Beijing-Dublin International College

SEMESTER I FINAL EXAMINATION - 2018/2019

Beijing-Dublin International College

《UNIVERSITY PHYSICS 2》 BDIC2008J

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Time Allowed: 95 minutes

Instructions for Candidates

Full marks will be awarded for complete answer to All questions.

BJUT Student ID: _____ UCD Student ID: _____

I have read and clearly understand the Examination Rules of both Beijing University of Technology and University College Dublin. I am aware of the Punishment for Violating the Rules of Beijing University of Technology and/or University College Dublin. I hereby promise to abide by the relevant rules and regulations by not giving or receiving any help during the exam. If caught violating the rules, I accept the punishment thereof.

Honesty Pledge：_____ (Signature)

Instructions for Invigilators

Non-programmable calculators are permitted.
No rough-work paper is to be provided for candidates.

Part 1: Multiple Choice (3 marks each question, 30 marks altogether)

1. A closed spherical surface with radius a is in uniform electric field $\vec{E}$. There is no charge within the spherical surface. Then the electric flux Φ_E through the surface is

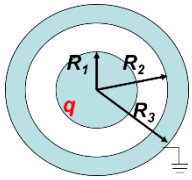
(A) $\Phi_E = 4\pi a^2 E$ (B) $\Phi_E = \pi a^2 E$

(C) $\Phi_E = 0$ (D) Φ_E cannot be determined without additional knowledge.

2. An electron is released from rest in a region of space with nonzero electric field. Which of the following statements is true?

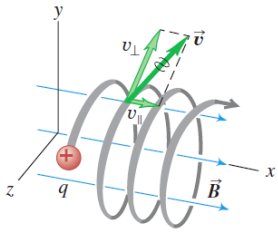
(A) The electron will move towards the region with higher potential.
(B) The electron will move towards the region with lower potential.
(C) The electron will move along a line of constant potential.
(D) Nothing can be concluded unless the direction of the electric field is known.

3. The small sphere has charge q distributed uniformly on it. Connect the conductor spherical shell to the earth with a ground wire. Then the charge on the outer spherical surface(R_3) is



(A) q (B) 0 (C) $-q$ (D) not certain

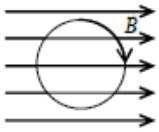
4. In a situation like that shown in the figure, the charged particle is a proton($q = 1.6\times10^{-19}C$) and the uniform, 0.5T magnetic field is directed along the x-axis. At t=0 the proton has velocity components $v_x = 2.0\times10^5$ m/s, $v_y = 0$, and and . $v_z = 2.0\times10^5$ m/s.Only the magnetic force acts on the proton. At t=0 the force on the proton is



(A) $-1.6\times10^{-14}\,\mathrm{N}\,\vec{j}$ (B) $1.6\times10^{-14}\,\mathrm{N}\,\vec{j}$

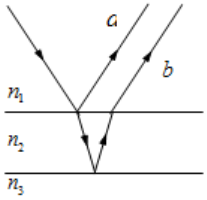
(C) $1.6\times10^{-14}\,\mathrm{N}\,\vec{j} + 1.6\times10^{-14}\,\mathrm{N}\,\vec{k}$ (D) $-1.6\times10^{-14}\,\mathrm{N}\,\vec{j} + 1.6\times10^{-14}\,\mathrm{N}\,\vec{k}$

5. The wire loop carries clockwise current. There is uniform magnetic field $\vec{B}$ directed to the right. What is the direction of the torque on the current loop?



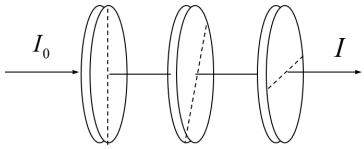
(A) Into the page (B) Out of the page
(C) Upward (D) Downward
(E) Zero

6. A ray of light is incident on a thin film. Two of the reflected rays are shown. Assume that rays a and b undergo a phase change because of differences in the indices of refraction. Which would be the proper ordering of the indices?



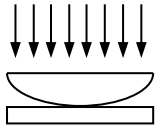
(A) $n_1 > n_2 > n_3$
(B) $n_2 > n_3 > n_1$
(C) $n_3 > n_2 > n_1$
(D) None of these; the specified phase changes cannot occur.

7. There are three polarizing sheets. The polarizing directions of the first and the third are perpendicular. The angle between the first and the second polarizing sheets is 45°. If the unpolarized incident light has intensity I_0, what is the transmitted intensity I through the device?



