PHYSICS

Data:
Acceleration due to gravity = $10m/s^2$, Mass of electron = $0.511MeV/c^2$
Charge of electron= 1.6×10^{-19} C, Velocity of light in vacuum, c= 3×10^{8} m/s
Boltzman constant, $k = 1.38 \times 10^{-23}$ J $K^{-1} = 8.67 \times 10^{-5}$ eV K^{-1}

1. An electric dipole is placed in a non-uniform electric field. It experiences
   a) a force but no torque
   b) no force, no torque
   c) a force and a torque
   d) no force but a torque

2. A battery of emf 10 V is connected across a 1 Ω resistor. The voltage across the 1Ω resistor is 5V. The internal resistance of the battery is
   a) 2 Ω b) 0.5 Ω c) 1 Ω d) 4 Ω

3. Which unit is appropriate for specifying magnetic induction?
   a) $N\,C^{-1}$ b) $N\,C^{-1}\,m^{-1}\,s$ c) $J\,C^{-1}\,m^{-1}\,s$ d) $A\,m^2$

4. Four masses of 1 kg each are placed at four corners of a square of side 2m placed symmetrically in xy plane. The square is set in rotation around z-axis with angular velocity ω = 2 rad s^{-1}. The angular momentum of this system in motion in SI units is
   a) 32 b) 16 c) 8 d) 64

5. At what distance from the point of equilibrium, the kinetic energy equals the potential energy for a simple harmonic oscillator of amplitude A?
   a) A/2 b) $A/\sqrt{2}$ c) A/4 d) $A/(2\sqrt{2})$

6. If the tension along a stretched string is doubled, the speed of sound along it will
   a) increase by a factor 2
   b) increase by a factor 4
   c) increase by a factor $\sqrt{2}$
   d) remain unchanged

7. The kinetic energy of an atom in helium gas held at temperature -200° C is of the order of
   a) 10eV b) 10^{-3} eV c) 10^{-6} eV d) 10^{-5} eV

8. The resistivity of copper is $0.01\Omega\ m^{-1}$. What is the resistance of a wire 50 cm long and having circular cross section area 0.1 mm^2
   a) 50 KΩ b) 5 K Ω c) 10 K Ω d) 15 K Ω

9. An alpha particle is accelerated by a potential difference of 4 volt. The energy acquired is
   a) 6.4 eV b) 4 eV c) 8 eV d) 3.2 eV

Rough work

10. A straight infinitely long thin wire along the z axis carries current 2 A. At a point (3,4,5) the magnitude of magnetic field intensity(**H**) in SI units is

a) $\frac{1}{5\pi}$ b) $\frac{2}{50\pi}$ c) $\frac{1}{25\pi}$ d) $\frac{1}{\sqrt{50\pi}}$

11. Twenty seven mercury drops of equal radii and having equal charges are combined to form a big drop. The ratio of the capacitance of the bigger drop to each individual drop is

a) 9:1 b)1:9 c) 3:1 d) 1:3

12. In its ground state, the Ar^+ ion has

a) 6 electrons in 1p state
b) 5 electrons in 3p state
c) 4 electrons in 3d state
d) one electron in 3s state

13. Positions of two masses m=1 and M=4 are given by the vectors $\mathbf{r_1}$= 3 **i** -4 **j** and $\mathbf{r_2}$= -7**i**- 4**j** .All numbers are in SI units. Distance of their center of mass from M is

a) 1 b) 2 c) 4 d) 5

14. A mass m is undergoing uniform circular motion in xy plane with constant speed 40 ms^{-1} around the origin. At t=0 its position coordinate is (6,8). What is the time period?

a) π s b)2π s c) $\pi/2$ s d) $20\pi/7$ s

15. At t=0, a projectile of mass 1 kg is projected with speed 10 ms^{-1} and making an angle 30° with the horizontal. The x-component of its velocity at t=1 s is

a) 8.66 ms^{-1} b) 5 ms^{-1} c) 10 ms^{-1} d) 7.07 ms^{-1}

16. The sides and mass of a solid cube of uniform density are measured each with accuracy ± 1%. The accuracy of its density D calculated using this data and using the formula $D=M/L^3$ is approximately

a) ± 1% b) ± 2% c) ± 3% d) ± 4%

17. Assume the earth to be a sphere of constant density and radius R. What is the acceleration due to gravity at a distance R/4 from the center of the earth?

a) 10 ms^{-2} b) 4 ms^{-2} c) 2.5 ms^{-2} d) 5 ms^{-2}

18. A unit charge is placed at point (0,3) in xy plane. The direction of electric field at the point (4,0) is along

a) unit vector **i**
b) unit vector(**i** - **j**)/$\sqrt{2}$
c) unit vector (4**i**-3**j**)/5
d) unit vector (-4**i** +3**j**)/5

19. A charge Q is set in a field of constant magnetic induction **B**= B **k** with a velocity **v** = 4 **i** + **k**. Its trajectory will trace a

a) straight line b) circle c) ellipse d) helix

Rough work

20. A proton and an alpha particle are accelerated by a constant electric field. Their accelerations will be in the ratio
a) 1:2 b) 1:1 c) 4:1 d) 2:1

21. A particle of rest mass m and momentum p is moving with a velocity very close to the velocity of light, c. Its total energy is approximately
a) mc^2 b) $p^2/2m$ c) p^2/m d) pc

22. Neutrino is a
a) chargeless, fermion of negligible mass
b) chargeless, massless, spinless boson
c) massless, chargeless fermion of spin 3/2
d) massless fermion of charge (1/3)e

23. In a circuit containing a capacitor and a resistance, as the frequency of the applied alternating current increases, the impedance
a) decreases b) increases
c) remains unchanged d) first increases and then decreases

24. Two electric bulbs having resistances in the ratio 2:1 are connected in parallel to a constant voltage source. The power dissipated in them has the ratio
a) 1:2 b) 1:4 c) 2:1 d) 4:1

25. Which of the following exhibits perfect diamagnetism?
a) insulator b) conductor
c) semiconductor d) superconductor

26. The critical angle for total internal reflection from a medium to air is 30^o. What is the velocity of light in the medium?
a) 3×10^8 ms^{-1} b) 1.5×10^8 ms^{-1}
c) 2×10^8 ms^{-1} d) 1.732×10^8 ms^{-1}

27. Two interfering waves have amplitudes in the ratio 5:1. The ratio of the maximum to the minimum intensity is
a) 25:1 b) 4:9 c) 6:4 d) 9:4

28. The optical path length across the thickness of a transparent slab is 10 cm. Its refractive index is 1.4. The thickness of the slab is
a)14 cm b) 10 cm c) 7.14 cm d) 19.6 cm

29. A telescope has an objective lens of diameter 10cm. What is its angular resolution (in radians) for a wavelength of 600nm?
a) 3.66×10^{-6} b) 7.32×10^{-6} c) 7.32×10^{-5} d) 7.32×10^{-7}

30. The ground state energy of hydrogen atom is -13.6 eV. What is the first excited state energy of He^+ ion?
a) -13.6 eV b) -6.8 eV c) -27.2 eV d) -19.2 eV

Rough work