HOCHIMINH CITY
UNIVERSITY OF TECHNOLOGY AND EDUCATION
FACULTY FOR HIGH QUALITY TRAINING
GROUP OF PHYSICS SUBJECTS

FINAL EXAM
1st SEMESTER – ACADEMIC YEAR 2020-2021
Subject: Principles of Physics 2
Course Number: PHYS130502E
Test number: 01 (2 pages).
Duration: 90 minutes.

Note:
+ Students are allowed to use one hand-written A4 paper sheet as a memory aid.
+ Proctors are NOT allowed to explain anything related to contents of the test.
+ The permeability of free space is $\mu_0 = 4\pi\times10^{-7}$ T.m/A. *The Coulomb constant is* $k = 9.00 \times 10^9$ N.m^2/C^2. *The speed of electromagnetic wave is* $C=3\times10^8$ m/s.

Question 1: (0.5 marks) Hospital personnel must wear special conducting shoes while working around oxygen in an operating room. What might happen if the personnel wore shoes with rubber soles?

A. She could be charged by the friction with the floor while walking.
B. The charge on her body could discharge with a spark possibly causing an explosive burning situation.
C. All of A and B.
D. None of A or B.

Question 2: (0.5 marks) A cubical gaussian surface surrounds a segment of a long, straight, charged filament that passes perpendicularly through two opposite faces (Figure 1). No other charges are nearby. Through how many of the cube's faces is the electric flux zero?

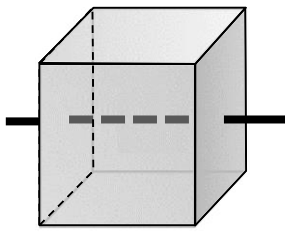


Figure 1.

A. 0 **B.** 2 **C.** 4 **D.** 6

Question 3: (0.5 marks) A beam of charged particles is projected in to a region of magnetic field as in Figure 2. Choose the correct statement(s) in the following ones!

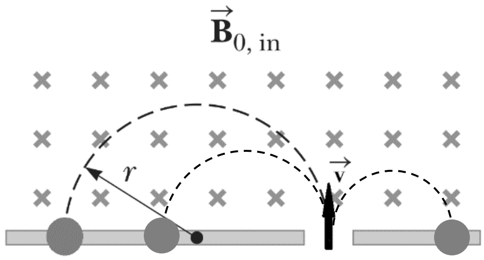


Figure 2.

A. If the particles are negatively charged, the beam deflects to the right.
B. Particles with smaller speed will have larger orbit.
C. The heavier particles will have larger radius *r* is.
D. If the magnitude of charge of the particle is small, its orbit is large.

Question 4: (0.5 marks) An electromagnetic wave with a peak magnetic field magnitude of 1.50×10^{-7} T has an associated peak electric field of what magnitude?

A. 5.00×10^{-16} N/C **B.** 2.00×10^{16} N/C
C. 2.20×10^4 N/C **D.** 45.0 N/C

Question 5: (1.0 mark) A spectral line occur at angles of 23.8° in the second-order spectrum of a grating spectrometer. If the grating has 3 660 slits/cm, what is the wavelength of the light?

Question 6: (1.0 mark) Eddy currents can produce significant drag, called magnetic damping, on the motion involved. Consider the apparatus shown in Figure 3, which swings a metal pendulum bob between the poles of a strong magnet. Significant drag acts on the bob as it enters and leaves the field, quickly damping the motion. Define the direction of the eddy currents in the bob at positions (1) and (2). Explain your answer.

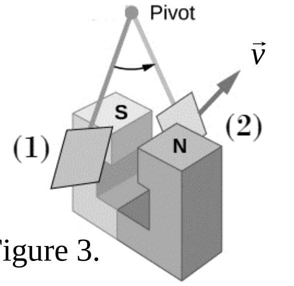


Figure 3.

Question 7: (2.0 marks) Three charged particles are at the corners of an equilateral triangle as shown in Figure 4.

a) Determine the direction and the magnitude of the electric field at the position of the 7.00-μC charge due to the 4.00-μC and –2.00-μC charges.

b) Calculate the potential energy of this charge system.

