1)

What is the order of the magnitude of the period of motion in the k – space for the tetragonal metal? The faces are separated by the distance of $G = 2 \times 10^{8}$ cm^{-1} and the magnetic field is $B = 10^{3}$ gauss.

(a) 1.2×10^{-10} sec
(b) 2 sec
(c) 4.5 sec
(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)

A boat leaves an island and sails a distance 285 km at an angle 40.0 north of west. In which direction must it now head so that its resultant displacement will be 115 km directly east of the island (in terms of south of east)? Determine the value of distance if boat sails to the resultant displacement of 115 km directly east of island.

(a) 90.6°, 183 km
(b) 28.8°, 380 km
(c) 88.5°, 580 km
(d) 72.8°, 1980 km

4)

Solve the delta function $\int_{-2}^{2} 9x^2\delta(3x+2)$.

(a) 0

(b) 3

(c) $-\frac{1}{3}$

(d) None of the above

5)

The diameter of a super conducting wire is 2 mm and the critical magnetic field is 9.7×10^3 A/m . Calculate the critical current in the wire.

(a) 120 A

(b) 121.9 A

(c) 119 A

(d) None of the above

6)

Consider the spin state of system to be $\begin{pmatrix}1\\0\end{pmatrix}$. If subsequent measurement of $\vec{S}$ is made along $\hat{n}$. Find the values of measurement and the corresponding probabilities.

a) $\cos^2\left(\frac{\theta}{2}\right), \sin^2\left(\frac{\theta}{2}\right)$

b) $\cos^2\left(\frac{\theta}{2}\right), \cos^2\left(\frac{\theta}{2}\right)$

c) $\sec^2\left(\frac{\theta}{2}\right), \cos^2\left(\frac{\theta}{2}\right)$

d) None of the above

7)

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) $V(\mathbf{r},t)=\dfrac{1}{4\pi\in_0}\dfrac{q}{R\sqrt{1-\dfrac{v^2}{c^2}\cos^2\theta}}$

(b) $V(\mathbf{r},t)=\dfrac{1}{4\pi\in_0}\dfrac{q}{R\sqrt{1-\dfrac{v^2}{c^2}\sin^2\theta}}$

(c) $V(\mathbf{r},t)=\dfrac{1}{4\pi\in_0}\dfrac{q}{R\sqrt{1+\dfrac{v^2}{c^2}\cos^2\theta}}$

8)

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

9)

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

10)

A particle in one dimensional moves under the influence of potential $V(x) = \alpha x^6$. For large *n*, what is the relation between the quantized energy level E_n and *n*?

a) $E \propto n^3$
b) $E \propto n^2$
c) $E \propto n$
d) None of the options