King Fahd University of Petroleum and Minerals

Department of Physics

PHYS102-051
MAJOR 2 EXAM
Test Code: **000**

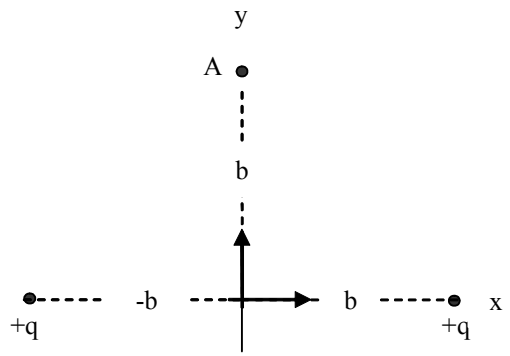
14 December 2005
Exam Duration: 2hrs (from 6:00pm to 8:00pm)

Name:	
Student Number:	
Section Number:	

1. Consider three charges on the x-axis: q_1= 2.0 μC located at x_1 = 0.0 m, q_2 located at x_2 = 4.0 m and q_3 = – 1.0 μC located at x_3= 6.0 m. What is the value of q_2 such that the force on q_3 is zero?
   A) q_2 = - 0.22 μC.
   B) q_2 = + 0.22 μC.
   C) q_2 = - 0.89 μC.
   D) q_2 = + 0.89 μC.
   E) q_2 = + 0.67 μC.

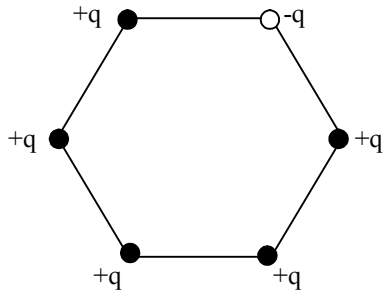
2. Consider two identical conductor spheres, S_1 and S_2. Initially, sphere S_1 has a charge of -40 μC and Sphere S_2 has a charge of +20 μC. If the spheres are touched together and then separated by a distance of 0.20 m, what is the resultant force between them?
   A) 44 N, attractive.
   B) 23 N, repulsive.
   C) 33 N, attractive.
   D) 33 N, repulsive.
   E) 55 N, attractive.

3. What is the electric field on the y-axis at a distance b from the origin due to two identical positive point charges, each of charge q, located on the x-axis one at a distance b and the other a distance –b from the origin?



   A) k q/($b^2\sqrt{2}$) in the negative y-direction.
   B) k q^2/b^2 in the positive y-direction.
   C) k q/($b^2\sqrt{2}$) in the positive y-direction.
   D) (k q/b^2)/ 2 in the positive y-direction.
   E) (k q/b^2)/ 2 in the negative y-direction.

4. Six point charges are placed on the corners of a regular hexagon as shown in the figure. Five of them have a charge of +1.0 μC and the sixth has a charge of – 1.0 μC. If the distance from the center of the hexagon to its corner is 1 cm, what is the electric field at the center?



A) 0.22×10^8 N/C.
B) Zero.
C) 0.89×10^8 N/C.
D) 1.8×10^8 N/C.
E) 0.45×10^8 N/C.

5. A particle of mass 1.0 g has a charge of 0.02 C moves through an electric potential difference of 50 V. If the initial velocity of the particle is 10 m/s, calculate its final velocity.
A) 34 m/s.
B) 55 m/s.
C) Zero.
D) 10 m/s.
E) 46 m/s.

6. A point charge is at the center (0,0) of a conducting sphere which has a radius of 0.3 m. Another point charge of 2μC is located at r =0.40 m. If the net flux through the surface of the sphere is 360 Nm^2/C, calculate the value of the charge inside the sphere.
A) 3.2 nC.
B) 3.6 nC.
C) 6.4 nC.
D) 7 nC.
E) 4.6 nC.

7. An insulating sphere with radius =0.22 m has charge distributed uniformly through its volume. What must be the total charge on the sphere if the electric field at 0.11 m from the center of sphere is 950 N/C ?
   A) 6 nC.
   B) 10 nC.
   C) 2 nC.
   D) 17 nC.
   E) 12 nC.