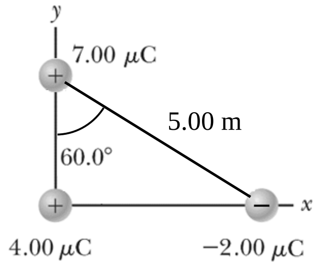


Figure 4.

Question 8: (2.0 marks) Three long, straight, parallel wires each carry a current of I = 2.50 A. Figure 5 is an end view of the wires, with each current coming out of the page. Taking a = 2.00 cm.

a) Determine the magnitude and direction of the magnetic field at point A.
b) Find the force that the current (2) acts on a unit length of the wire carrying the current (1).

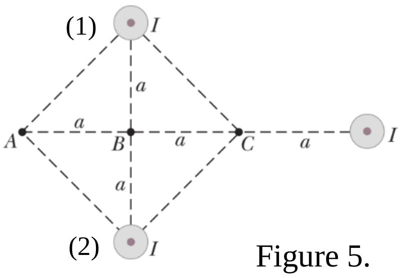


Figure 5.

Question 9: (2.0 marks) An oil film (n = 1.45) floating on water (n_w = 1.33) is illuminated by white light at normal incidence. The film is 280 nm thick.

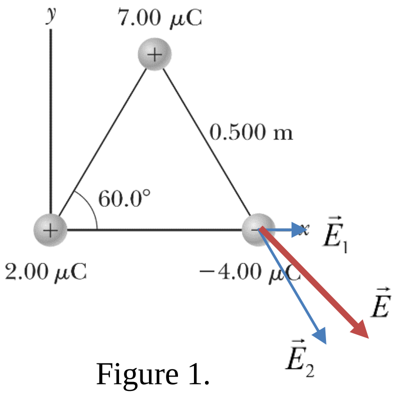
a) Find the wavelength of the light in the visible spectrum most strongly reflected.
b) Find the wavelength of the light in the visible spectrum that produces destructive interference in the reflected light.

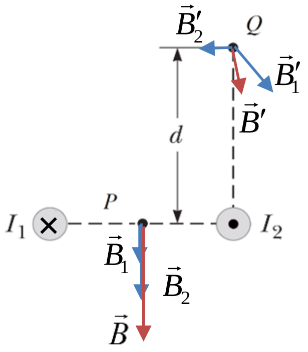
The End

ELO of the subject (knowledge)	Test contents
[ELO 1.1]: Understanding various concepts, and laws related to electric and magnetic fields, and the theorem of electromagnetic field.	Questions: 1, 2, 3, 4, 6, 7, 8
[ELO 2.1]: Applying the knowledge of electric and magnetic fields to explain phenomena and to solve the related problems.	Questions: 1, 2, 3, 4, 6, 7, 8
[ELO 3.1]: Understanding various concepts, and laws related to ray optics and wave optics	Question: 5, 9
[ELO 3.2]: Applying the knowledge of ray and wave optics to explain phenomena and to solve the related problems.	Question: 5, 9

Date: January 11th, 2021
Head of Group of Physics Subjects
(Sign and write full name)

SOLUTIONS, KEYS AND SCORES
For Questions in Final Exam of Principles of Physics 2
Edited by: Phan Gia Anh Vu
Date of Exam: July 20th 2020

