

PHYS 102 – SECOND MAJOR EXAM – TERM 011

QUESTION NO: 1

An infinite non-conducting sheet has a surface charge density $0.10 \times 10^{-6} \text{ C/m}^2$ on one side. How far apart are equipotential surfaces whose potentials differ by 90 V?

- A. 1.8 cm.
- B. 1.6 cm.
- C. 2.0 cm.
- D. 0.88 cm.
- E. 2.5 cm.

QUESTION NO: 2

A point charge of $-50e$ lies at the center of a hollow spherical metal shell that has a net charge of $-100e$, as seen in figure(4).

Calculate the charge on the

(a) shell's inner surface, and (b) on its outer surface.

[e is the magnitude of the charge on the electron.]

- A. (a) Zero (b) $-150e$.
- B. (a) $-50e$ (b) $-100e$.
- C. (a) $50e$ (b) $-100e$.
- D. (a) $-50e$ (b) $150e$.
- E. (a) $50e$ (b) $-150e$.

QUESTION NO: 3

Consider a metallic sphere carrying a charge of $4.0 \times 10^{-8} \text{ C}$ and having a potential of 400 v. Find the diameter of the sphere.

- A. 6.0 m.
- B. 1.8 m.
- C. 3.6 m.
- D. 4.2 m.
- E. 1.2 m.

QUESTION NO: 4

An electric dipole consists of charges $+2e$ and $-2e$ separated by $0.78 \times 10^{-9} \text{ m}$. It is in an electric field of strength $3.0 \times 10^6 \text{ N/C}$. Calculate the magnitude of the torque on the dipole when the dipole is perpendicular to the field.

[e is the magnitude of the charge on the electron.]

- A. $6.5 \times 10^{-22} \text{ N.m}$.
- B. $3.5 \times 10^{-22} \text{ N.m}$.
- C. $8.5 \times 10^{-22} \text{ N.m}$.
- D. 0 N.m.
- E. $7.5 \times 10^{-22} \text{ N.m}$.

QUESTION NO: 5

At 20 degree C. a 100-W light bulb has a resistance of 12 ohms. To increase the resistance of the light bulb to 48 ohms, the temperature of the filament should be:

[Assume the temperature coefficient of resistivity of the filament is constant and $= 0.006 (\text{degree C})^{*(-1)}$].

- A. 520 degree C.
- B. 576 degree C.
- C. 654 degree C.
- D. 150 degree C.
- E. 500 degree C.

QUESTION NO: 6

An ideal monatomic gas is confined to a cylinder by a piston. The piston is slowly pushed in so that the gas temperature remains at 27 degree C. During the compression, 750 J of work is done on the gas. The change in the entropy of the gas is:

- A. -3.0 J/K.
- B. Zero.
- C. -2.5 J/K.
- D. 3.0 J/K.
- E. 2.5 J/K.

QUESTION NO: 7

A 2.5 micro F capacitor, C1, is charged to a potential difference $V_1 = 10 \text{ V}$ using a 10 V battery. The battery is then removed and the capacitor is connected to an uncharged capacitor, C2, with capacitance of 10 micro F. What is the potential difference across C1 and C2, respectively?

- A. 6 V, 6 V.
- B. 1 V, 9 V.
- C. 2 V, 8 V.
- D. 5 V, 5 V.
- E. 2 V, 2 V.

QUESTION NO: 8

Consider an isolated capacitor of capacitance C_0 and charge Q_0 . Which of the following statements is true when a dielectric slab is inserted between the plates of the capacitor?

- A. The capacitance goes to zero.
- B. The potential difference across the capacitor does not change.
- C. The capacitance of the capacitor does not change.
- D. The charge on the capacitor does not change.
- E. The energy stored in the capacitor does not change.

QUESTION NO: 9

Two equal charges, each of 0.12 C, are separated by a distance of 1.8 m. What is the work done, by an external agent, to bring a charge of 0.15 C from infinity to the midpoint between the two charges?

- A. 3.6×10^8 J.
- B. 2.1×10^8 J.
- C. 2.0×10^8 J.
- D. 1.7×10^7 J.
- E. 0.6×10^8 J.

QUESTION NO: 10

Calculate the electric flux (ϕ) through the curved surface of a cone of base radius R and height h. The electric field E is uniform and perpendicular to the base of the cone, and the field lines enter through the base. The cone has no charge enclosed inside it, as seen in figure (2).