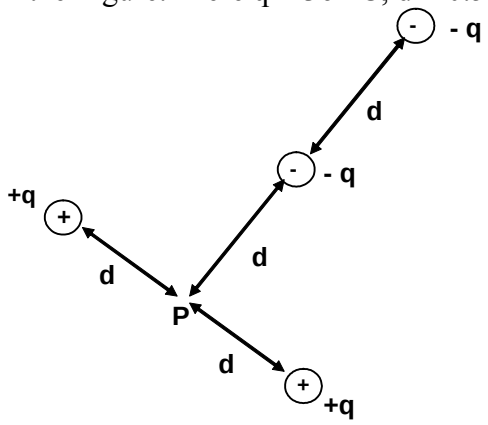
8. Which of the following statements is correct?
   A) The electric flux through a Gaussian surface depends on the shape of the surface.
   B) The electric flux through a closed surface does not depend on the net charge enclosed by the surface.
   C) The electric field inside a uniformly charged solid conducting sphere in electrostatic equilibrium is zero.
   D) The electric potential inside a uniformly charged sphere in electrostatic equilibrium is zero if the potential at infinity is zero.
   E) The electric field lines are always parallel to Gaussian surface.

9. A square shaped charged plate having a side length 1.5 m. The electric field near its surface is 10^5 N/C and directed normally into the plate. What is the total charge at the surface of the plate?
   A) +4 μC.
   B) +2 μC.
   C) -2 μC.
   D) -4 μC.
   E) -7 μC.

10. A proton moves in a uniform electric field of 2.5×10^7 N/C from point **A** to point **B** by traveling a distance of 1.5 m. Find the work done and the potential difference between point a and b.
   A) 8×10^{-12} J; 6.75×10^7 V.
   B) 5×10^{-12} J; 3.75×10^7 V.
   C) 6×10^{-12} J; 4.75×10^7 V.
   D) 7×10^{-12} J; 5.35×10^7 V.
   E) 6×10^{-12} J; 3.75×10^7 V.

11. The electric potential at point in an XY plane is given by $V = 3X^2 - 4Y^2$.
what are the magnitude and direction of the electric field at a point (4m, 2m) ?
    A) E = 29 N/C and 146 counterclockwise from + x-axix.
    B) E = 80 N/C and 127counterclockwise from + x-axix.
    C) E = 56 N/C and 136 counterclockwise from + x-axix.
    D) E = 76 N/C and 126 counterclockwise from + x-axix.
    E) E = 29 N/C and 34 counterclockwise from + x-axix.

12. What is the net potential at point **P** due to four point charges arranged in the configuration as shown in the Figure. Here q = 36 nC, d = 0.5 m

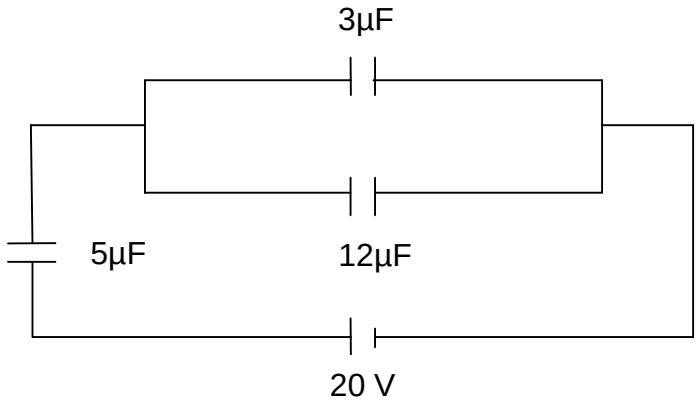


    A) Vp = 162 V.
    B) Vp = 324 V.
    C) Vp = 296 V.
    D) Vp = 648 V.
    E) Vp = 872 V.

13. Which one of the following statements is true?
    A) The electric field is a scalar quantity.
    B) We have to do positive work to move a charged particle along an equipotential surface.
    C) The electric field lines are perpendicular to the equipotential surfaces.
    D) The electric potential is a vector quantity.
    E) Any two equipotential surfaces are always perpendiculars.

14. A parallel-plate capacitor has an area of 16 cm^2. The plates are separated by 0.5 mm and are connected across a 60 V battery. Find the magnitude of the charge on each plate.
    A) 3.2 nC.
    B) 0.5 nC.
    C) 2.6 nC.
    D) 1.7 nC.
    E) 4.8 nC.

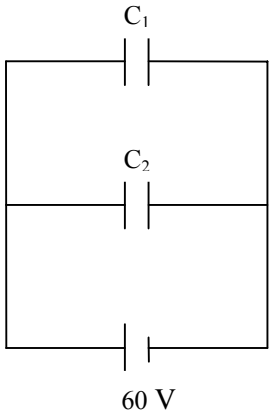
15. Consider the arrangement of capacitors shown in the figure. Find the energy stored in the 5μF capacitor.



