Beijing-Dublin International College

SEMESTER I FINAL EXAMINATION - 2017/2018

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. In which of the following problems would Gauss' law be useful?

(A) Finding the electric field at various points on the surface of a uniformly charged cylinder of finite length
(B) Finding the electric flux through the end surface of a uniformly charged cylinder
(C) Finding the electric field at various points on the surface of a uniformly charged cube
(D) Finding the electric flux through one side of a uniformly charged cube

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

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

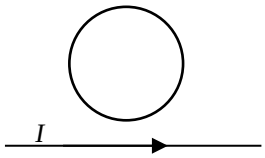
3. A paralled-plate capacitor is charged by connecting it to an ideal battery; the capacitor is then disconnected. Originally the energy stored in the capacitor is E_0. If the distance between the plates is doubled, then the new energy stored in the capacitor will be

(A) $4E_0$ (B) $2E_0$ (C) E_0 (D) $E_0/2$

4. Of the three vectors in the equation $\vec{F} = q\vec{v} \times \vec{B}$, which pair are always at right angles?

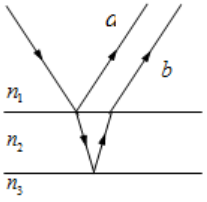
(A) None (B) $\vec{B}$ and $\vec{v}$
(C) $\vec{F}$ and $\vec{B}$ (D) All three must be at right angles.

5. The long, straight wire carries a constant current I to the right. What is the direction of the induced current in the wire loop?



(A) Clockwise
(B) Counter-clockwise
(C) There is no induced current.
(D) The induced current starts off in one direction, but at time t_r it stops and then begins flowing in the other direction.

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. A vertically oriented, ideal polarizing sheet transmits 50% of the incident unpolarized light. The polarizing sheet is now rotated through 45° .What fraction of the incident intensity now passes?

(A) 0% (B) 50% (C) 100% (D) Either 0% or 100%

8. Monochromatic light with a frequency well above the cutoff frequency is incident on the emitter in a photoelectric-effect apparatus. The frequency of the light is then doubled while the intensity is kept constant. How does this affect the stopping potential?

(A)The stopping potential will increase.
(B)The stopping potential will decrease.
(C)The stopping potential will remain the same.

9. The experiment which proved that De Broglie's hypothesis was right firstly is

(A) Rutherford experiment (B) Compton experiment

(C) Stern-Gerlach experimen (D) The Davisson-Germer experiment

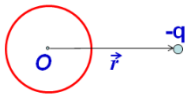
10. The four quantum numbers of a $3d$ electron in hydrogen atom can be

(A) (2, 1, 2, 1/2) (B) (3, 1, 1, −1/2)

(C) (1, 0, 1, −1/2) (D) (3, 2, 0, 1/2)

Part2: Blank Filling (20 marks altogether)

1.(5 marks) There is no charge on the conductor spherical surface. The vector from the spherical centre to point charge $-q$ is $\vec{r}$. The induced charge on the conductor spherical surface is _____; The electric field at point O produced by the induced charge is _____.



2. (3 points) The integral form of Maxwell equations is

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

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

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

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

Determine which equation the following descriptions are 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._____

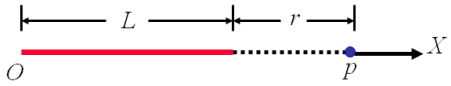
3. (4 marks) In the experiment of single-slit diffraction, light of wavelength λ is incident normally on a $a = 3\lambda$ width single slit. $a\sin\theta$ can be divided into _____ half-wavelength-bands corresponding to a 30° diffraction angle, and there is a _____(bright/dark) fringe on the screen for this diffraction angle.

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 point x=_____ the distribution probability of the particle is maximum.

5. (4 marks) Atoms can emit photons by spontaneous emission and stimulated emission. Photons produced by spontaneous emission_____ coherent, but photons produced by stimulated emission_____ coherent.(are/are not)

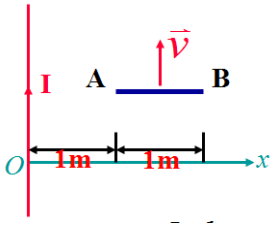
Part 3: Calculation(10 marks each question, 50 marks altogether)

1. A rod of length L has charge Q spread uniformly along it. Find the electric field of point P on the extended line of the rod and the distance from the right endpoint of the rod to the point P is r.



2. A conductor sphere of radius a has a charge Q and is surrounded by an isotropical dielectric (relative permittivity ε_r) up to a radius b. What is the potential at the centre of the sphere? (Let $V(\infty) = 0$)

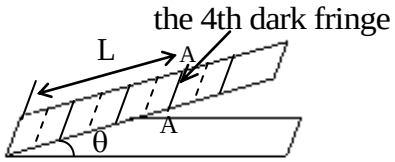
3. A long straight current I is 40A. A bar AB is perpendicular to current I and moves with speed *v*=2m/s in parallel with I. Find the motional electromotive force of AB bar. Which end has the higher electric potential?



4. The 500nm light strikes the two plates at normal incidence. The interference fringes of reflected lights from the two sides of the air wedge separating two glass plates are shown in the figure. It is the fourth dark fringe at A at a distance $L = 1.56cm$ from the wedge edge.

(1)What is the splitter angle θ?

(2)If the wavelength is 600nm, is it a bright or dark fringe at A?



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.

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

(2) What is the minimum value of a?

(3) How many bright fringes can we observe?