Prince Sultan University
College of Humanities and Sciences
Department of Mathematics and Sciences

COURSE DETAILS:

PHYSICS II	**PHY205**	**Final Exam**
Semester:	First Semester - Term 221	
Date:	Tuesday, December 27, 2022	
Time Allowed:	120 minutes	

STUDENT DETAILS:

Student Name:	
Student Serial Number:	
Section and Instructor:	***Circle your section number:*** **Sec. 843 (9:00 AM)** **Sec. 847 (11:00 AM)** **Sec. 850 (8:00 AM)**

INSTRUCTIONS:

- You may use a scientific calculator that does not have programming or graphing capabilities. NO borrowing calculators.
- NO talking or looking around during the examination.
- NO mobile phones. If your mobile is seen or heard, your exam will be taken immediately.
- Show all your work when required and be organized.
- You may use the back of the pages for extra space but be sure to indicate that on the page with the problem.

GRADING:

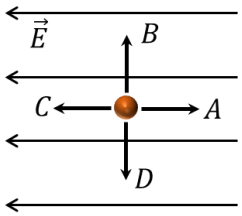
	Part 1	**Part 2**				**Total**
Student's Mark						
Full Mark	**20**	**20**				**40**

Part 1 (20 Marks): 20 multiple choice questions, 1 mark each
Indicate the answer choice that best completes the statement or answers the question

Q1. A uniform electric field $E = 350$ N/C is directed in the positive y-direction. Point A is located at $(0, 0)$ and point B is located at $(2\text{ cm}, 3\text{ cm})$ inside the field. What is the electric potential difference between the two points $(V_B - V_A)$?

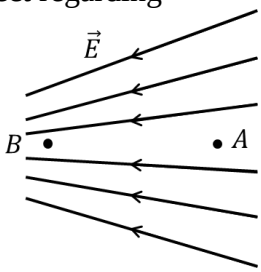
a) $+12.6$ V
b) $+7.0$ V
c) -7.0 V
d) -10.5 V

Q2. A Proton is placed in a uniform electric field directed as shown. Which arrow represents the direction of the electric force that will act on it?



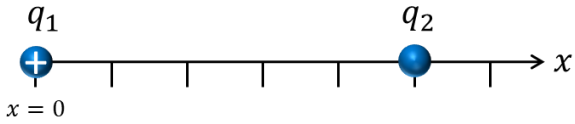
a) Arrow A
b) Arrow B
c) Arrow C
d) Arrow D

Q3. The electric field in a region of space is represented by the lines shown in the figure. A and B represent two points in the field. Which of the following statements is correct regarding the potential V and the magnitude of the electric field E at the two points?



a) $V_B > V_A$ and $E_B > E_A$
b) $V_B > V_A$ and $E_B < E_A$
c) $V_B < V_A$ and $E_B > E_A$
d) $V_B < V_A$ and $E_B < E_A$

Q4. Two charges are placed on the x-axis; $q_1 = 1.6\ \mu$C at $x = 0$ and an unknown charge q_2 is placed at $x = 5$ m. If the electric field at the point $x = 2$ m is zero, what is the unknown charge q_2?



a) -2.4 µC
b) $+2.4$ µC
c) -3.6 µC
d) $+3.6$ µC

Q5. When an electron is released from rest in a uniform electric field it gains a speed of 3×10^4 m/s. What is the change in the potential energy of the electron ΔU?

a) $+1.4 \times 10^{-25}$ J
b) $+4.1 \times 10^{-22}$ J
c) -1.4×10^{-25} J
d) -4.1×10^{-22} J

Q6. A parallel-plate capacitor of plate area 0.015 m^2 and separation 0.2 mm. The region between the plates is filled with a dielectric material with dielectric constant $\kappa = 6.7$. If the capacitor was charged using a 6 V battery, what will be the charge stored in the capacitor?

a) 26.7 nC
b) 44.5 nC
c) 13.4 nC
d) 37.1 nC

Q7. To charge a 15 μF capacitor you connect the uncharged capacitor in series to a 9 V battery and a 5×10^6 Ω resistor. What will be the charge on the capacitor after 50 seconds of charging?