(A) $I_0/2$ (B) $I_0/4$ (C) $I_0/8$ (D) 0

8. Plane monochromatic light are incident normally on a plane convex lens. When you lay down the plane convex lens lightly the fringes will



(A) Move to the right (B) Move to the left
(C) Expand outward (D) Contract inward

9. An electron is accelerated by a voltage of 54V, the de Broglie wavelength of this electron is (Hint: $h = 6.63 \times 10^{-34}$ J·s; $m_e = 9.1 \times 10^{-31}$kg)

(A) 0.27 nm (B) 0.05 nm (C) 0.45 nm (D) 0.17 nm

10. The frequency of the photon emitted in the transition from the second excited level to the ground level of the hydrogen atom is

(A) 2.9×10^{15} Hz (B) 2.5×10^{15} Hz (C) 1.5×10^{34} Hz (D) 1.8×10^{34} Hz

Part 2: Blank Filling (20 marks altogether)

1. (3 points) The integral form of Maxwell equations is

$$\int_S \vec{D}\cdot d\vec{S} = \int_V \rho dV \qquad \text{(A)}$$

$$\int_L \vec{E}\cdot d\vec{l} = -\int_s \frac{\partial \vec{B}}{\partial t}\cdot d\vec{S} \qquad \text{(B)}$$

$$\int_S \vec{B}\cdot d\vec{S} = 0 \qquad \text{(C)}$$

$$\int_L \vec{H}\cdot d\vec{l} = \int_s (\vec{\delta} + \frac{\partial \vec{D}}{\partial t})\cdot d\vec{S} \qquad \text{(D)}$$

Determine which equation in the following descriptions is related to.

(1) The changing magnetic fields must be accompanied with electric fields. _____

(2) Magnetic field lines never have end points, they always form closed loops. _____

(3) There are electric fields surrounding a charge. _____

2. (4 marks) In the experiment of single-slit diffraction, light of wavelength λ is incident normally on a $a = 4\lambda$ width single slit. $a\sin\theta$ can be divided into _____ half-wavelength-bands corresponding to a 30° diffraction angle, and there is a _____(bright/dark) fringe on the screen for this diffraction angle.

3. (4 marks) When ultraviolet light with a wavelength of 254 nm falls on a clean copper surface, the stopping potential necessary to stop emission of photoelectrons is 0.181 V. The work function for this surface is _____and the photoelectric threshold wavelength for this copper surface is _____.

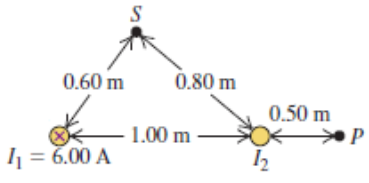
4. (4 marks) The wave function of a particle is $\psi(x) = \frac{1}{\sqrt{a}}\cos\frac{3\pi x}{2a}$ $(-a \le x \le a)$. The distribution probability of the particle at point $x=a/2$ is_____. At points x=_____ the distribution probability of the particle is maximum.

5. (5 marks) The angular momentum of a *3p* electron in hydrogen atom is_____ and the possible combinations of four quantum numbers are (__,__,__,__), (__,__,__,__), (__,__,__,__).

Part 3: Calculation(10 marks each question, 50 marks altogether)

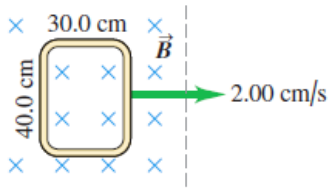
1. A thin spherical shell with radius R_1 is concentric with a larger thin spherical shell with radius R_2 and $R_2 > R_1$. Both shells are made of insulating material. The smaller shell has charge q_1 distributed uniformly over its surface, and the larger shell has charge q_2 distributed uniformly over its surface. Take the potential to be zero at an infinite distance from both shells. (a) What is the electric potential due to the two shells at the common centre? (b) What is the electric potential difference between the two surfaces?

2. Two long, straight, parallel wires are 1.00m apart. The wire on the left carries a current I_1 of 6.00A into the plane of the paper.
(a) What must the magnitude and direction of the current I_2 be for the net field at point *P* to be zero?



(b) What is the magnitude of the net field at *S*? (Hint: $\mu_0 = 4\pi \times 10^{-7}\ \mathrm{N/A^2}$)

3. A rectangle measuring 30.0 cm by 40.0 cm is located inside a region of a spatially uniform magnetic field of 1.25 T, with the field perpendicular to the plane of the coil. The coil is pulled out at a steady rate of 2.00cm/s traveling perpendicular to the field lines. The region of the field ends abruptly as shown. Find the electromotive force(emf) induced in this coil when it is (a) all inside the field; (b) partly inside the field.



4. A soap bubble(n=1.33) is floating in air. If the thickness of the bubble wall is 320nm, what is the wavelength of the visible light that is reflected least? Suppose incident angle is zero. (Hint: wavelength of visible light ranges from 380nm to 780nm approximately.)

5. Plane monochromatic waves with wavelength λ=600nm are incident normally on a plane transmission grating. The diffraction angle of the second principal maximum is 30°， and the third principal maximum is missing order.

(a) What is the grating constant a+b?

(b) What is the minimum value of a?

(c) How many bright fringes can we observe?