CROWN PMT ACADEMY

kad road shipra suncity

MOCK

JEE main - Physics

Time Allowed: 1 hour **Maximum Marks: 100**

General Instructions:

- All questions are compulsory.
- There are 25 questions where the first 20 questions are MCQs and the next 5 are numerical.
- You will get 4 marks for each correct response and 1 mark will be deducted for an incorrect answer.

PHYSICS (Section-A)

Attempt any 20 questions

1. A magnet of total magnetic moment $10^{-2}\hat{i}$ A-m^2 is placed in a time varying magnetic field, B$\hat{i}$(cosωt), where B = 1T and ω = 0.125 rad/s. The work done for reversing the direction of the magnetic moment at t = 1s is **[4]**

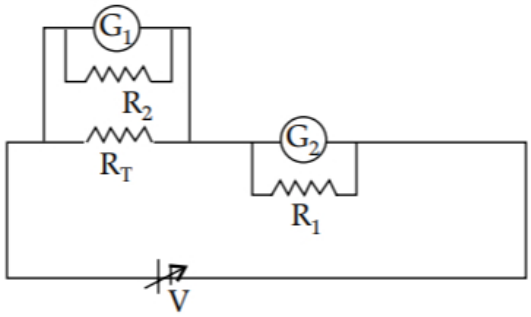
   a) 0.028 J
   b) 0.014 J
   c) 0.01 J
   d) 0.007 J

2. **Statement I**: If the number of turns in the coil of a moving coil galvanometer is doubled then the current sensitivity becomes double. **[4]**
   Statement II: Increasing current sensitivity of a moving coil galvanometer by only increasing the number of tums in the coil will also increase its voltage sensitivity in the same ratio:
   In the light of the above statement, choose the correct answer from the options given below

   a) Statement I is true but Statement II is false
   b) Both Statement I and Statement II are false
   c) Statement I is false but Statement II is true
   d) Both Statement I and Statement II are true

3. A student is provided with a variable voltage source V, a test resistor $R_T = 10\Omega$, two identical galvanometers G_1 and G_2 and two additional resistors, $R_1 = 10M\Omega$ and $R_2 = 0.001\Omega$. For conducting an experiment to verify ohm's law, the most suitable circuit is: **[4]**

a)



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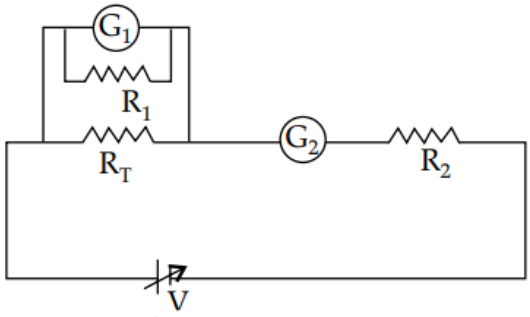

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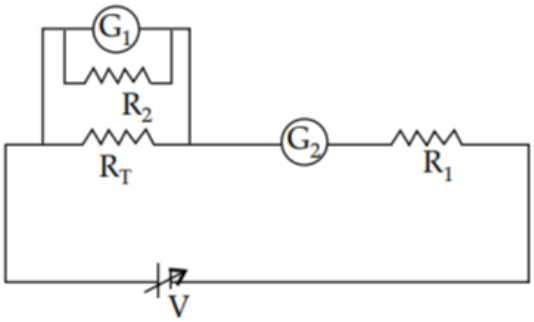

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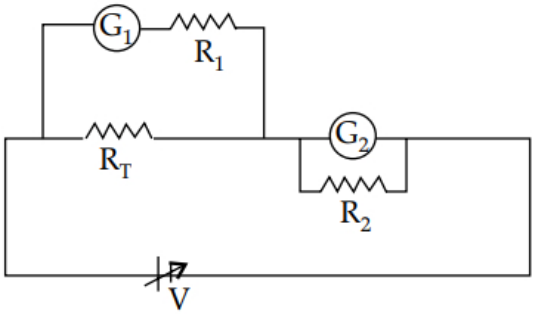


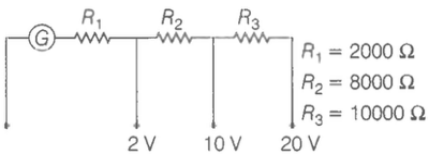
4. A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, then new value of the magnetic field is: **[4]**

a) 4B b) B

c) 2B d) $\frac{B}{2}$

5. A galvanometer of resistance 100Ω has 50 divisions on its scale and has sensitivity of 20 μA/division. It is to be converted to a voltmeter with three ranges of 0-2 V, 0-10 V and 0-20 V. The appropriate circuit to do so is **[4]**

a)