- A. $\pi R h E$.
- B. $\pi (R^2) E$.
- C. $-2\pi R E$.
- D. $-\pi (R^2) E$.
- E. $2\pi R E$.

QUESTION NO: 11

A charge of $+3.2 \times 10^{-6}$ C is placed at the origin. A second charge (q_2) is placed at $x = 3.0$ m. If a charge of 1.0×10^{-6} C experiences no force if placed at $x = 4.0$ m, then q_2 is:

- A. $+2.1 \times 10^{-6}$ C.
- B. $+0.2 \times 10^{-6}$ C.
- C. -3.3×10^{-6} C.
- D. -0.2×10^{-6} C.
- E. -2.1×10^{-6} C.

QUESTION NO: 12

What is the electric potential energy of an electron at a distance $r = 2.40 \times 10^{-10}$ m from the nucleus of a hydrogen atom? (the nucleus consists of a single proton)

- A. -6.0 eV.
- B. 6.0 eV.
- C. -6.8 eV.
- D. -8.5 eV.
- E. 6.8 eV.

QUESTION NO: 13

A solid piece made of copper has the shape and dimensions shown in figure (6). Determine the resistance for the current that flows through the solid in the z-direction.

(resistivity of copper = 1.69×10^{-8} ohm-meter).

- A. 8.5×10^{-6} ohms.
- B. 2.9×10^{-5} ohms.
- C. 3.4×10^{-6} ohms.
- D. 8.5×10^{-7} ohms.
- E. 2.1×10^{-7} ohms.

QUESTION NO: 14

Which of the following statements are WRONG:

- 1. The efficiency of the ideal engine is greater than one.
- 2. The change in entropy is zero for reversible isothermal processes.
- 3. In cyclic processes, the change in entropy is zero.
- 4. If steam is condensed, its entropy will decrease.
- 5. If ice is melted, its entropy will decrease.

- A .1,3 and 5.
- B .1,2 and 4.
- C .1,2 and 5.
- D. 2,3 and 4.
- E .1,2 and 3.

QUESTION NO: 15

As shown in figure (3), a small non-conducting ball of mass $m = 1.0 \times 10^{-6}$ kg and charge $q = 2.0 \times 10^{-8}$ C, distributed uniformly through its volume, hangs from an insulating thread that makes an angle $\theta = 20$ degrees with a vertical, uniformly charged non-conducting sheet (shown in cross section). Considering the weight of the ball and assuming that the sheet extends far vertically and into and out of the page, calculate the surface charge density of the sheet.

- A. 2.5×10^{-9} C/m².
- B. 4.0×10^{-9} C/m².
- C. 5.0×10^{-9} C/m².
- D. 8.7×10^{-9} C/m².
- E. 3.2×10^{-9} C/m².

QUESTION NO: 16

An ideal engine, whose low-temperature reservoir is at 27 degrees Celsius, has an efficiency of 20 %. By how much should the temperature of the high-temperature reservoir be increased to increase the efficiency to 50 % ?

- A. 20 K.
- B. 88 K.
- c. 225 K.
- D. 975 K.
- E. 300 K.

QUESTION NO: 17

A proton is shot out along the +x-axis from the origin with a speed of 1.0×10^6 m/s. In this region a uniform electric field of 2500 N/C exists in the negative x-direction. Find the distance traveled by the proton before it momentarily comes to rest.

- A. 2.1 m.
- B. 2.9 m.
- C. 1.0 m.
- D. 4.2 m.
- E. 8.9 m.

QUESTION NO: 18

Which of the following statements is WRONG:

- A. Electric field can exert a torque on an electric dipole.
- B. Electric field lines extend away from a positive charge.
- C. A shell of uniform charge density exerts a constant force on a charge inside it.
- D. A shell of uniform charge density exerts a constant force on a charge outside it.
- E. The magnitude of the charge on a positive ion is an integer multiple of the electron charge.

QUESTION NO: 19

Consider the circuit shown in figure (5). If $C_1 = 1$ micro F, $C_2 = 6$ micro F and $C_3 = 3$ micro F, what is the charge on C_3 ?

- A. 5 micro C.
- B. 2 micro C.
- C. 6 micro C.
- D. 3 micro C.
- E. 9 micro C.

