PHYSICS 241 TEST 1 Monday, February 17, 2003

This 15-question test (each question is worth approximately 6.67 points) is worth 100 points, each question is weighted equally. Please fill out the answer sheet with soft lead pencil. Be sure to give your name, student ID #, date, Course #, Test 1, and ****SIGN**** the answer sheet. Be prepared to present your Student picture ID card when handing in your answer sheet. You may keep the sheets with the questions and your work.

Pick the nearest value for your answer (there may be slight round-off errors). If your answer is significantly different from all possible answers, you have made some mistake.

Don't get hung up too long over any one question until you have tried all of them.

You are expected to bring your own sheet of equations and words explaining the equations. Here are a few possibly useful constants or equations.

ε_o = 8.85×10^{-12} C^2/Nm^2 $k = 8.99 \times 10^9$ $Nm^2/C^2 = 1/4\pi\varepsilon_o$

$g = 9.8\ m/s^2$ $G = 6.67 \times 10^{-11} Nm^2/kg^2$

weight = mg

1.) A point charge q is placed exactly at the corner of a cube. What is the electric flux through one of the "opposite" cube faces which does NOT touch the charge? [Hint: do some of the faces pass zero flux? Hint: exploit the symmetries of this configuration to (a) determine the fraction of the total flux that aims at the opposite faces and (b) share the flux among those faces.]

a) q/ε_o
b) $q/4\pi\varepsilon_o$
c) $q/6\varepsilon_o$
d) $q/12\varepsilon_o$
e) $q/24\varepsilon_o$

2.) The flux of the uniform electric field E = (13 , 30 , 16)N/C through a 2.0 m^2 portion of the yz plane is:

a) 26 N m^2/C
b) 32 N m^2/C
c) 92 N m^2/C
d) 48 N m^2/C
e) 60 N m^2/C

3.) Charges Q_1 = +10nC and Q_2 = -30nC are placed on the x axis at x = 0 and x = 50 cm, respectively. What is the net electric flux, in Nm^2/C, through a spherical surface of radius r = 40 cm centered on the origin of coordinates?

a) 4520
b) -2260
c) 90
d) 1130
e) -180

4.) A 50 _F capacitor is charged to 150 V. It is then connected to both ends of a 20 _F capacitor. How much charge is stored on the positive plate of the 20 _F capacitor?

a) 2.14 mC
b) 5.36 mC
c) 7.50 mC
d) 3.00 mC
e) 100. mC

5.) A 50 _F capacitor and a 20 _F capacitor are connected in series and charged to 150 V. How much charge is stored on the positive plate of the 20 _F capacitor?

a) 2.14 mC
b) 5.36 mC
c) 7.50 mC
d) 3.00 mC
e) 100. mC

6.) A 50 _F capacitor and a 20 _F capacitor are connected in parallel and charged to 150 V. How much charge is stored on the positive plate of the 20 _F capacitor?

a) 2.14 mC
b) 5.36 mC
c) 7.50 mC
d) 3.00 mC
e) 100. mC

7.) A circular disk of uniform charge density _ = 120 _C/m^2 has a radius of 10 cm. What is the electric field magnitude, in N/C, at a point on the axis of symmetry 15 cm from the disk?

a) 0.97×10^3
b) 3.18×10^4
c) $5{,}32 \times 10^5$
d) 9.11×10^5
e) 1.14×10^6

8.) Find the magnitude of the electric field, E, in V/m, at the point (1.5m, -1.5m) in the x-y plane for the potential function $V(x, y) = (x^2y - y^2x - 10)V$, using the gradient operators.

a) 7.75
b) 9.55
c) 15.50
d) 0
e) 77.5

9.) An active thundercloud can have a potential exceeding 3 MV relative to the Earth's surface. Assume a not untypical cloud system whose bottom is 1 mile (~1.6 km) above the earth and has an area of 100 km2. Estimate the energy, U, stored in this cloud if it is at the stated potential (treat it and the Earth as a giant capacitor.)

a) 0.83 MJ
b) 2.49 MJ
c) 4.98 MJ
d) 8.30 MJ
e) 9.96 MJ

10.) An uncharged conducting spherical shell with inner and outer radii 1.8 m and 2.1 m surrounds a concentric conducting solid sphere of 0.3 m radius charged with +13mC. What is the potential of the inner sphere at a distance of 0.1 m from the center? (relative to V = 0 at $r = \infty$). [Hint: notice carefully ALL equipotentials, and do two separate integrals in the two empty-space regions !)

a) 3.25 V
b) 117 MV
c) 234 MV
d) 314 MV
e) 380 MV

11.) The above system is filled with oil (dielectric constant $\kappa = 27$). What is its capacitance (between the shell and the center sphere) ?

a) 40 pF
b) 40 nF
c) 1.08 pF
d) 1.08 nF
e) 2.7 nF

12.) Charges of 20, 40, 60, and -80 mC are placed at the corners of a 1.3 m square. What is the electric potential, V, at the center of the square?

a) 1.96 GV
b) 1.17 GV
c) 0.78 GV
d) 0.39 GV
e) 0.28 GV

13.) A 2 μC charge is placed at the origin, an identical charge is placed 2m from the origin on the x axis, and a third identical charge is placed 2 m from the origin on the y axis. The magnitude of the force on the charge at the origin is:

a) 9.0×10^{-3} N
b) 6.4×10^{-3} N
c) 1.3×10^{-2} N
d) 1.8×10^{-2} N
e) 3.6×10^{-2} N

14.) The force exerted by a uniform electric field on a dipole is:

a) parallel to the dipole moment
b) perpendicular to the dipole moment
c) parallel to the electric field
d) perpendicular to the electric field
e) none of the above

15.) A charged oil drop with a mass of 2×10^{-4} kg is held suspended by a downward electric field of 300 N/C. The charge on the drop is [warning: be careful about signs]

a) $+1.5 \times 10^{-6}$ C
b) -1.5×10^{-6} C
c) $+6.5 \times 10^{-6}$ C
d) -6.5×10^{-6} C
e) 0

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SEE IMPORTANT MARKING INSTRUCTIONS ON SIDE 2

LAST NAME: KEY | FIRST NAME | MI

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USE A #2 PENCIL ONLY

Question	Marked
1	E
2	A (T)
3	D
4	A (T)
5	A (T)
6	D
7	E
8	B (F)
9	B (F)
10	E
11	D
12	D
13	C
14	E
15	D

COMPLETE ALL INFORMATION AS DIRECTED

SECTION NUMBER | TEST/QUIZ NUMBER | STUDENT IDENTIFICATION NUMBER

INSTRUCTOR V. Bzhyxx

COURSE Phys 241

DATE 17 Feb 2003

SIGNATURE