UNIVERSITY OF SASKATCHEWAN
Department of Physics and Engineering Physics

Physics 111.6
MIDTERM TEST #4

March 10, 2005   Time: 90 minutes

NAME: _____   STUDENT NO.: _____
(Last)   **Please Print**   (Given)

LECTURE SECTION (please circle):

01	Dr. A. Robinson
02	B. Zulkoskey
03	Dr. K. McWilliams
C15	F. Dean

INSTRUCTIONS:

1. You should have a test paper, a formula sheet, and an OMR sheet. The test paper consists of 9 pages. **It is the responsibility of the student to check that the test paper is complete**.

2. Enter your name and <u>STUDENT NUMBER</u> on the OMR sheet.

3. The test paper, the formula sheet and the OMR sheet must all be submitted.

4. The test paper will be returned. The formula sheet and the OMR sheet will <u>NOT</u> be returned.

PLEASE DO NOT WRITE ANYTHING ON THIS TABLE

QUESTION NO.	MAXIMUM MARKS	MARKS OBTAINED
Part A	10	
Part B	10	
C1	5	
C2	5	
C3	5	
TOTAL	35	

PART A

FOR EACH OF THE FOLLOWING QUESTIONS IN PART A, ENTER THE MOST APPROPRIATE RESPONSE ON THE OMR SHEET.

A1.   At a distance r_1 from a point charge, the magnitude of the electric field created by the charge is E_1. At a distance r_2 from the charge, the magnitude of the electric field is $E_2 = E_1/9$. Which of the following expressions is correct for the relationship between r_2 and r_1?

   (A) $r_2 = 1/9\ r_1$ (B) $r_2 = 1/3\ r_1$ (C) $r_2 = \sqrt{3}\ r_1$ (D) $r_2 = 3\ r_1$ (E) $r_2 = 9\ r_1$

A2.   Which one of the following statements is **_NOT_** correct?

   (A) The SI unit of electric potential may be expressed as joules/coulomb.
   (B) The SI unit of electric potential energy is joules.
   (C) The SI unit of electric field strength is newtons/coulomb.
   (D) A non-SI unit of the electric field strength is the electron volt.
   (E) The SI unit of electric potential may be expressed as volts.

A3.   The diagram shows the electric field lines due to two charges. Which one of the following statements is **_NOT_** correct?

   (A) The charges are both positive.
   (B) The charges have the same magnitude.
   (C) There is a single point in space between the two charges where the net electric field strength is zero.
   (D) The electric field strength is strongest in regions with more field lines.
   (E) The charges have different signs.
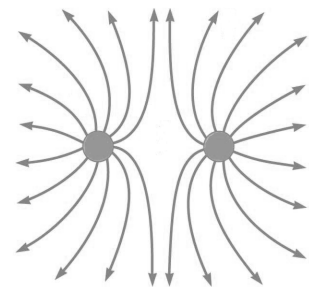
A4.   What quantity is measured by a battery rating given in ampere-hours (A·h)?

   (A) electric current   (B) electric resistance   (C) electric potential
   (D) electric charge   (E) power

A5.   The resistivity of aluminum is greater than that of copper. Is it possible for a copper wire and an aluminum wire of the same length to have the same resistance?

   (A) No, the copper wire will have a greater resistance.
   (B) No, the aluminum wire will have a greater resistance.
   (C) Yes, and the aluminum wire will have a larger diameter than that of the copper wire.
   (D) Yes, and the copper wire will have a larger diameter than that of the aluminum wire.
   (E) It is impossible to answer this question without knowing the values of the resistivities.

A6. Consider an ideal voltage source connected to several resistors in parallel. Which one of the
following statements is ***NOT*** correct?

(A) The equivalent parallel resistance is less than the smallest resistance value of any of the
individual resistors.
(B) The same current flows through all resistors connected in parallel.
(C) The same voltage drop occurs across all resistors in parallel.
(D) The current can diverge at junctions in the circuit.
(E) The total power delivered to the resistors in parallel is equal to the power delivered to the
equivalent resistance.

A7. A real battery has an emf of V volts and an internal resistance of r ohms. When this battery is
connected to a radio with a resistance of R ohms, an expression for the current I flowing in the
circuit is

(A) $I = \dfrac{V}{(r+R)}$.

(B) $I = \dfrac{V}{(R-r)}$.

(C) $I = V(r+R)$.

(D) $I = V\left(\dfrac{r}{R+r}\right)$.

(E) $I = \dfrac{(r+R)}{V}$.

A8. Which one of the following is ***NOT*** an electromagnetic wave?

(A) radio waves   (B) sound waves   (C) heat
(D) ultraviolet radiation   (E) visible light

A9. Which one of the following statements concerning electromagnetic waves is ***NOT*** correct?

