Condensed Matter Physics

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Updated : November 1, 2023

Part B - Advanced

Quick Note: Condensed Matter Physics is not included in the Core Part A syllabus.

1. Lead is superconducting below 7 K and has a critical magnetic field 800×10^{-4} tesla close to 0 K. At 2 K the critical current that flows through a long lead wire of radius 5 mm is closest to
(February 15, 2022)

A. 1760 A

B. 1670 A

C. 1950 A

D. 1840 A

2. A lattice is defined by the unit vectors $\vec{a_1} = a\hat{i}$, $\vec{a_2} = -\frac{a}{2}\hat{i} + \frac{a\sqrt{3}}{2}\hat{j}$, and $\hat{a_3} = a\hat{k}$, where $a > 0$ is a constant. The spacing between the (100) planes of the lattice is
(November 19, 2020)

A. $\sqrt{3}a/2$

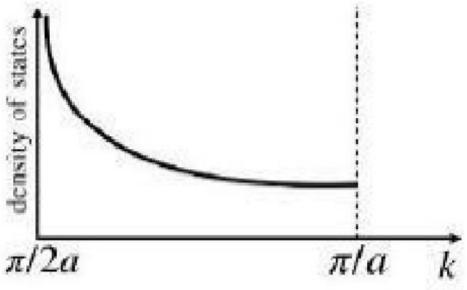
B. $a/2$

C. a

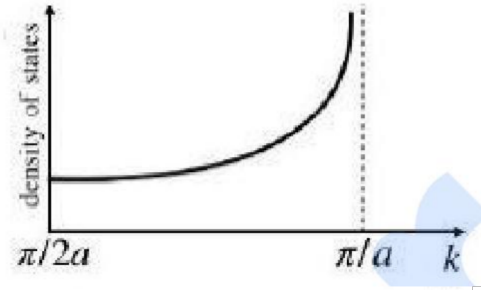
D. $\sqrt{2}a$

3. A tight binding model of electrons in one dimension has the dispersion relation $\varepsilon(k) = -2t(1 - \cos ka)$, where $t > 0$, a is the lattice constant and $\frac{-\pi}{a} < k < \frac{\pi}{a}$. Which of the following figures best represents the density of states over the range $\frac{\pi}{2a} \leq k < \frac{\pi}{a}$?
(November 19, 2020)

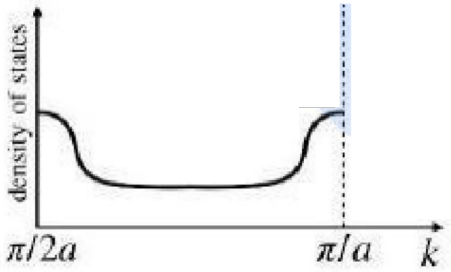
A.



B.



C.



D.