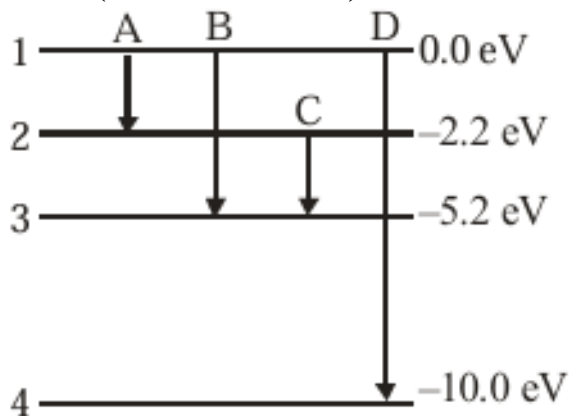
(1) B

(2) A

(3) C

(4) D

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11. A particle executes simple harmonic motion between $x = -A$ and $x = A$. If the time taken by the particle to go from $x = 0$ to $x = A$ is 2 s, then the time taken by particle in going from $x = -A$ to $x = A/2$ is:

(1) 3 s

(2) 2 s

(3) 1.5 s

(4) 4 s

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12. Match List I with List II:

List I	List II
A. Isothermal Process	I. Work done by the gas decreases internal energy
B. Adiabatic Process	II. No change in internal energy
C. Isochoric Process	III. The heat absorbed goes partly to increase internal energy and partly to do work
D. Isobaric Process	IV. No work is done on or by the gas

Choose the correct answer from the options given below :

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

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

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

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

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13. Match List I with List II:

List I	List II
A. Troposphere	I. Approximate 65-75 km over Earth's surface
B. E-Part of Stratosphere	II. Approximate 300 km over Earth's surface
C. F_2-Part of Thermosphere	III. Approximate 10 km over Earth's surface
D. D-Part of Stratosphere	IV. Approximate 100 km over Earth's surface

Choose the correct answer from the options given below :

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

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

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

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

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14. A body of mass m is taken from earth surface to the height equal to twice the radius of earth (R_e), the increase in potential energy will be:

(g = acceleration due to gravity on the surface of Earth)

(1) $3mgR_e$

(2) $\frac{1}{3}mgR_e$

(3) $\frac{2}{3}mgR_e$

(4) $\frac{1}{2}mgR_e$

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15. A wire of length 1 m moving with velocity 8 m/s at right angles to a magnetic field of 2 T. The magnitude of induced emf between the ends of wire will be:

(1) 20 V

(2) 8 V

(3) 12 V

(4) 16 V

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16. The distance travelled by a particle is related to time t as $x = 4t^2$. The velocity of the particle at $t = 5$ s is:

(1) 40 m/s

(2) 25 m/s

(3) 20 m/s

(4) 8 m/s

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17. Two objects are projected with the same velocity u but at different angles α and β with the horizontal. If $\alpha + \beta = 90°$, the ratio of horizontal range of the first object to the 2nd object will be:

(1) $4 : 1$

(2) $2 : 1$

(3) $1 : 2$

(4) $1 : 1$

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18. The resistance of a wire is 5 Ω. If it's stretched to 5 times of its original length, its new resistance will be:

(1) $625\,\Omega$

(2) $5\,\Omega$

(3) $125\,\Omega$

(4) $25\,\Omega$

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19. Given below are two statements:

Statement I: Stopping potential in photoelectric effect does not depend on the power of the light source.

Statement II: For a given metal, the maximum kinetic energy of the photoelectron depends on the wavelength of the incident light.

In the light of above statements, choose the most appropriate answer from the options given below.

(1) Statement I is incorrect but statement II is correct

(2) Both Statement I and Statement II are incorrect

(3) Statement I is correct but statement II is incorrect

(4) Both statement I and statement II are correct

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20. Every planet revolves around the sun in an elliptical orbit:

Statements:

A. The force acting on a planet is inversely proportional to the square of the distance from the sun.

B. The force acting on a planet is inversely proportional to the product of the masses of the planet and the sun.

C. The centripetal force acting on the planet is directed away from the sun.

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D. The square of the time period of the revolution of a planet around the sun is directly proportional to the cube of the semi-major axis of the elliptical orbit.

