Prince Sultan University
College of Humanities and Sciences

جامعة الأمير سلطان
كلية الإنسانيات والعلوم

Final Examination Cover Sheet

Course Code: PHY205 **Course Title:** Physics 2 **Term:** Fall Semester **Year**: 2023 /2024

Course Instructor(s): Prof. Mohamed Bououdina, Dr. Elham Dannoun, Dr. Hazem Abu-Farsakh

Exam Duration: 2 hours **Exam Date:** December 26, 2023 **Number of Exam Pages (including cover page):** 10

Exam Rules

During the exam:

- Students are **NOT** allowed to **TALK** to each other.
- Students should keep the **bags and abaya in the front of the exam hall.**
- Students are not allowed to **HAVE** or **USE CELL PHONE, SMART WATCHES, HEADPHONE or STUDY MATERIAL**.
- Students must **ensure that they have signed in and signed out.**

If you have any of the following items, give it to the invigilator right away before looking at the questions:

The PSU Honor Code

"أتعهد أنا الطالب الموقع أدناه بأنني قرأت التعليمات أعلاه وبأن أكون ملتزمًا بقوانين الجامعة"

"I have read the above guidelines and I do hereby pledge to conduct myself with honesty and integrity during the examination and abide by the rules and regulations of the University."

Student's Name:_____ **Student's Signature:** _____

Student's ID#:_____ **Student's Section#:** _____

Question No.	Marks	Student's Score
Question 1:	**20**	
Question 2:	**20**	
Total (40)		

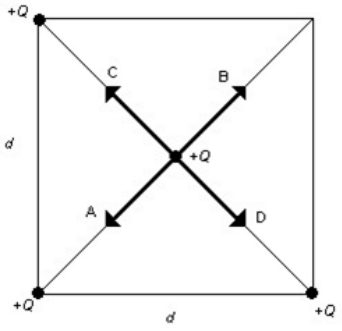
_____ _____

Marker's Signature **Reviewer's Signature**

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. Two charges, Q1 and Q2, are separated by a certain distance R. If the magnitudes of the charges are doubled and their separation is also doubled, then what happens to the electrical force between these two charges?
(a) It is doubled.
(b) It is halved.
(c) It is quadrupled.
(d) It remains the same.

Q2. Three equal positive charges are at three of the corners of a square of side d. A fourth charge of equal magnitude and same type is at the center of the square as shown in the Figure. Which of the arrows shown represents the net force acting on the charge at the center of the square?
(a) A
(b) B
(c) C
(d) D



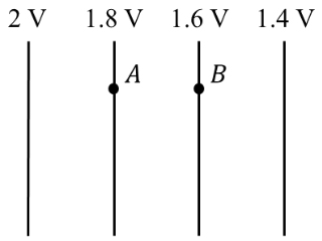
Q3. The Gaussian surfaces A and B enclose the same positive charge +Q. The area of Gaussian surface A is three times larger than that of Gaussian surface B. The flux of electric field through Gaussian surface A is:
(a) nine times larger than the flux of electric field through Gaussian surface B.
(b) three times larger than the flux of electric field through Gaussian surface B.
(c) equal to the flux of electric field through Gaussian surface B.
(d) three times smaller than the flux of electric field through Gaussian surface B.

Q4. Two-point charges, initially **2.0 cm** apart, experience a 1 N force. If they are moved to a new separation distance of **8.0 cm**, what is the electric force between them?
(a) 4 N
(b) 16 N
(c) 1/4 N
(d) 1/16 N

Q5. If you want to manufacture a parallel plate capacitor, which of the following statement might make larger valued capacitor:
(a) Increase the plate area.
(b) Decrease the separation distance.
(c) Increase the dielectric constant.
(d) All the above

Q6. When an electron moves in a direction opposite to the electric field, which of the following statements is correct:
(a) The electron's potential energy decreases, but the electric potential increases.
(b) The electron's potential energy increases, but the electric potential decreases.
(c) The electron's potential energy and the electric potential both increase.
(d) None of the above.

Q7. The figure shows equipotential surfaces with the value of potential marked for each line. If the distance between points A and B is 2.5 cm, what is the intensity of the electric field between these two points?