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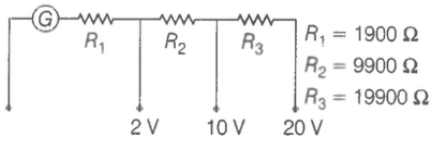
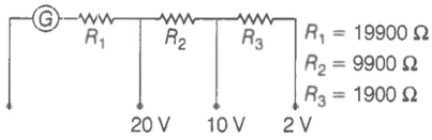
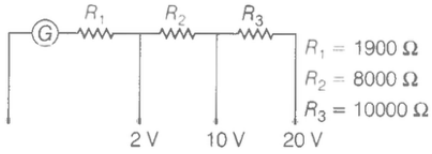


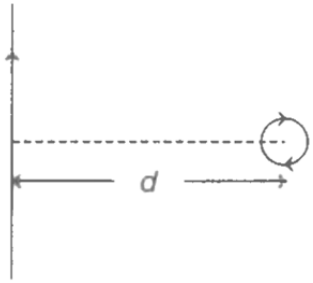
c)



d)



6. An infinitely long current-carrying wire and a small current-carrying loop are in the plane of the paper as shown. The radius of the loop is a and distance of its centre from the wire is d (d >> a). If the loop applies a force F on the wire, then **[4]**



a) $F \propto \left(\frac{a}{d}\right)$

b) $F \propto \left(\frac{a}{d}\right)^2$

c) F = 0

d) $F \propto \left(\frac{a^2}{d^3}\right)$

7. A charged particle going around in a circle can be considered to be a current loop. A particle of mass m carrying charge q is moving in a plane with speed v under the influence of a magnetic field $\vec{B}$. The magnetic moment of this moving particle: **[4]**

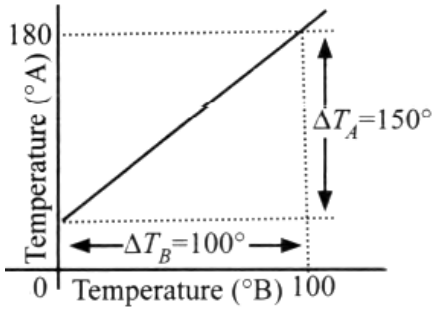
a) $\frac{mv^2 \cdot \vec{B}}{2B^2}$

b) $-\frac{mv^2\vec{B}}{2\pi B^2}$

c) $-\frac{mv^2\vec{B}}{B^2}$

d) $-\frac{mv^2\vec{B}}{2B^2}$

8. The graph between two temperature scales A and B is shown in figure. Between upper fixed point and lower fixed point there are 150 equal divisions on scale A and 100 on scale B. The relationship for conversion between the two scales is given by: **[4]**



a) $\frac{T_B-180}{100} = \frac{T_A}{150}$

b) $\frac{T_B-40}{100} = \frac{T_A}{150}$

c) $\frac{T_A-180}{100} = \frac{T_B}{150}$

d) $\frac{T_A-30}{150} = \frac{T_B}{100}$

9. A proton moving with a constant velocity passes through a region of space without any change in its velocity. If E and B represent electric and magnetic fields respectively, the region of space may not have: **[4]**

a) $E \neq 0, B = 0$

b) $E \neq 0, B \neq 0$

c) $E = 0, B \neq 0$

d) $E = 0, B = 0$

10. An electron is moving along +x direction with a velocity of 6×10^6 ms^{-1}. It enters a region of the uniform electric field of 300 V/cm pointing along +y direction. The magnitude and direction of the magnetic field set up in this region such that the electron keeps moving along the x-direction will be: **[4]**

a) 3×10^{-4} T, along -z direction

b) 3×10^{-4} T, along +z direction

c) 5×10^{-3} T, along -z direction

d) 5×10^{-3} T, along +z direction

11. The magnetic moments associated with two closely wound circular coils A and B of radius r_A = 10 cm and r_B = 20 cm respectively are equal if: (Where N_A, I_A and N_B, I_B are number ofturn and current of A and B respectively) **[4]**

a) $N_A = 2N_B$

b) $2N_AI_A = N_BI_B$

c) $4N_AI_A = N_BI_B$

d) $N_AI_A = 4N_BI_B$

12. A solid conducting sphere having a charge Q is surrounded by an uncharged concentric conducting hollow spherical shell. Let the potential difference between the surface of the solid sphere and that of the outer surface of the hollow shell be V. If the shell is now given a change of -3Q, the new potential difference between the same two surfaces is **[4]**

a) 4V b) -2V

c) V d) 2V

13. The current sensitivity of moving coil galvanometer is increased by 25%. This increase is achieved only by changing in the number of turns of coils and area of cross section of the wire while keeping the resistance of galvanometer coil constant. The percentage change in the voltage sensitivity will be: **[4]**

a) -50% b) +25%

c) Zero d) -25%

14. Two long parallel wires carrying currents 8 A and 15 A 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. (Given : $\sqrt{2}$ = 1.4) **[4]**

15. A conducting metal circular-wire-loop of radius r is placed perpendicular to a magnetic field which varies with time as B = $B_0 e^{\frac{-t}{\tau}}$, where B_0 and x are constants, at time t = 0. If the resistance of the loop is R then the heat generated in the loop after a long time ($t \to \infty$) is: **[4]**

a) $\frac{\pi^2 r^4 B_0^2}{2\tau R}$

b) $\frac{\pi^2 r^4 B_0^4}{2\tau R}$

c) $\frac{\pi^2 \mathbf{r}^4 \, B_0^2 R}{\tau}$

d) $\frac{\pi^2 r^4 B_0^2}{\tau R}$

16. The time period of a satellite of earth is 24 hours. If the separation between the earth and the satellite is decreased to one fourth of the previous value, then its new time period will become. **[4]**

a) 12 hours b) 3 hours

c) 6 hours d) 4 hours

17. Magnetic field in a plane electromagnetic wave is given by $\vec{B}$ = B_0c sin(kx + ωt) $\hat{j}$V/m **[4]**

Expression for corresponding electric field will be:

Where c is speed of light.

a) $\vec{E}$ = B_0c sin(kx + ωt)$\hat{k}$V/m

b) $\vec{E}$ = B_0c sin(kx - ωt)$\hat{k}$V/m

c) $\vec{E}$ = $\frac{B_0}{c}$c sin(kx + ωt)$\hat{k}$V/m

d) $\vec{E}$ = - B_0c sin(kx + ωt)$\hat{k}$V/m

18. Electron beam used in an electron microscope, when accelerated by a voltage of 20 kV. has a de-Broglie wavelength of λ_0. If the voltage is increased to 40 kV. then the de-Broglie wavelength associated with the electron beam would be: **[4]**

a) 3 λ_0

b) $\frac{\lambda_0}{2}$

c) 4 λ_0

d) $\frac{\lambda_0}{\sqrt{2}}$

19. In a hydrogen-like, an atom electron makes the transition from an energy level with quantum number n to another with a quantum number (n - 1). If n >> 1, the frequency of radiation emitted is proportional to **[4]**

a) $\frac{1}{n^2}$

b) $\frac{1}{n^3}$

c) $\frac{1}{n^4}$

d) $\frac{1}{n}$

20. Consider the nuclear fission **[4]**

$Ne^{20} \rightarrow 2He^4 + C^{12}$

Given that the binding energy/nucleon of Ne^{20}, He^4 and C^{12} are, respectively, 8.03 MeV, 7.07 MeV and 7.86 MeV, identify the correct statement:

a) energy of 11.9 MeV has to be supplied

b) energy of 12.4 MeV will be supplied

c) energy of 3.6 MeV will be released

d) 8.3 MeV energy will be released

PHYSICS (Section-B)

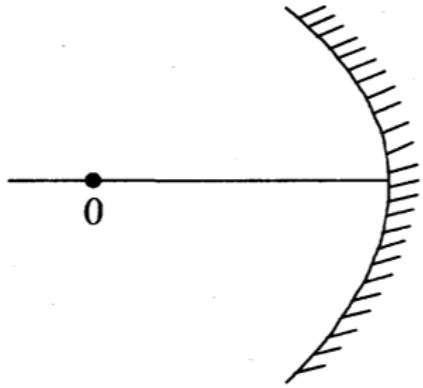
Attempt any 5 questions

21. The electric field in a region is given by $\vec{E}$ = $\frac{2}{5}E_0\hat{i}$ + $\frac{3}{5}E_0\hat{j}$ with E_0 = 4.0 $\times 10^3$ $\frac{N}{C}$. **[4]**

The flux of this field through a rectangular surface area 0.4 m^2 parallel to the Y - Z plane is _____ Nm^2 C^{-1}.

22. An inductor of 0.5 mH, a capacitor of 200 μF and a resistor of 2Ω are connected in series with a 220 V ac source. If the current is in phase with the emf, the frequency of ac source will be _____ $\times 10^2\ Hz$. **[4]**

23. An object **o** is placed at a distance of 100 cm in front of a concave mirror of radius of curvature 200 cm as shown in the figure. The object starts moving towards the mirror at a speed 2 cm/s. The position of the image from the mirror after 10s will be at _____ cm. **[4]**



24. Two travelling waves produces a standing wave represented by equation, y = 1.0 mm cos(1.57 cm^{-1}) × sin(78.5 s^{-1})t. The node closest to the origin in the region x > 0 will be at x = _____ cm. **[4]**

25. A square aluminium (shear modulus is 25 × 10^9 Nm^{-2}) slab of side 60 cm and thickness 15 cm is subjected to a shearing force (on its narrow face) of 18.0 × 10^4 N. The lower edge is riveted to the floor. The displacement of the upper edge is _____ μm. **[4]**