PHYSICS DEPARTMENT

PHY 2053 Sample Exam Spring 2000

B. Whiting Sec.#_____

Name (print, last first): _____ Signature: _____

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

DIRECTIONS

(1) **Code your test number on your green answer sheet (use 76–80 for the 5-digit number)**. Code your name on your answer sheet. **Darken circles completely (errors can occur if too light)**. Code your student number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout, along with the scratch work most questions demand.
(4) Work the questions in any order. Incorrect answers are not taken into account in any way; you may guess at answers you don't know if you feel that a correct answer is listed. Guessing on all questions will most likely result in failure.
(5) If none of the answers is correct, please leave the answer sheet blank. It is not our intention to omit the right answer, but in case of a mistake, please leave the answer sheet blank.
(6) **Blacken the circle of your intended answer completely, using a number 2 pencil**. Do not make any stray marks or the answer sheet may not read properly.
(7) As an aid to the examiner (and yourself), in case of poorly marked answer sheets, please circle your selected answer on the examination sheet.
(8) Good luck!!!

>>>>>>>>**WHEN YOU FINISH** <<<<<<<<

Hand in the green answer sheet separately.

Constants

$k = 1/(4\pi\epsilon_0) = 9.0 \times 10^9\,\mathrm{N\,m^2/C^2}$		$\epsilon_0 = 8.85 \times 10^{-12}\mathrm{C^2/(N\,m^2)}$	$e = 1.6 \times 10^{-19}$ C
$1\mu\mathrm{C} = 10^{-6}$ C	$g = 9.8$ m/s^2	electron mass: $m_e = 9.11 \times 10^{-31}$kg	proton mass: $m_p = 1.67 \times 10^{-27}$kg

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1. A 100 watt heater operates with a potential difference of 120 V across it. The heater element is nichrome wire of radius 0.25×10^{-3}m and resistivity 1.5×10^{-6}- m. What is the length of the wire?

   (1) 34.5 m (2) 66.2 m (3) 18.9 m (4) 24.6 m (5) 43.1 m

2. A 10 μF capacitor and a 15 μF capacitor are connected in series and charged by a 12 V battery. What voltage is required to charge a parallel configuration of the same capacitors to the same total energy (in J)?

   (1) 2.1 (2) 5.9 (3) 0.5 (4) 34.8 (5) 4.2

3. A copper wire 1 km in length and 1 cm in diameter dissipates 4900 W of power. How much current (in A) is flowing through the wire? The resistivity of copper (ρ_{Cu} is 1.72×10^{-8}- m.

   (1) 150 (2) 80 (3) 20 (4) 3000 (5) 5

4. A 0.2 kg, +5.4 nC point charged is attached to a conducting sheet by an insulating thread. (See Figure 2) The sheet has a surface charge density of $+1.82\mu\mathrm{C/cm^2}$. Find the angle (in degrees) that the thread makes with the conducting sheet.

   (1) 70.6 (2) 4.5 (3) 82.0 (4) 34.9 (5) 19.4

5. A wire with an original resistance of 8-- is melted down and from the same volume reformed into a wire that is one fourth as long as the original wire. What is the resistance (in -) of the new wire?

   (1) 0.5 (2) 4 (3) 32 (4) 128 (5) 2

6. Three charges ($q_1 = +4\mu$C, $q_2 = -1\mu$C, and $q_3 = -2\mu$C) are arranged as shown in Figure 1. What is the magnitude of the force (in N) on charge q_3?

   (1) 1.1×10^{-2} (2) 1.8×10^{-2} (3) 1.3×10^{-2} (4) 1.4×10^{-2} (5) 4.5×10^{-3}

7. The current flowing in a wire is 22 mA. How many electrons pass by a given point on the wire in 1 minute?

   (1) 5.6×10^{17} (2) 3.2×10^{20} (3) 1.4×10^{17} (4) 5.6×10^{19} (5) 8.3×10^{18}

8. Two capacitors with different capacitances C_1 and C_2 can be connected to a battery either in series or in parallel. Which of the following statements are **correct**?

   (1) When connected in parallel, C_1 and C_2 have the same charge on them.
   (2) All are true.
   (3) None are true.
   (4) When connected in series, C_1 and C_2 have the same charge on them.
   (5) When connected in series, C_1 and C_2 have the same voltage across them.