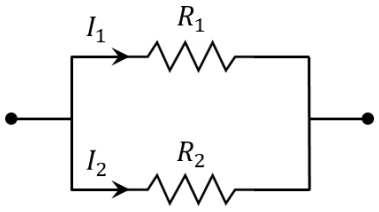
a) 6.57×10^{-5} C
b) 6.93×10^{-5} C
c) 7.70×10^{-6} C
d) 7.30×10^{-6} C

Q8. A capacitor charged by a 3 V battery stores energy U. If the same capacitor is charged by a 6 V battery, it stores

a) $U/4$
b) $2\,U$
c) $4\,U$
d) $U/2$

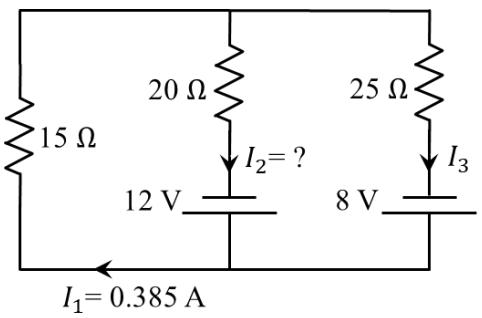
Q9. In the figure, the resistors $R_1 = 2$ kΩ and $R_2 = 8$ kΩ. If the current in R_1 is 2 mA, what is the current in R_2?

a) 8.0 mA
b) 1.0 mA
c) 0.5 mA
d) 2.0 mA



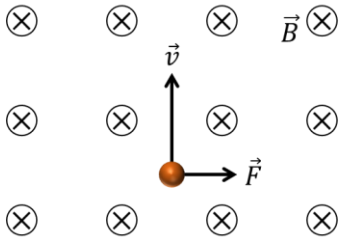
Q10. In the figure, given $I_1 = 0.385$ A, what is value of the current I_2?

a) 0.245 A
b) 0.311 A
c) 0.089 A
d) 0.111 A



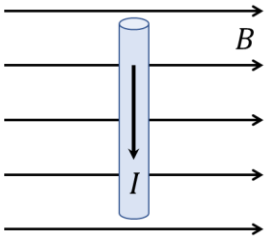
Q11. An unknown charge moving at 3×10^4 m/s towards the $+y$ direction enters a region of uniform magnetic field of magnitude $B = 0.4$ T directed in the $-z$ direction. The charge is affected by a force $F = 8.4 \times 10^{-2}$ N and directed in the $+x$ direction, as shown. What is the unknown charge?

a) $-3.5\ \mu$C
b) $+3.5\ \mu$C
c) $-7.0\ \mu$C
d) $+7.0\ \mu$C



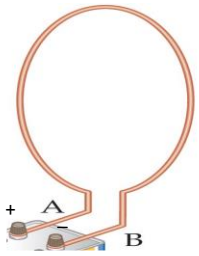
Q12. A current carrying wire is placed in a uniform magnetic field region as shown in the figure. What is the direction of the magnetic force acting on this wire?

a) Out of page ($+z$ direction)
b) Into the page ($-z$ direction)
c) $+x$ directrion
d) $-x$ direction



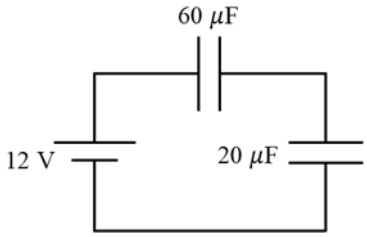
Q13. A circular loop in the plane of the page is connected to a battery as shown. Side A is connected to the positive terminal of the battery and side B is connected to the negative terminal. The direction of the magnetic field at the center of the loop will be:

a) Into the page ($-z$ direction)
b) Out of the page ($+z$ direction)
c) $+x$ direction
d) $-x$ direction



Q14. Two capacitors are connected to a 12 V battery as shown in the figure. What is the charge on the 60 μF capacitor?

a) 3.6×10^{-4} C
b) 9.0×10^{-5} C
c) 6.0×10^{-5} C
d) 1.8×10^{-4} C



Q15. According to Faraday's law of induction, an electric current is induced in a conducting coil placed in an external magnetic field when:

a) the strength of the magnetic field is changing
b) the area of the of the conducting coil is changing
c) both a and b are correct.
d) none of the above will induce an electric current.

Q16. A mirror of unknown type created an image with a magnification of +1. This mirror is:

a) Convex mirror
b) Concave mirror
c) Plane mirror
d) None of the above.

Q17. In ray tracing, the ray parallel to the principal (optical) axis of a concave mirror will always reflect:

a) perpendicular to the mirror
b) passing through the focal point of the mirror
c) parallel to the principal axis
d) passing through the center of curvature of the mirror.

Q18. Which of the following statements is NOT true regarding concave mirrors:

a) their focal point is in front of the mirror
b) their focal length is negative
c) they always form real images
d) Both b and c.

Q19. When the magnification of an image is -3, this image is:

a) Real, inverted, enlarged
b) Virtual, upright, enlarged
c) Real, upright enlarged
d) Virtual, inverted, enlarged.

