Name: ________________________________ **Section**

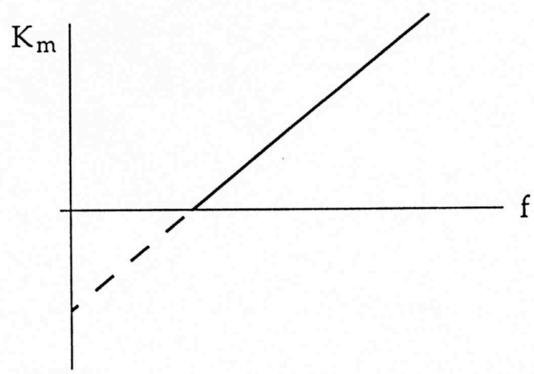
Problem 1: (50)

Question 1: c

Photons with an energy of 7.52 eV strike a material that has a work function of 4.22 eV. The maximum kinetic energy of the electron emitted from this material is

a. 7.5 eV
b. 12 eV
c. 3.3 eV
d. 0.98 eV
e. No electrons are ejected by these photons.

Question 2: e



The curve shows the maximum kinetic energy of photoelectrons ejected from a clean metal surface as a function of the frequency of the incident light. The slope of this curve represents

a. photoelectric current.
b. the de Broglie wavelength.
c. the work function.
d. the energy of the incident photon.
e. Planck's constant.

Question3:
e

The work function for tungsten is 4.58 eV. What is the kinetic energy of electrons emitted when light of wavelength 400 nm is incident on a tungsten surface? (Planck's constant $h = 6.626 \times 10^{-34}$ J · s = 4.136×10^{-15} eV · s.)

a. 0.74 eV
b. 1.5 eV
c. 7.7 eV
d. 2.9 eV
e. No electrons are emitted.

Question 4: b

An electron and a positron (an antielectron) each have an energy of 0.51 MeV. They destroy one another to produce two identical photons. The frequency of these photons is

a. 4.1×10^{11} Hz
b. 1.2×10^{20} Hz
c. 3.7×10^{20} Hz
d. 1.6×10^{9} Hz
e. 2.2×10^{20} Hz

Question 5: e

If the absolute temperature of a blackbody is doubled, the amount of energy radiated per second is multiplied by

a. $\sqrt{2}$
b. 2
c. 8
d. 4
e. 16

Question 6: e

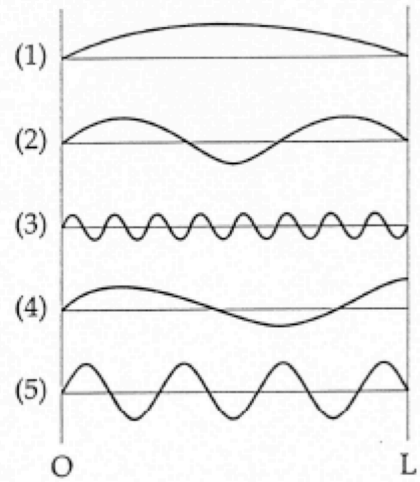
The peak in the radiation spectrum emitted by a blackbody at T = 1600 K is at $\lambda = 1.90$ μm. What is the wavelength at the peak if T = 3000 K?

a. 3.6 μm
b. 2.6 μm
c. 1.9 μm
d. 1.4 μm
e. 1.0 μm

Question 7: d

The figure shows the wave functions for several stationary states of a particle in a one-dimensional box with the wall considered to be infinitely hard. The wave function that could not be representative of a particle in this one-dimensional box is

a. 1
b. 2
c. 3
d. 4
e. 5



Question 8:

For the electron wave function shown in FIGURE Q40.3, at what position or positions is the electron most likely to be found? Least likely to be found? Explain.

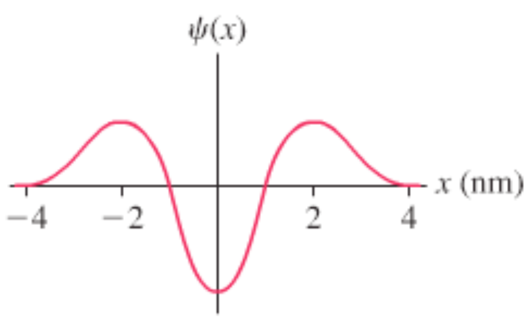


FIGURE Q40.3

The electron is most likely to be found at the point or points where $|\psi(x)|^2$ is a maximum. The graph given in the problem shows ψ(x). The figure here shows $|\psi(x)|^2$. Notice that $|\psi(x=0\text{ nm})|^2 > |\psi(x=\pm 2\text{ nm})|^2$, even though ψ (x = 0 nm) < 0 in the original graph. So, the electron is most likely to be found at x = 0 nm. The electron is least likely to be found where $|\psi(x)|^2$ is a minimum. From the figure, $|\psi(x)|^2 = 0$ at x = ±1 nm. Thus, the electron is *least* likely to be found at x = ±1 nm.

Question 9

What is the value of the constant a in **FIGURE Q40.5**?

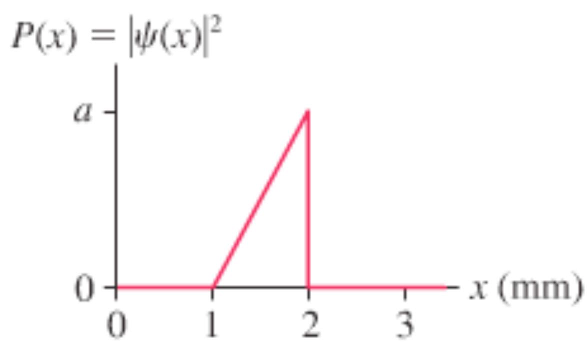


FIGURE Q40.5

40.5. The area under the probability density curve must be one. That is, $\int_{-\infty}^{\infty} P(x)\,dx = 1$. For that to be true for Figure Q40.4, a must be 2 mm^{-1}, because the area of a triangle is half the base times the height.

Question 10

FIGURE Q40.6 shows wave packets for particles 1, 2, and 3. Which particle can have its velocity known most precisely? Explain.

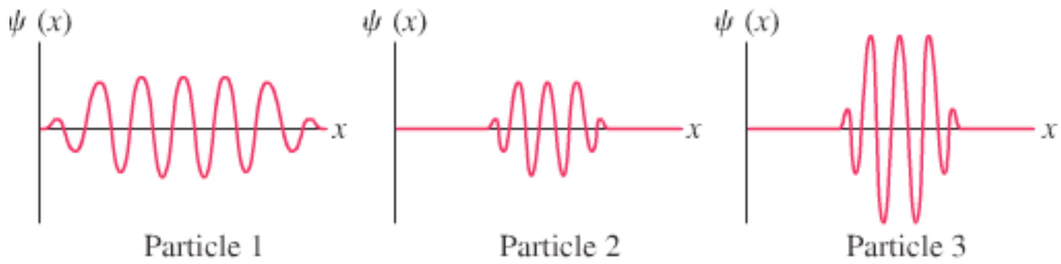


FIGURE Q40.6

Particle 1 because it has a less definite Δx and therefore a more definite $\Delta p = \Delta mv$.