9. A parallel plate capacitor is connected to a battery and charged. The battery is then disconnected from the capacitor. The plates are then moved closer together. Which of the following statements is CORRECT?

   (1) The voltage across the plates decreases
   (2) The charge on plates increases
   (3) The electric field between the plates increases
   (4) The capacitance decreases
   (5) The stored electrical energy increases

10. Two protons initially separated by 10^{-6} m are traveling toward each other with velocities of 1.7×10^4 m/s. How close (in m) will they come to each other?

    (1) 5.4×10^{-7} (2) 9.8×10^{-12} (3) 4.8×10^{-10} (4) 3.2×10^{-9} (5) 2.1×10^{-7}

11. A proton and an electron are separated by distance r. What is the ratio of the magnitude of the gravitational force to the electric force? (You do not need to know the value of r to do this.)

    (1) 2.4×10^{39} (2) 4.4×10^{-40} (3) 6.5×10^{39} (4) 1.2×10^{-40} (5) 3.6×10^{-46}

12. A spherical rubber (insulating) balloon has charge uniformly distributed on its surface. The balloon is then deflated to one fifth its original radius. Which of the following statements is correct? Assume the balloon begins and ends as a sphere.

(1) None of the above
(2) At a point far away from the balloon, the electric field increases
(3) At a point just outside the outer surface of the balloon, the electric field increases
(4) At a point just outside the outer surface of the balloon, the electric remains constant
(5) At a point far away from the balloon, the electric field decreases

13. An aluminum wire and a silver wire have identical resistances and lengths. What is the ratio of the radius of the aluminum wire to that of the silver wire? The resistivities of aluminum and silver are 2.82×10^{-8}- m and 1.59×10^{-8}- m, respectively.

(1) 1.33 (2) 0.75 (3) 2.11 (4) 1.77 (5) 0.56

14. Two point charges are located on the x-axis as follows: charge $q_1 = +9.0 \times 10^{-6}$ C is at $x = -1$ m and charge $q_2 = -2 \times 10^{-6}$ C is at $x = 3$ m. What is the net force (in N) in the +x-direction of a third charge $q_3 = +4 \times 10^{-6}$ C located at $x = 5$ m?

(1) -9.0×10^{-3} (2) 9.0×10^{-3} (3) -2250 (4) 2250 (5) -15.5

15. The magnitude of the electric field at a distance of 10 meters from a negative point charge is E. What is the magnitude of the electric field at the same location if the magnitude of the charge is doubled?

(1) $4E$ (2) $E/2$ (3) E (4) $2E$ (5) $E/4$

16. A parallel plate capacitor is connected to a battery and charged to a voltage V and charge Q. The battery is then disconnected from the capacitor and a dielectric material (□) is placed between its plate. Which of the following statements is true?

(1) The voltage decreases; the charge is constant
(2) The voltage is constant; the charge increases
(3) The voltage is constant; the charge is constant
(4) The voltage increases; the charge is constant
(5) The voltage is constant; the charge decreases

17. A +2.5 nC charge with mass 10^{-4} kg is suspended using a thin insulating wire with negligible mass as shown in Figure 3. A second −2.5 nC charge is located 1 cm to the left of the suspended charge. Find the angle (in degrees).

(1) 29.9 (2) 4.5 (3) 24.2 (4) 20.1 (5) 16.2

18. Two point charges are located on the x-axis as follows: charge $q_1 = +4.0\mu$C is at $x = -2$ m, charge $q_2 = -16.0\mu$C is at $x = 5$ m. Where can a third charge be placed such that the net force it experiences is identically 0 N?

(1) 6.0 m (2) 0.6 m (3) 4.3 m (4) 0.3 m (5) −9.0 m

19. In Figure 9, the charge on the 100 μF capacitor is 500 μC ($\mu\text{C} = 10^{-6}\text{C}$). What is the voltage (in V) across the 160 μF capacitor?

(1) 4.3 (2) 5.0 (3) 17 (4) 1.8 (5) 9.0

20. Six point charges are arranged in a hexagon as shown in Figure 4. What is the direction (in degrees) of the electric field at the center of the hexagon?