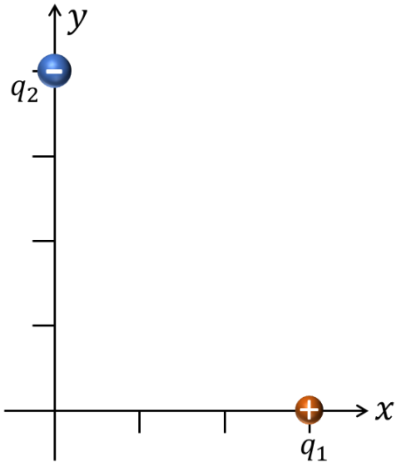
Q20. An object is located 2 m in front of a plane mirror, the distance between the object and the image formed by this mirror will be:

a) 2 m
b) 1 m
c) 4 m
d) Not enough information

Part 2 (20 marks): Solve the following problems in the provided space and show your detailed solution, including the used formulas and units.

Q1. (5 marks) A charge $q_1 = 3.2\ \mu$C is placed on the x-axis at $x = 3$ m and another charge $q_2 = -5.6\ \mu$C is placed on the y-axis at $y = 4$ m, as shown.

a) (2 marks) Determine the magnitude and direction of the force acting on q_2

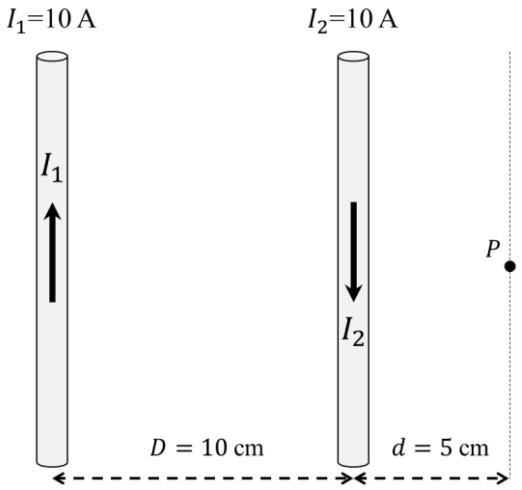


b) (2 mark) Determine the electric potential at the point $(3, 4)$ m

c) (1 mark) Determine the electric flux through a sphere of radius 4.5 m centered at the origin.

Q2. (5 marks) Two long straight wires are separated by (10 cm). The first wire carries a current of 10 A upward, the second carries a current of 10 A downward, as shown in the figure below.

a) (3 marks) Find the value and direction of the net magnetic field at the position P on the dashed line that is 5 cm to the right of wire 2.

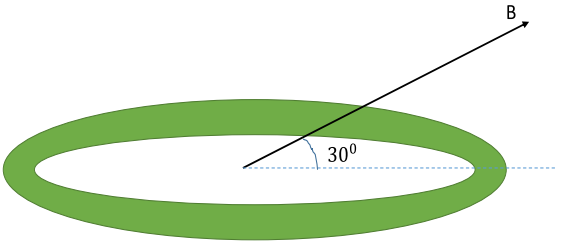


b) (1 mark) Calculate the force exerted on the first wire per 1 m length.

c) (1 mark) Are these wires going to attract or rebel?

Q3. (5 marks) A single conducting loop of wire has a radius of 30 cm and a resistance of 200 Ω. The loop is in uniform magnetic field $B = 0.3$ T directed at an angle $30°$ with the plane of the loop, as shown in the figure.

a) (2 marks) Calculate the magnetic flux in the loop.



b) (2 marks) If the magnetic field is reduced to zero in 0.2 s, what is the magnitude of the induced current?

c) (1 mark) If the magnetic field of part (a) remained constant and the loop kept motionless, is there going to be an induced electric current in the loop? Explain.

Q4. (5 marks) An object of height 1 m is placed 50 cm in front of a spherical mirror. If the image got formed 40 cm behind the mirror, answer the following questions:

a) (2 marks) Find the focal length of this mirror.

b) (1 mark) Is it a convex or concave mirror? Explain.

c) (1 mark) Find the height of the image.

d) (1 mark) Describe the image formed by this mirror.

End of questions.

Scratch Paper

Name: _____

TABLE OF CONSTANTS

Quantity		Value
Acceleration of gravity	g	9.8 m/s^2
Elementary charge	e	1.6×10^{-19} C
Electron's mass	m_e	9.11×10^{-31} kg
Proton's mass	m_p	1.67×10^{-27} kg
Permittivity of free space	ε_0	8.85×10^{-12} C^2/N.m^2
Coulomb's constant	k	$1/4\pi\varepsilon_0 \approx 9 \times 10^9$ N.m^2/C^2
Permeability of free space	μ_0	$4\pi \times 10^{-7}$ T.m/A

COMMON PREFIXES

Prefix		Value
mega	M	10^6
kilo	k	10^3
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}