Prince Sultan University

Department of Mathematics & Physics

PHY205- Physics2

Final Exam

First Semester, Term 161

Sunday 22/1/2017

Examination Time : 120 minutes

Name (Please Print). . . . . .

Student I.D. . . . . .

Section. . . . . .

Important Instructions:

1. You can use a scientific calculator that does not have programming or graphing capabilities.

*2. You may **NOT** borrow a **calculator** from anyone.*

*3. Do not use **RED pen**.*

*4. This is a closed books and notes exam. Do **NOT** use notes or textbooks.*

*5. There should be **NO** talking during the examination.*

*6. Your will be **expelled** immediately from the exam if your mobile phone is seen or heard.*

*7. Any signs of **cheating** may cause you being expelled from the exam.*

*8. This examination has **3 parts**. **Part 1** has **12 multiple choice questions**, each question worth **1 point**. **Part 2** has **6 multiple choice questions**, each question worth **2 point. Part 3** has **4 workout problems** each problem worth **4 points**.*

Make sure your paper has all the questions and problems.

Part 1: 12 Multiple Choice Questions (1 mark each)

1) Electric field lines:
a) are always directed towards the source charge.
b) are vectors in the direction of the electric field
c) form closed loops
d) cross each other in the region between two point charges

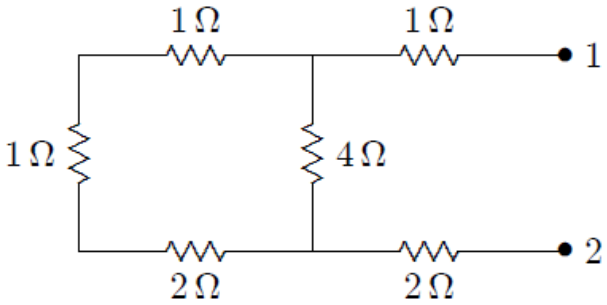
2) Two ***identical*** capacitors are hooked in parallel to an external circuit. Which of the following quantities must be the same for both capacitors?
I. the charge stored on the capacitor
II. the voltage across the capacitor
III. the capacitance of the capacitor
a) I only
b) II only
c) II and III only
d) I, II, and III

3) Which of the following statements about electric and magnetic fields is **FALSE**:
a) A charge moving along the direction of an electric field will experience a force, but a charge moving along the direction of a magnetic field will not experience a force.
b) All charges experience a force in an electric field, but only moving charges can experience a force in a magnetic field.
c) A positive charge always moves in the direction of an electric field; a positive charge always moves perpendicular to a magnetic field.
d) All moving charges experience a force parallel to an electric field and perpendicular to a magnetic field.

4) Two charges q_1= -20 nC and q_2 = 30 nC are inside a closed cylinder of length 0.5m and radius 0.1m. The net electric flux through the cylinder is:
a) 2260 N/C.m^2 b) 3390 N/C.m^2 c) 1130 N/C.m^2 d) 4520 N/C.m^2

5) What is the equivalent resistance between points 1 and 2 of the circuit shown is?

a) 3 Ω
b) 4 Ω
c) 5Ω
d) 6Ω



6) A fiber optic cable ($n = 1.50$) is submerged in water ($n = 1.33$). What is the critical angle for light to stay inside the cable?

a) 62.5° b) 83.1° c) 41.8° d) 27.6°

7) Nearsightedness can usually be corrected with

a) converging lenses.
b) diverging lenses.
c) cylindrical lenses.
d) spherical lenses.

8) Which of the following is a correct statement?

a) A concave mirror always produces a real image.
b) A convex mirror always produces a virtual image.
c) A concave mirror always produces a virtual image.
d) A convex mirror always produces a real image.

9) Which one of the following is a characteristic of a compound microscope?

a) The objective is a diverging lens.
b) The eyepiece is a diverging lens.
c) The image formed by the objective is virtual.
d) The image formed by the objective is real.

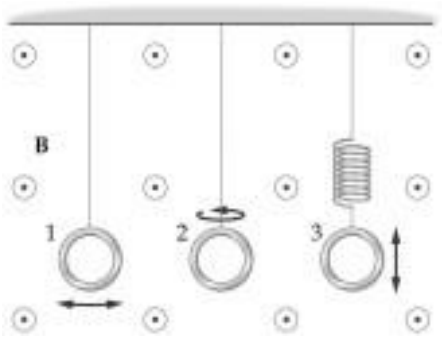
10) An object 4.0 cm in height is placed 8.0 cm in front of a concave mirror with a radius of curvature of 20.0 cm. What is the position of its image in relation to the mirror and what are its characteristics?

a) 40.0 cm on the other side of mirror, real, 6.0 times bigger
b) 10.0 cm on the other side of mirror, virtual, 10.0 times bigger
c) 18.0 cm on the same side of mirror, virtual, 2.25 times bigger
d) 40.0 cm on the other side of mirror, virtual, 5.0 times bigger

11) The maximum voltage of an ac signal is 8.0 V. What is the rms value of this voltage?

a) 4.0 V b) 6.2 V c) 5.7 V d) 11.3 V

12) The three loops of wire shown in the figure all subject to the same uniform magnetic field $\vec{B}$ that does not vary with time. Loop 1 oscillates back and forth as the bob in a pendulum, loop 2 rotates about a vertical axis, and loop 3 oscillates up and down at the end of a spring. Which loop, or loops, will have an induced emf?



a) Loop 1
b) Loop 2
c) Loop 3
d) All loops

Part 2: 6 Multiple Choice Questions (2 mark each)

1) A negative charge of -20 μC is placed on the x-axis at x=6 cm and an unknown charge Q is placed on the x-axis at x=-12 cm. What is the value of the unknown charge Q if the net electric field produced at the origin is zero?

a) 5 μC b) -5 μC c) 80 μC d) -80 μC

2) Two bulbs marked 200 watt-250 volts and 100 watt-250 volts are joined in series to 250 volts supply. The power consumed in circuit is:

a) 100 watt b) 33 watt c) 67 watt d) 300 watt.