QUESTION NO: 20

For the arrangement of charges shown in figure (1), the electric field at the point p is:

- A. $2.0 \cdot k \cdot q / (d^2)$ in the negative y-direction.
- B. Zero.
- C. $1.3 \cdot k \cdot q / (d^2)$ in the negative y-direction.
- D. $2.0 \cdot k \cdot q / (d^2)$ in the positive y-direction.
- E. $1.3 \cdot k \cdot q / (d^2)$ in the positive y-direction.

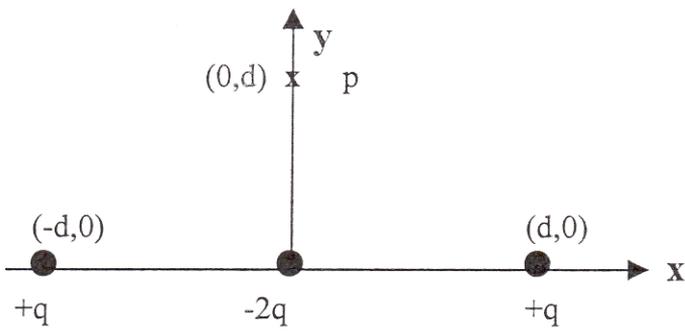


Figure 1

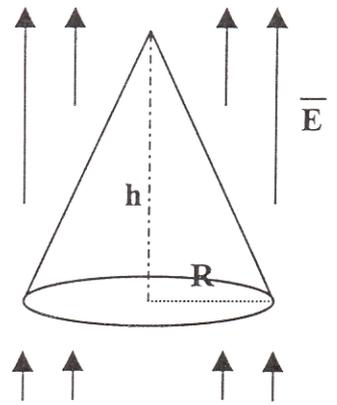


Figure 2

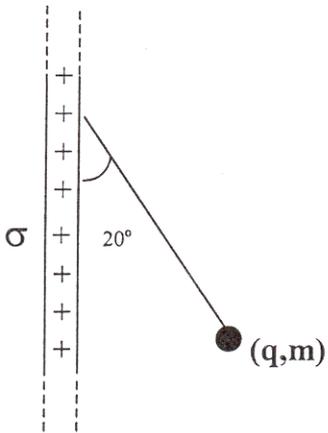


Figure 3

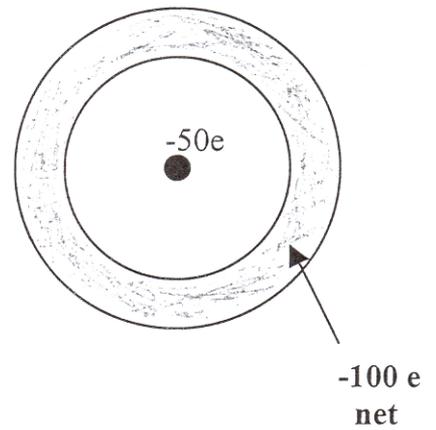


Figure 4

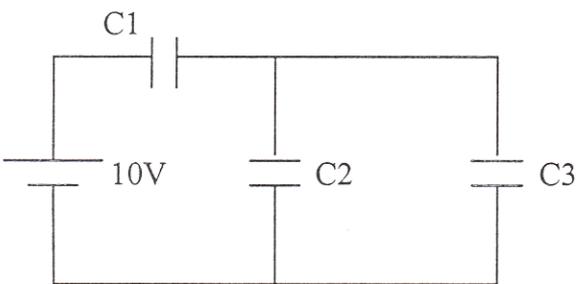


Figure 5

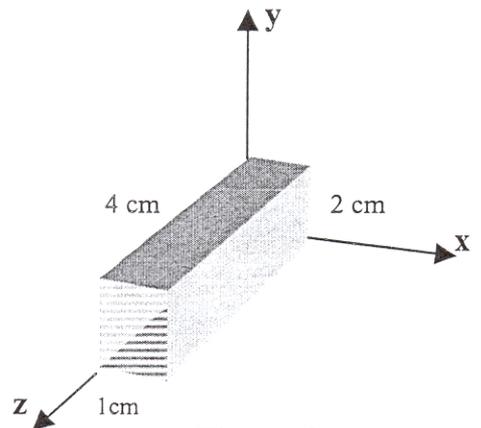


Figure 6