(A) Electromagnetic waves are transverse waves.
(B) Electromagnetic waves can travel through a vacuum.
(C) Electromagnetic waves can travel through a material substance.
(D) Electromagnetic waves are made up of electric and magnetic fields that are parallel to each
other.
(E) All electromagnetic waves travel at the speed of light in a vacuum.

A10. White light travels through the air and enters a glass prism, but when the light emerges from the
prism different colours of light are observed. Which one of the following statements explains this
observation?

(A) The separation of white light into its component colours is due to the increase in the speed of
light within the glass.
(B) Some of the colour components of the white light are absorbed by the glass and only the
remaining components are observed.
(C) The index of refraction of the glass depends on the wavelength of the light, so the colour
components of the white light are refracted at different angles.
(D) Only some of the colour components are refracted by the glass; these are the only ones that
are observed.
(E) White light is separated into its component colours by total internal reflection within the
prism.

PART B

FOR EACH OF THE FOLLOWING PROBLEMS, WORK OUT THE SOLUTION IN THE SPACE PROVIDED AND ENTER YOUR ANSWERS ON PAGE 6.

ONLY THE ANSWERS WILL BE MARKED. THE SOLUTIONS WILL NOT BE MARKED.

B1.   A proton is accelerated from rest at plate A. Plate A has a potential of +45.0 V and plate B has a potential of –132 V. Calculate the kinetic energy of the proton as it passes through plate B.
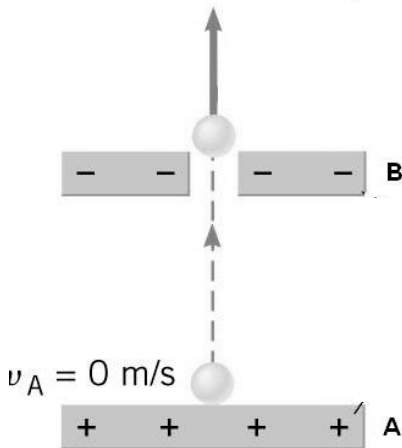
B2.   Calculate the electric potential at point P, due to the two charges shown in the diagram.
       Note: 1 nC = 1×10^{-9} C.
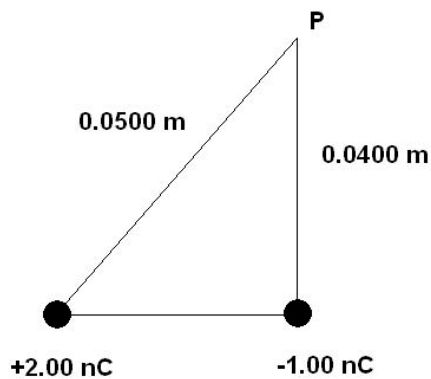
B3.   Calculate the power consumed by a 267 Ω resistor when it is connected to a 12.0 V battery.

B4.   An ac voltage, whose peak value is 170 V, is applied across a toaster that has a resistance of
        26.2 Ω. Calculate the ***rms*** current that flows through the toaster.

B5.　Light in a vacuum is incident on the surface of a solid slab of transparent material. The angle of incidence is 32.0° and the angle of refraction is 21.0°. Calculate the index of refraction of the slab material.

ANSWERS FOR PART B

ENTER THE ANSWERS FOR THE PART B PROBLEMS IN THE BOXES BELOW.

THE ANSWERS MUST CONTAIN THREE SIGNIFICANT FIGURES AND THE UNITS MUST BE GIVEN.

ONLY THE ANSWERS WILL BE MARKED. THE SOLUTIONS WILL NOT BE MARKED.

B1

B2

B3

B4

B5

PART C

**IN EACH OF THE FOLLOWING QUESTIONS, GIVE THE COMPLETE SOLUTION AND ENTER THE FINAL ANSWER IN THE BOX PROVIDED.**

THE ANSWERS MUST CONTAIN THREE SIGNIFICANT FIGURES AND THE UNITS MUST BE GIVEN.

SHOW YOUR WORK. NO CREDIT WILL BE GIVEN FOR ANSWERS ONLY. EQUATIONS NOT PROVIDED ON THE FORMULA SHEET MUST BE DERIVED.