(1) 0 (2) 60 (3) 300 (4) 210 (5) 120

31111

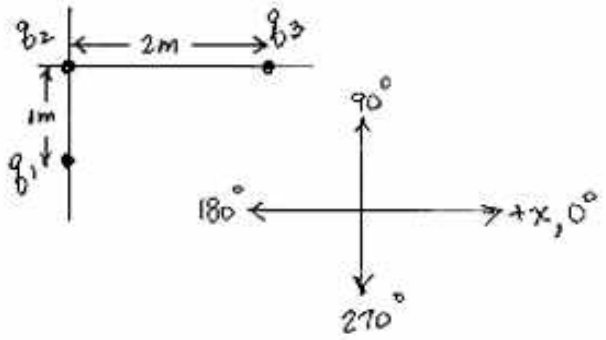


Figure 1

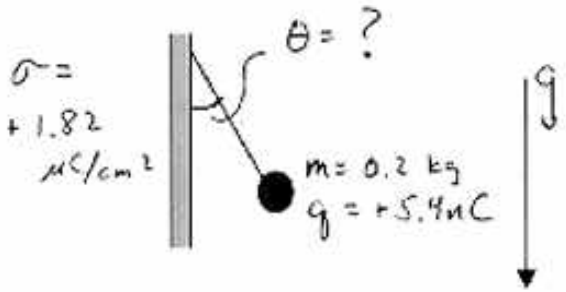


Figure 2

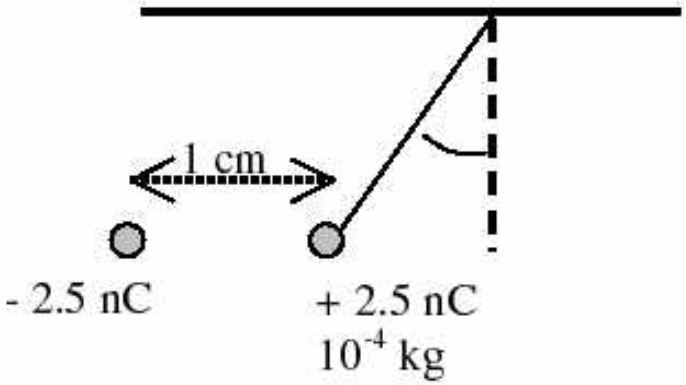
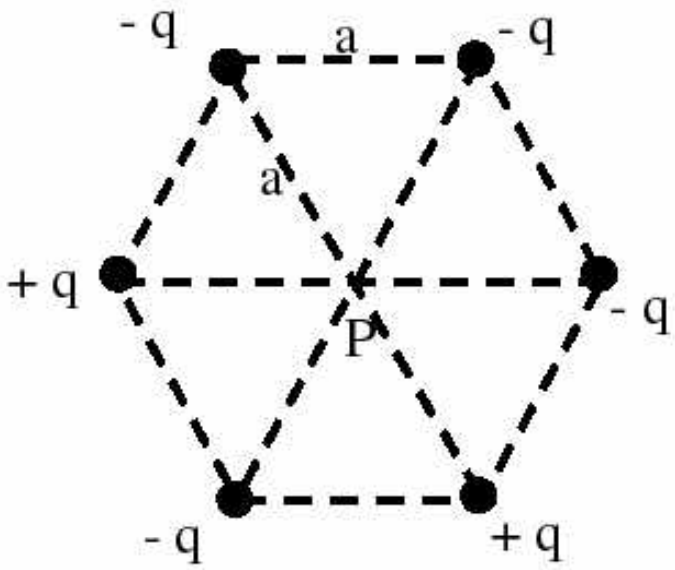


Figure 3



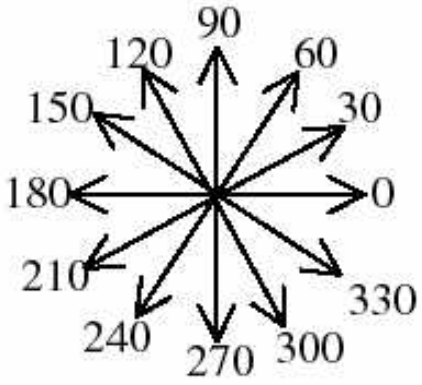


Figure 4