

انسباير ملزمة الوحدة الأولى حول التأثير الكهروضوئي وكومتون ودي برولي



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ← المناهج الإماراتية ← الصف الثاني عشر المتقدم ← فيزياء ← الفصل الثالث ← ملفات متنوعة ← الملف

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المزيد من مادة
فيزياء:

التواصل الاجتماعي بحسب الصف الثاني عشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف الثاني عشر المتقدم والمادة فيزياء في الفصل الثالث

ملخص وأوراق عمل الدرس الأول Nucleus The من وحدة physics particle and Nuclear منهج انسباير

1

مذكرة الدرس الثاني Atom the and Theory Quantum من وحدة Atoms in Electrons منهج انسباير

2

أوراق عمل الدرس الأول التيار الكهربائي من الوحدة الخامسة التيار والمقاومة متبوعة بالإجابات

3

ملخص وحلول الدرس الأول التيار الكهربائي من الوحدة الخامسة التيار والمقاومة

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ملخص الدرس الأول التيار الكهربائي من الوحدة الخامسة التيار والمقاومة

5

Topic 6 – Quantum Physics

Subtopic 6.1: The Photoelectric Effect

KPI 6.1.1

1. Which of the following best describes the photoelectric effect?

- A. The reflection of light from a metal surface.
- B. The emission of electrons when a metal is heated to high temperatures.
- C. The absorption of photons by atoms, causing them to emit visible light.
- D. The emission of photoelectrons when certain metals are exposed to electromagnetic radiation.

KPI 6.1.1

2. The photoelectric effect provided evidence for which of the following?

- A. The wave nature of light.
- B. The particle nature of light.
- C. The absorption of light by metals.
- D. The reflection of light from surfaces.

KPI 6.1.2

3. Which of the following will decrease the energy of a photon?

- I. Increasing its wavelength
- II. Decreasing its wavelength
- III. Increasing its frequency
- IV. Decreasing its frequency

- A. I and III
- B. I and IV
- C. II and III
- D. II and IV

KPI 6.1.2

4. The energy of a photon is inversely proportional to its ____ and directly proportional to its ____.

- A. speed intensity
- B. frequency wavelength
- C. intensity speed
- D. wavelength frequency

KPI 6.1.3, 6.1.4

5. In the photoelectric effect, if the incident photons have a wavelength more than the threshold wavelength, ____.

- A. electrons will be ejected from the metal surface
- B. there will be photoelectric current
- C. no electrons will be emitted from the metal surface
- D. the kinetic energy of the ejected electrons increases

KPI 6.1.4

6. Which feature of the photoelectric effect supports the quantum (photon) model of light?

- A. The emission of electrons depends on the amplitude of the light wave.
- B. The energy of emitted electrons increases with exposure time.
- C. The emission of electrons depends on the frequency of light, not its intensity.
- D. Electrons can be ejected even if light energy is below the threshold frequency.

KPI 6.1.5

7. In a photoelectric-effect experiment, what is the role of the photocell?

- A. To store electrical energy for later use.
- B. To amplify the intensity of the incoming light.
- C. To convert electrical energy into mechanical motion.
- D. To generate an electric current when photons strike the metal surface.

KPI 6.1.5, 6.1.6

8. Which of the following decreases if we decrease the brightness of the light received by the cathode of a photoelectric cell?

- A. The frequency of the light
- B. The wavelength of the photons
- C. The speed of the photons
- D. The number of photons per second traveling in the beam

KPI 6.1.6

9. A light beam falls on a metal surface and electrons are ejected. Which of the following is true regarding the photoelectrons if the intensity of the light is increased?