Question	Answer	Score
1	**C.** All of A and B.	0.5
2	**B.** 2	0.5
3	A. If the particles are negatively charged, the beam deflects to the right. **C.** The heavier particles will have larger radius *r* is.	0.5
4	**D.** 45.0 N/C	0.5
5	$d\sin\theta_{bright} = m\lambda$ $\lambda = \frac{d\sin\theta_{bright}}{m}$ $d = \frac{1\times10^{-2}}{3660}$	0.5 0.5
6		0.5 0.5
7	a) The electric field at the position of the –4.00-μC charge is the superposition of the electric fields $\vec{E}_1$ and $\vec{E}_2$ created by 2.00-μC and 7.00-μC charges. respectively.  Figure 1. $\vec{E}_1 = \frac{9\times10^9\times(2\times10^{-6})}{0.5^2}\hat{i} = 7.2\times10^4\hat{i}$ $\vec{E}_1 = \frac{9\times10^9\times(7\times10^{-6})}{0.5^2}\left(\hat{i}\cos60° - \hat{j}\sin60°\right)$ $= 12.6\times10^4\left(\hat{i} - \hat{j}\sqrt{3}\right)$ Thus: $\vec{E} = \vec{E}_1 + \vec{E}_2 = 19.8\times10^4\hat{i} - 21.8\times10^4\hat{j}$ The magnitude of $\vec{E}$ is: 29.4×10^4 N.m^2/C^2 b) The electric force exerting on the –4.00-μC charge is: $\vec{F} = q\vec{E} = -4\times10^{-6}\left(19.8\times10^4\hat{i} - 21.8\times10^4\hat{j}\right) = \left(-79.2\times10^{-2}\hat{i} + 87.2\times10^{-2}\hat{j}\right)$N The magnitude of $\vec{F}$ is: 1.18 N	0.5 0.5 0.5 0.5 0.5

8	a) The magnetic field at P is the superposition of the magnetic fields $\vec{B}_1$ and $\vec{B}_2$ (shown in the figure 2) created by I_1 and I_2 currents. respectively. The total magnetic field at P is $\vec{B}=\vec{B}_1+\vec{B}_2$. Because $\vec{B}_1$ and $\vec{B}_2$ have the same direction. $\vec{B}$ has the same direction with them. The magnitude of the fields: $B_1=\frac{\mu_0 I_1}{2\pi d/2}=\frac{2\times10^{-7}\times2}{0.15}=26.7\times10^{-7}$ T $B_2=\frac{\mu_0 I_2}{2\pi d/2}=\frac{2\times10^{-7}\times4}{0.15}=53.3\times10^{-7}$ T $B=B_1+B_2=80.0\times10^{-7}$ T  Figure 2. b) The magnetic field at Q is the superposition of the magnetic fields $\vec{B}'_1$ and $\vec{B}'_2$ (shown in the figure 2) created by I_1 and I_2 currents. respectively. $\vec{B}'_1=\frac{\mu_0 I_1\cos45°}{2\pi\sqrt{2}d}(\hat{i}-\hat{j})=\frac{2\times10^{-7}}{0.3}(\hat{i}-\hat{j})=6.67\times10^{-7}(\hat{i}-\hat{j})$T $\vec{B}'_2=\frac{\mu_0 I_2}{2\pi d}(-\hat{i})=\frac{2\times10^{-7}\times4}{0.3}(\hat{i}-\hat{j})=26.7\times10^{-7}(-\hat{i})$T $\vec{B}'=\vec{B}'_1+\vec{B}'_2=(-20.0\hat{i}-6.67\hat{j})\times10^{-7}$ T. The magnitude of $\vec{B}'_1$ is 21×10^{-7} T	0.5 0.5 0.5 0.5
9	a. For constructive and destructive interference. we require: $2nt=m\times\lambda_{green}$. $n=1.25$ $2nt=(m'+0.5)\times\lambda_{purple}$ $\frac{\lambda_{green}}{\lambda_{purple}}=\frac{m'+0.5}{m}=\frac{520}{416}=\frac{5}{4}=\frac{2.5}{2}\rightarrow m=m'=2;$ $t=\frac{m\times\lambda_{green}}{2n}=\frac{2\times520\,nm}{2\times1.25}=416\,nm$ b. No. it isn't $2nt=m'\lambda_{ultraviolet}\rightarrow m'=\frac{2nt}{\lambda_{ultraviolet}}=\frac{2\times1.25\times416\,nm}{260\,nm}=4$ This ultraviolet light has constructive interference on the surface of the coated film.	0.5 0.5 0.5 0.5