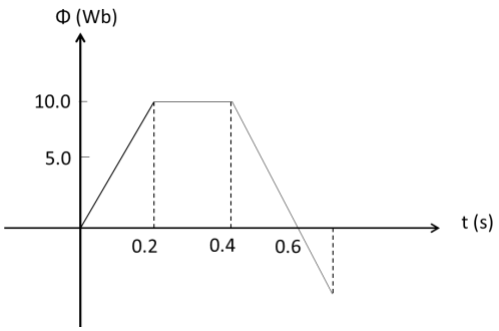


(a) 2 V/m
(b) 4 V/m
(c) 6 V/m
(d) 8 V/m

Q8. A proton is projected with a velocity of 7.0×10^3 m/s into a magnetic field of 0.60 T perpendicular to its direction of motion. What is the magnetic force acting on the proton?
(a) 3.4×10^{-16} N
(b) 4.2×10^{-16} N
(c) 13×10^{-16} N
(d) 6.7×10^{-16} N

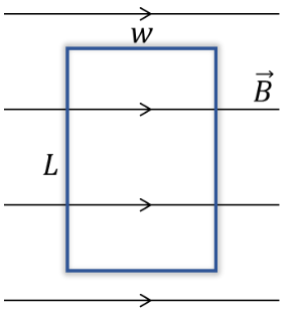
Q9. A proton moving to the right ($+x$-direction) enters a magnetic field pointing into the page ($-z$-direction). The direction of the force acting on the proton is:
(a) $+y$-direction
(b) $-y$-direction
(c) $-x$-direction
(d) $+z$-direction

Q10. The magnetic flux through a single-loop coil varies as function of time is illustrated in the Figure. What is the induced emf in the coil in the time interval from t = 0 to t = 0.2 seconds.



(a) -10 V
(b) -50 V
(c) -20 V
(d) -5 V

Q11. A rectangular loop of wire carrying a current of 2.0 A is placed in a magnetic field of strength is 0.40 T. The length of the loop L = 0.16 m and its width w = 0.04 m. What is the magnetic flux through the loop when the plane of the loop is parallel to the magnetic field, as shown in the figure?



(a) - 2.6×10^{-3} T·m^2
(b) +2.6×10^{-3} T·m^2
(c) Zero T·m^2
(d) 1.3×10^{-3} T·m^2

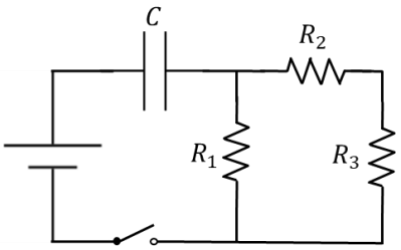
Q12. A conducting wire is doubled in length and tripled in diameter; its new resistance will be:

(a) $\frac{2}{9}$ the old resistance
(b) $\frac{2}{3}$ the old resistance
(c) $\frac{9}{2}$ the old resistance
(d) $\frac{3}{2}$ the old resistance

Q13. A battery that produces a potential difference V is connected to a 4-watt light bulb. Then, the 4-watt light bulb is replaced with a 1-watt light bulb. Which light bulb has greater resistance?

(a) The 4-watt light bulb
(b) The 1-watt light bulb
(c) Both light bulbs have equal resistance.
(d) Not enough information.

Q14. What is the time constant of the RC-circuit shown in the figure, given that $C = 350\ \mu$F and $R_1 = R_2 = R_3 = 45$ kΩ?

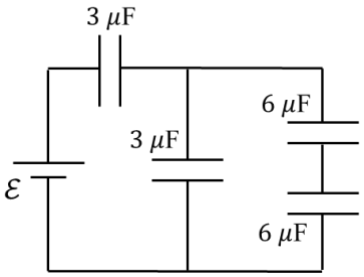


(a) 3.5 seconds
(b) 10.5 seconds
(c) 7 seconds
(d) 9 seconds

Q15. In the RC-circuit in the previous question the emf of the battery is 2 V and the capacitor was initially uncharged. If the switch is closed, what will be the charge on the capacitor after one time constant?

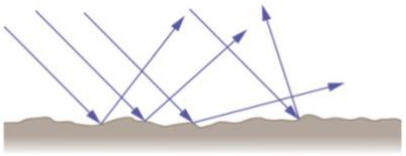
(a) 700 μC
(b) 350 μC
(c) 441 μC
(d) 259 μC

Q16. What is the equivalent capacitance of the capacitors shown in the figure?



(a) 9 μF
(b) 6 μF
(c) 3 μF
(d) 2 μF

Q17. The type of reflection indicated in the figure at the right is:



(a) The specular reflection that occurs on smooth surfaces.
(b) The specular reflection that occurs on rough surfaces.
(c) The diffuse reflection that occurs on smooth surfaces.
(d) The diffuse reflection that occurs on rough surfaces.

Q18. Which of the following mirrors forms a "Virtual, Upright, Enlarged" image?
(a) Plane Mirror
(b) Convex Mirror
(c) Concave Mirror
(d) All of the above.