3) The magnitude of the magnetic field at a distance of 5 cm from a current carrying wire is 1.2T. What is the magnitude of the magnetic field at a distance of 3 cm from the same wire?

a) 2T b) 1.2T c) 0.72T d) 18T

4) An object 2 cm high is placed 10 cm in front of a mirror. What type of mirror and what radius of curvature is needed for an image that is upright and 4 cm tall?

a) Concave, R = 20 cm
b) Concave, R = 40 cm
c) Convex, R = –10 cm
d) Convex, R = –20 cm

5) A circular coil of diameter 20 cm, with 16 turns is in a 0.13 Tesla field that is perpendicular to the coil plane. If the coil is rotated so its plane is parallel to the field in 0.01 s, find the average induced emf.

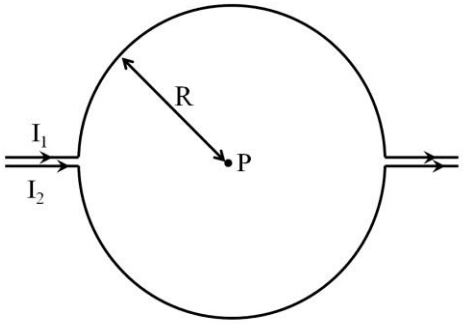
a) 6.5 V b) 4.6 V c) 0.41 V d) 26.1 V

6) An ideal transformer steps down 120 volts to 12 volts. If the resistance of the secondary coil is 2Ω, what is the current in the primary coil?

a) 12 A b) 6 A c) 1.2 A d) 0.6 A

Part 3: Solve the following four problems in the space provided in between showing all your steps (4 marks each)

Problem 1: In shown figure, two currents $I_1 = 11$ A and $I_2 = 8$ A are passing through two semicircles each of radius 15 cm.

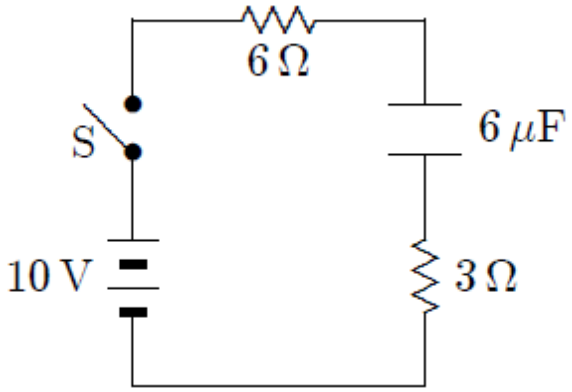


a) What is the magnitude of the net magnetic field produced at their common center P?

b) What will be the magnitude and direction of the force acting on an electron that passes through point P at a speed of 4×10^4 m/s towards the top of the page?

Problem 2: In the circuit shown, the capacitor is initially uncharged. At time t = 0, switch S is closed. Calculate:

a) the time constant of the circuit.

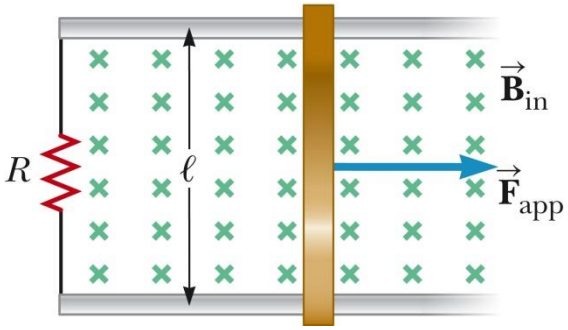


b) the current in the circuit when t = 13 μs

c) the charge of the capacitor at the moment when the current is 0.8 A?

Problem 3: A conducting rod with a length of 25 cm is placed on a U-shaped metal wire that has a resistance R of 8 Ω as shown in in the figure. The wire and the rod are placed in the plane of the paper. A constant magnetic field of strength 0.4 T is applied perpendicular into the paper. An applied external force moves the rod to the right with a constant speed of 6 m/s.

a) Determine the direction of the induced current in the wire. Explain your answer.



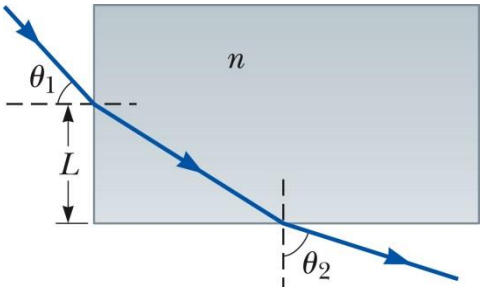
b) Calculate the magnitude of the induced current in the wire.

c) Calculate the power delivered by the applied external force.

d) What is the magnitude of the applied force which keeps the rod at constant velocity?

Problem 4: A light ray incident from air enters a rectangular block of plastic at an angle $\theta_1 = 45°$ and exits again into air from the adjacent side at an angle $\theta_2 = 76°$, as shown in the figure below.

a) Determine the index of refraction of the plastic



b) Given that the refractive index of diamond is 2.42, determine the speed of light in diamond.