    A) 1.1μJ.
    B) 0.45 mJ.
    C) 3.6 mJ.
    D) 4.8 μJ.
    E) 0.56 mJ.

16. A dielectric materials is inserted completely between the plates of a capacitor. If the potential difference is kept constant, and the charge was increased by 60%, determine the dielectric constant of the material.
    A) 1.6
    B) 2.5
    C) 3.5
    D) 1.1
    E) 2.0

17. Two capacitors, C_1= 2 μF and C_2 = 6 μF, are in parallel with a 60 V battery. The battery is removed and plates of opposite sign are connected. Find the final potential difference for each capacitor.



A) 20 V, 20 V.
B) 30 V, 30 V.
C) 20 V, 40 V.
D) 20 V, 40 V.
E) 40 V, 20 V.

18. If 1200 C of charge flows through a 10-ohm resistor in 4 minutes, what is the value of the voltage across the resistor?
A) 120 V.
B) 5 V.
C) 50 V.
D) 75 V.
E) 20 V.

19. Two wires are made from different materials and carry the same uniform current. The current density in both is the same only if:
A) the potential differences across them are the same.
B) their lengths are the same.
C) both their lengths and radii are the same.
D) their radii are the same.
E) the electric fields in them are the same.

20. In a simple circuit a voltage of 5 V is applied across a 10 Ohm resistance. The energy dissipated in the resistor in 2 minutes is:
    A) 50 J.
    B) 250 J.
    C) 105 J.
    D) 150 J.
    E) 300 J.

Physics 102
Formula Sheet for 2nd Major Exam
First Semester 2005-2006 (Term 051)

$Q = mc\Delta T, \quad Q = mL$

$Q = nc_p\Delta T, \quad Q = nc_v\Delta T$

$W = Q_h - Q_c$

$\text{å} = \frac{W}{Q_h} = 1 - \frac{Q_c}{Q_h}$

$K = \frac{Q_c}{W}$

$\frac{Q_c}{Q_h} = \frac{T_c}{T_h}, \quad \Delta S = \int \frac{dQ}{T}$

$F = k\frac{q_1 q_2}{r^2}, \quad \Phi = \int_{\text{Surface}} \vec{E}.d\vec{A}$

$E = \sigma/2\varepsilon_o, \quad E = \sigma/\varepsilon_o$

$E = k\frac{q}{r^2}, \quad E = k\frac{q}{R^3}r, \quad E = \frac{2k\lambda}{r}$

$U = -\vec{P}\cdot\vec{E}$

$\vec{\tau} = \vec{P}\times\vec{E}$

$\Phi_c = \oint \vec{E}.d\vec{A} = \frac{q_{in}}{\varepsilon_0}$

$E_x = -\frac{\partial V}{\partial x}, \quad E_y = -\frac{\partial V}{\partial y}, \quad E_z = -\frac{\partial V}{\partial z}$

$\Delta V = V_B - V_A = -\int_A^B \vec{E}.d\vec{S} = \frac{\Delta U}{q_0}$

$V = k\frac{q}{r}$

$U = k\frac{q_1 q_2}{r_{12}}$

$C = \frac{q}{V}, \quad C = \kappa C_0$

$U = \frac{1}{2}CV^2$

$v = v_o + at$

$x - x_o = v_o t + \frac{1}{2}a t^2$

$v^2 = v_o^2 + 2a(x - x_o)$

Constants:

Pi = π
k = 9.0×10^9 N.m^2/C^2
ε_0 = 8.85×10^{-12} C^2/N.m^2
e = -1.6×10^{-19} C
m_e = 9.11×10^{-31} kg
m_p = 1.67×10^{-27} kg
k_B = 1.38×10^{-23} J/K
N_A = 6.022×10^{23} molecules/mole
R = 8.314 J/mol. K
1 atm = 1.013×10^5 N/m^2
g = 9.8 m/s^2

---

micro = 10^{-6}
nano = 10^{-9}
pico = 10^{-12}

$a*b**c = ab^c$

$\text{Sqrt}(a) = \sqrt{a}$

Answer Key

1. A
2. B
3. C
4. D
5. E
6. A
7. B
8. C
9. D
10. E
11. A
12. B
13. C
14. D
15. E
16. A
17. B
18. C
19. D
20. E