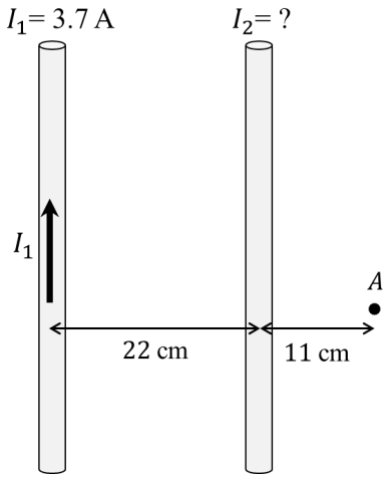
Q19. If the magnification of an image formed by a certain Mirror equals -0.7, then this image's characteristics are:
(a) Real, inverted, Reduced.
(b) Virtual, Upright, Reduced.
(c) Real, Upright, Reduced.
(d) Virtual, Inverted, Reduced.

Q20. Which one of the following is the correct value for the magnification of a plane mirror?
(a) +1
(b) -1
(c) +0.25
(d) -0.25

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) Consider two current-carrying wires as shown in the Figure.

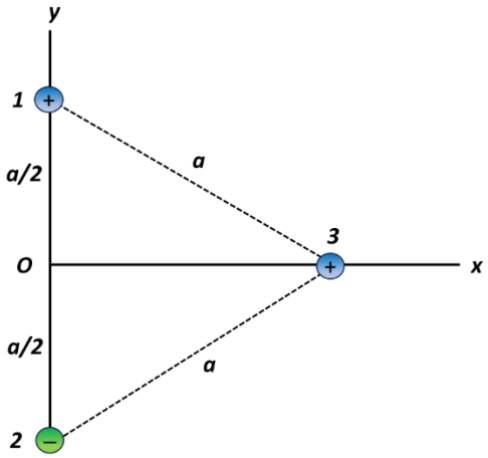
(a) If the net magnetic field at point A is zero, find the magnitude and direction of the current I_2. (3 marks)



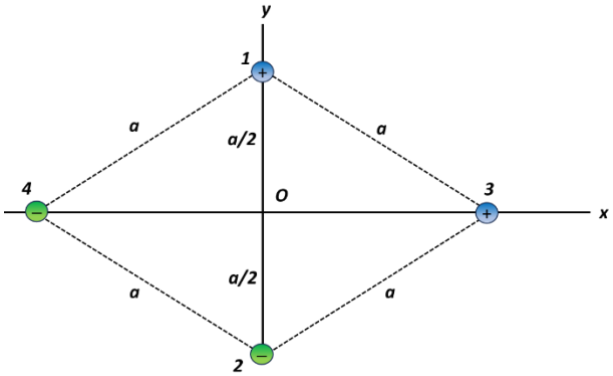
(b) If the length of the two wires is 10 cm each, find the magnitude and direction of the force acting on the first wire. (2 marks)

Q2. (5 marks) Three charges are placed at the vertices of an equilateral triangle of side a = 0.93 m, as shown in the Figure. $q_1 = q_3 = +7.3\ \mu C$ while $q_2 = -7.3\ \mu C$

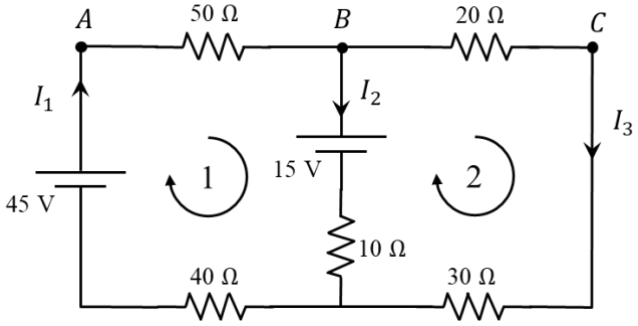
(a) (3 marks) Find the magnitude and direction of the net electric field created by the three charges on the origin.



(b) (2 mark) A fourth charge $q_4 = -7.3\ \mu C$ is added as shown in the Figure. Find the net electric potential at the origin.



Q3. Consider the electric circuit shown in the figure.



(a) (4 marks) Apply Kirchhoff's rules to determine the unknown currents.

(b) (1 mark) What is the potential difference between points A and C?

Q4. An object of height 50 cm is placed 40 cm in front of a convex mirror of a radius of curvature of 100 cm.

(a) (2 marks) Determine the location of the image.

(b) (1 mark) Determine the magnification of the image.

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

(d) (1 mark) Write the final characteristics of the image.

End of questions.

Scratch Paper

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
Coulomb's constant	k	9×10^9 N.m^2/C^2
Permittivity of free space	ε_0	8.85×10^{-12} C^2/N.m^2 $= 1/4\pi k$
Permeability of free space	μ_0	$4\pi\ x\ 10^{-7}$ T.m/A

COMMON PREFIXES

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