1)

A comet with orbital period of 1,500 years is moving around the Earth. What is the length of the semi major axis of the comets orbit?

(a) 50 AU
(b) 100 AU
(c) 1500 AU
(d) None of the above

2)

If there are 10^{13} donors/cm^3 in a semiconductor, find the hall coefficient and the concentration of the conduction electrons at 4 K. The effective mass is $0.01m$ and ionization energy is 1 meV.

(a) -1.3×10^{-14} CGS units and 0.46×10^{13} electrons/cm^3
(b) 2.36 CGS units and 12 electrons
(c) 4.003×10^{6} CGS units 2.34 electrons/cm
(d) None of the above

3)

Calculate the concentration of the schottky vacancies at 300 K, if the energy required in removing a sodium atom from the inner layers of the crystal to the boundary is 1 eV.

(a) 5×10^{9} per cm^3
(b) 10^{5} cm^3
(c) 4×10^{-8} cm^3
(d) None of the above

4)

For the potential $V_0 = \dfrac{6\pi^2\hbar^2}{8ma^2}$ determine the number of bound states.

a) 6
b) 4
c) 3
d) 1

5.

Determine the expression for the scalar potential of a point charge? Consider the point charge moves with constant velocity. Let q be the charge of the point charge, R be the radius, **v** be the velocity, **r** be the position of the particle to the field point, and θ be the angle between **R** and **v.**

(a) $V(\mathbf{r},t)=\dfrac{1}{4\pi\epsilon_0}\dfrac{q}{R\sqrt{1-\dfrac{v^2}{c^2}\cos^2\theta}}$

(b) $V(\mathbf{r},t)=\dfrac{1}{4\pi\epsilon_0}\dfrac{q}{R\sqrt{1-\dfrac{v^2}{c^2}\sin^2\theta}}$

(c) $V(\mathbf{r},t)=\dfrac{1}{4\pi\epsilon_0}\dfrac{q}{R\sqrt{1+\dfrac{v^2}{c^2}\cos^2\theta}}$

(d) None of the above

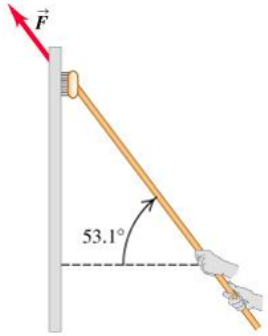
6)

The energy of protons produced by a proton synchrotron is $4\ \mathrm{GeV}$. Calculate the kinetic energy of charge 8 ^{+14}N ions accelerated by the accelerator.

(a) 3.88 GeV/c
(b) 31.1 GeV/c
(c) 17.1 GeV/c
(d) None of the above

7)

As shown in the following figure, a man pushes his brush on a vertical window at constant speed using a force vector F. The weight of the brush is 15.0 N and the coefficient of kinetic friction is 0.150. Calculate the magnitude of the force vector F.



(a) 21.1 N
(b) 16.4 N
(c) 15.6 N
(d) 32.2 N

8)

A particle of mass m is placed in the ground sate of one dimensional harmonic potential $V(x)=\frac{1}{2}kx^2$. The ground state wave function is $\psi=\sqrt{\frac{\alpha}{\sqrt{\pi}}}e^{-\frac{1}{2}\alpha^2x^2}$. Find the probability of the particle available in the ground state, if the value of α is doubled.

a) $\frac{1}{9}$
b) 1
c) $\frac{4}{5}$
d) None of these

9)

What is the value of the commutator $\left[\hat{a},\hat{H}\right]$.

(a) $\hbar\omega\hat{a}$
(b) $-\hbar\omega\hat{a}$
(c) 0
(d) None of these

10)

Consider the four energy levels $E, 2E, 3E$ and $4E$. Express the partition function of two particles for (a) identical particles (b) distinguishable.

a)
$$z_f = e^{-3\beta\varepsilon} + e^{-4\beta\varepsilon} + 2e^{-5\beta\varepsilon} + e^{-6\beta\varepsilon} + e^{-7\beta\varepsilon}$$
$$z_d = \left(e^{-\beta\varepsilon} + e^{-2\beta\varepsilon} + e^{-3\beta\varepsilon} + e^{-4\beta\varepsilon}\right)^2$$

b)
$$z_f = 1 + e^{-4\beta\varepsilon} + 2e^{-5\beta\varepsilon} + e^{-6\beta\varepsilon} + e^{-7\beta\varepsilon}$$
$$z_d = \left(e^{-\beta\varepsilon} + e^{-2\beta\varepsilon} + e^{-3\beta\varepsilon} + e^{-4\beta\varepsilon}\right)^3$$

c)
$$z_f = e^{-3\beta\varepsilon} + e^{-4\beta\varepsilon} + e^{-5\beta\varepsilon} + e^{-6\beta\varepsilon} + e^{-7\beta\varepsilon}$$
$$z_d = \left(e^{-\beta\varepsilon} + e^{-2\beta\varepsilon} + e^{-3\beta\varepsilon} + e^{-4\beta\varepsilon}\right)^2$$

d) None of the above