Options:

(1) A and D only

(2) C and D only

(3) B and C only

(4) A and C only

Section B

21. A capacitor has a capacitance of 5 μF when its parallel plates are separated by an air medium of thickness d. A slab of material with a dielectric constant of 1.5, having an area equal to that of the plates but with thickness $d/2$, is inserted between the plates. The capacitance of the capacitor in the presence of the slab will be ___ μF :

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22. A train blowing a whistle of frequency 320 Hz approaches an observer standing on the platform at a speed of 66 m/s. The frequency observed by the observer will be (given speed of sound = 330 m/s):

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23. An object is placed on the principal axis of a convex lens of focal length 10 cm as shown. A plane mirror is placed on the other side of the lens at a distance of 20 cm. The image produced by the plane mirror is 5 cm inside the mirror. The distance of the object from the lens is:
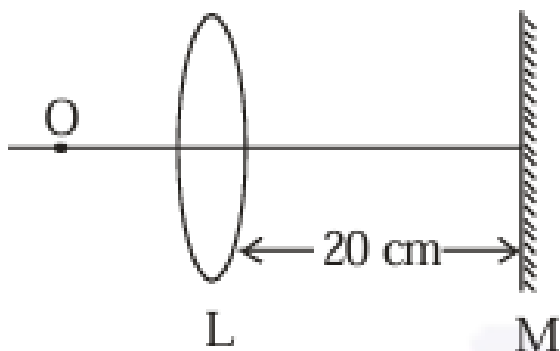
24. Two long parallel wires carrying currents 8A and 15A in opposite directions are placed at a distance of 7 cm from each other. A point P is at equidistant from both the

wires such that the lines joining the point P to the wires are perpendicular to each other. The magnitude of magnetic field at P is ___ $\times 10^{-6}\,T$.

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25. A spherical drop of liquid splits into 1000 identical spherical drops. If u_i is the surface energy of the original drop and u_f is the total surface energy of the resulting drops, the ratio $\frac{u_f}{u_i} = \frac{10}{x}$. Then value of x is ___:

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26. A body of mass 1 kg collides head-on with a stationary body of mass 3 kg. After the collision, the smaller body reverses its direction of motion and moves with a speed of 2 m/s. The initial speed of the smaller body before collision is:

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27. A nucleus disintegrates into two smaller parts, which have their velocities in the ratio 3:2. The ratio of their nuclear sizes will be $\left(\frac{x}{3}\right)^{\frac{1}{3}}$. The value of x is:

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28. Two cells are connected between points A and B as shown. Cell 1 has an emf of 12 V and internal resistance of 3Ω. Cell 2 has an emf of 6 V and internal resistance of 6Ω. An external resistor of 4Ω is connected across A and B. The current flowing through R will be ___ A.

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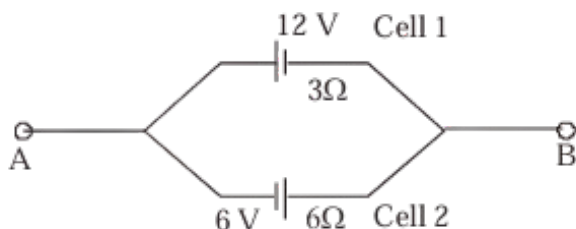
29. A series LCR circuit is connected to an AC source of 220 V, 50 Hz. The circuit contains a resistance $R = 80\,\Omega$, an inductor of inductive reactance $X_L = 70\,\Omega$, and a capacitor of capacitive reactance $X_C = 130\,\Omega$. The power factor of the circuit is $\frac{x}{10}$. The value of x is:

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30. If a solid sphere of mass 5 kg and a disc of mass 4 kg have the same radius. Then the ratio of the moment of inertia of the disc about a tangent in its plane to the moment of inertia of the sphere about its tangent will be $\frac{x}{7}$. The value of x is: