PHY

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)

1. If V denotes the potential difference across the plates of a capacitor C, the dimensions of CV^2 are: **[4]**

   a) Not expressible in [MLT]   b) $[ML^2T^{-2}]$

   c) $[MLT^{-2}]$ d) $[M^2LT^{-1}]$

2. A drunkard is walking along a straight road. He takes 5 steps forward and 3 steps backward and so on. Each step **[4]** is one meter long and takes one second. There is a pit on the road 11 meters away from the starting point. The drunkard will fall into the pit after:

   a) 37 seconds   b) 29 seconds

   c) 31 seconds   d) 21 seconds

3. A projectile is thrown into space so as to have the maximum possible horizontal range equal to 400 m. Taking **[4]** the point of projection as the origin, the coordinates of the point where the velocity of the projectile is minimum are:

   a) (400, 200)   b) (200, 100)

   c) (400, 100)   d) (200, 200)

4. A Diwali rocket is ejecting 50 g of gas/es at a velocity of 400 m/s. The acceleration force on the rocket will be: **[4]**

   a) 20 dyne   b) 22 dyne

   c) 220 dyne   d) 100 dyne

5. If the kinetic energy of a particle is increased by 300%, the momentum of the particle will increase by: **[4]**

   a) 300%   b) 50%

   c) 150%   d) 100%

6. Four identical thin rods each of mass M and length l, form a square frame. The moment of inertia of this frame **[4]** about an axis through the centre of the square and perpendicular to its plane is:

   a) $\frac{13}{3}Ml^2$ b) $\frac{2}{3}Ml^2$

   c) $\frac{4}{3}Ml^2$ d) $\frac{1}{3}Ml^2$

7. If a section of soap bubble (of radius R) through its centre is considered, the force on one half due to surface **[4]** tension is:

    a) 2T/R   b) $4\pi RT$

    c) $2\pi RT$ d) $\pi R^2 T$

8. 2 kg water at 60^oC is mixed with 1 kg of unknown liquid at 30^oC kept in a vessel of heat capacity 200 J/K. The **[4]** specific heat of water is 4200 J/kg K. If the final temperature is 50^oC, the specific heat capacity of unknown liquid?

    a) 1580 Jkg^{-1} K^{-1} b) 1480 Jkg^{-1} K^{-1}

    c) 1180 Jkg^{-1} K^{-1} d) 1480 Jkg^{-1} K^{-1}

9. An ideal gas is taken around the cycle ABCA as shown in the P-V diagram. The net work done by the gas during **[4]** the cycle is equal to:

    a) $12P_1V_1$ b) $3P_1V_1$

    c) $6P_1V_1$ d) $2P_1V_1$

10. The potential energy of a particle executing SHM is 2.5 J when its displacement is half its amplitude. The total **[4]** energy of the particle is:

    a) 12 J   b) 10 J

    c) 2.5 J   d) 20 J

11. Choose the correct relation regarding potential. Here A, B, C and D all are at equal distance from point O. Then: **[4]**

    a) $|V_C| = |V_DI > |V_A| = |V_B|$ b) $|V_A| = |V_B| > |V_C| = |V_D|$

    c) $|V_A| > |V_C| = |V_DI > |V_B|$ d) $|V_B| > |V_C| = |V_D| > |V_A|$

12. When 0.005 A current flows through a moving coil galvanometer it gives full scale deflection. It is converted **[4]** into a voltmeter to read 5 volt using an external resistance of 975 Ω. The resistance of the galvanometer, in ohms, is:

    a) 25   b) 5

c) 10   d) 15

13. The relation connecting magnetic susceptibility χ_m and relative permeability μ_r is: **[4]**

a) $\chi_m = \frac{1}{\mu_r}$ b) $\chi_m = \mu_r + 1$

c) $\chi_m = 3(1 + \mu_r)$ d) $\chi_m = \mu_r - 1$

14. A 50 Hz AC current of peak value 2 A flows through one of the pair of coils. If the mutual inductance between the pair of coils is 150 mH, then the peak value of voltage induced in the second coil is: **[4]**