C1. Consider the arrangement of charges shown below:

$+x$

| 1.56 m | 1.29 m | 1.45 m |

$q_1 = +1.30\ \mu C$ $q_2 = -1.45\ \mu C$ $q_3 = -1.15\ \mu C$ **P**
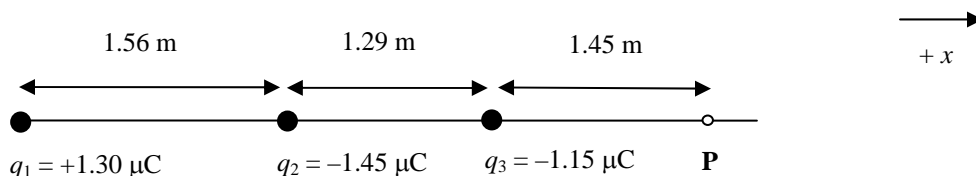
(a) Calculate the magnitude and direction of the electric field at point P due to the three collinear charges.

magnitude:

direction:

(b) If a test charge of $-1.85\ \mu C$ was placed at point P, what would be the magnitude and direction of the electric force on it?

magnitude:

direction:

C2.   An alpha particle (charge of +2e, mass of 6.64×10^{-27} kg) has a kinetic energy of 4.24×10^3 eV.
       The alpha particle enters a region where there is a uniform magnetic field of 0.341 T that is
       directed perpendicularly to the alpha particle's velocity.

When the alpha particle leaves the
region of magnetic field it is moving
opposite to its original direction.

1

⊙ B

2
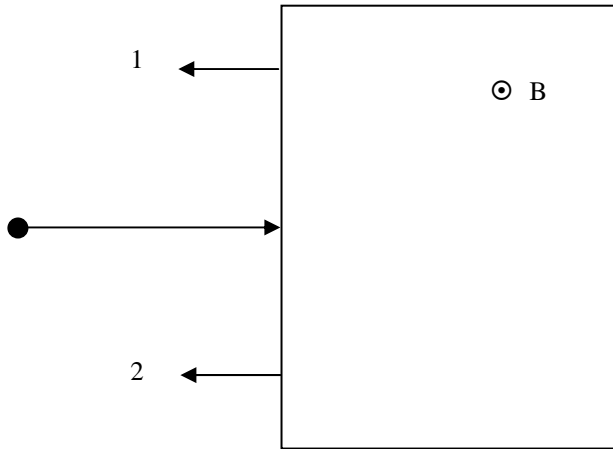
(a) On the diagram, draw the trajectory of the alpha particle while it is in the region of magnetic
    field. Which one of the exit paths, 1 or 2, correctly shows the direction of the velocity of the
    alpha particle when it leaves the region of magnetic field?

(b) Calculate the time, t, during which the alpha particle is in the region of magnetic field. You
    must derive any equations that are not on the formulae sheet.

C3. An object is placed 20.0 cm to the left of a thin diverging lens whose focal points are 35.0 cm from the lens.
   (a) Draw a ray diagram showing the image formed by the lens. Indicate clearly whether the final image is real or virtual, and whether the image is upright or inverted.
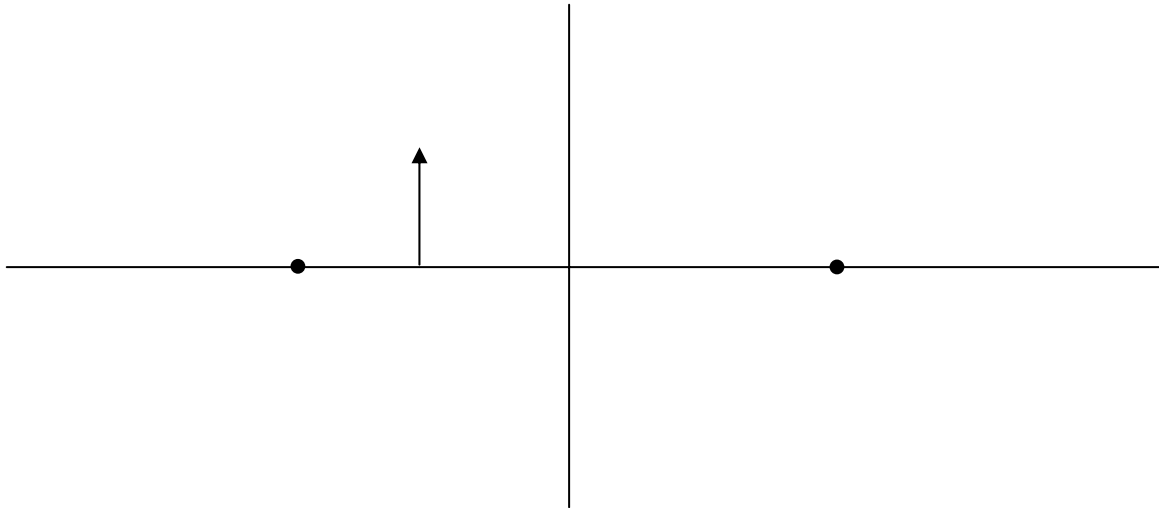
   (b) Calculate the image distance (including the sign).

   (b) Calculate the magnification (including the sign).

END OF EXAMINATION