a) $60\,\pi$V   b) $30\,\pi$V

c) $15\,\pi$V   d) $300\,\pi$V

15. The rms value of potential difference V shown in the adjoining figure is: **[4]**
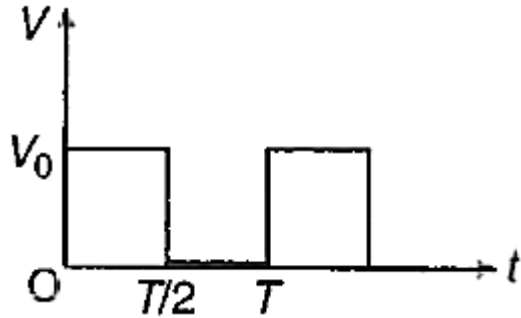
a) $\frac{V_0}{\sqrt{2}}$ b) $\frac{V_0}{2}$

c) $\frac{V_0}{\sqrt{3}}$ d) V_0

16. Instantaneous displacement current of 1.0 A in the space between the parallel plates of 1μF capacitor can be established by changing the potential difference of: **[4]**

a) 10^8 V/s   b) 10^{-6} V/s

c) 10^{-8} V/s   d) 10^6 V/s

17. Two electrons are moving with non-relativistic speeds perpendicular to each other. If corresponding de Broglie wavelengths are λ_1 and λ_2, their de Broglie wavelength in the frame of reference attached to their centre of mass is: **[4]**

a) $\frac{1}{\lambda_1} = \frac{1}{\lambda_1} + \frac{1}{\lambda_2}$ b) $\lambda_{CM} = \lambda_1 = \lambda_2$

c) $\lambda_{CM} = \frac{2\lambda_1\lambda_2}{\sqrt{\lambda_1^2 + \lambda_2^2}}$ d) $\lambda_{CM} = \left(\frac{\lambda_1 + \lambda_2}{2}\right)$

18. The relationship between kinetic energy (K) and potential energy (U) of electron moving in an orbit around the nucleus is: **[4]**

a) U = -2K   b) U = -3K

c) $U = -\frac{1}{2}K$ d) U = -K

19. The fusion of hydrogen into helium is more likely to take place: **[4]**

a) at high temperature and high pressure   b) at low temperature and low pressure

c) at low temperature and high pressure   d) at high temperature and low pressure

20. Gallium Arsenide phosphide LED emits light radiation of wavelength about: **[4]**
(Given: E_g of GaAsP LED = 1.9 eV)

a) $3533 \overset{o}{A}$

b) $4533 \overset{o}{A}$

c) $5533 \overset{o}{A}$

d) $6533 \overset{o}{A}$

PHYSICS (Section-B)

21. Two positive point charges of 12 and 5 microcoulombs, are placed 10 cm apart in air. The work needed to bring them 4 cm closer is: **[4]**

22. Two satellites S_1 and S_2 are revolving in circular orbits around a planet with radius $R_1 = 3200$ km and $R_2 = 800$ km respectively. The ratio of speed of satellite S_1 to the speed of satellite S_2 in their respective orbits would be $\frac{1}{x}$ where x = **[4]**

23. A pendulum is suspended by a string of length 250 cm. The mass of the bob of the pendulum is 200 g. The bob is pulled aside until the string is at 60° with vertical as shown in the figure. After releasing the bob the maximum velocity attained by the bob will be _____ ms^{-1}. (if g = 10 m/s^2) **[4]**

$l = 250$ cm, $60°$
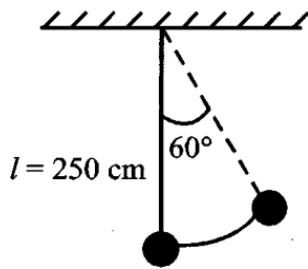
24. A charge particle of 2 μC accelerated by a potential difference of 100 V enters a region of uniform magnetic field of magnitude 4 mT at right angle to the direction of field. The charge particle completes semicircle of radius 3 cm inside magnetic field. The mass of the charge particle is_____ $\times$ 10^{-18} kg. **[4]**

25. If the temperature of the sun was to increase from T to 2T and its radius from R to 2R, then the ratio of the radiant energy received on the earth to what it was previously will be _____ P.m. **[4]**