	Number of photoelectrons	Maximum kinetic energy
A.	Increases	Increases
B.	Increases	Remains the same
C.	Remains the same	Remains the same
D.	Remains the same	Increases

KPI 6.1.7, 6.1.8

10. If a metal has a work function of 3.0 eV, which of the following photons can eject an electron?

- I. A photon with $\lambda = 300 \text{ nm}$
- II. A photon with $\lambda = 400 \text{ nm}$
- III. A photon with $\lambda = 700 \text{ nm}$

- A. I only
- B. III only
- C. I and II only
- D. I, II and III

KPI 6.1.8

11. What is the energy, in eV, of a photon that has a wavelength of 620 nm?

- A. 1 eV
- B. 2 eV
- C. 3 eV
- D. 4 eV

KPI 6.1.9

12. Two metal surfaces A and B have different work functions, such that the work function of A is greater than the work function of B. If the same light shines on both surfaces, which of the following best describes the difference between the electrons emitted from the two surfaces?

- A. More electrons are emitted from A than from B
- B. Fewer electrons are emitted from A than from B
- C. Electrons emitted from A have less energy than those emitted from B
- D. Electrons emitted from A have more energy than those emitted from B

KPI 6.1.9

13. A certain metal has a work function of ϕ . Which of the following is closest to the cutoff frequency of this surface?

- A. hc/ϕ
- B. ϕ/hc
- C. ϕ/h
- D. h/ϕ

KPI 6.1.10

14. Which of the following statements is incorrect?

- A. Threshold frequency depends on the metal used
- B. The emission of photoelectrons is an instantaneous process
- C. Photoelectric emission does not occur below the threshold frequency
- ✓ D. The number of photoelectrons emitted per unit time increases with the frequency of the incident light

KPI 6.1.11

15. Photons are incident upon a metal surface with work function of 8.0 eV , and photoelectrons with maximum kinetic energy of 12.0 eV are emitted from the surface. What is the energy of an incident photon?

- A. 0.67 eV
- B. 1.5 eV
- C. 4.0 eV
- D. 20 eV

KPI 6.1.8, 6.1.11

16. A light of wavelength 300 nm is incident on Beryllium metal which has a work function of 3.90 eV . Calculate the maximum kinetic energy of the photoelectrons.

- A. 0.23 eV
- B. 1.22 eV
- C. 3.57 eV
- D. 4.38 eV

KPI 6.1.11

17. A material with a threshold frequency of f_0 is illuminated with light of frequency $2.5 f_0$. The maximum kinetic energy of the ejected photoelectrons is ____.

- A. $1.0 hf_0$
- B. $1.5 hf_0$
- C. $2.5 hf_0$
- D. $3.5 hf_0$

KPI 6.1.11, 6.1.12

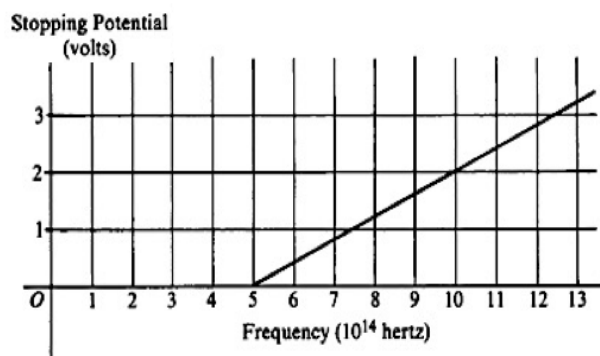
18. A photocell has the metal aluminum with a work function of 4.08 eV . What is its stopping potential if photons of energy 6.40 eV strike the surface of the metal?

- A. 1.56 eV
- B. 2.32 eV
- C. 3.77 eV
- D. 6.55 eV

KPI 6.1.13

Questions 19 to 21

The graph below shows the variation of the stopping voltage V_{stop} in terms of the incident frequency f .



19. What is the cutoff frequency?

- A. 0 Hz
- B. $2.0 \times 10^{14} \text{ Hz}$
- C. $4.0 \times 10^{14} \text{ Hz}$
- D. $5.0 \times 10^{14} \text{ Hz}$

20. What is the work function?

- A. 1.8×10^{-19} J
- B. 2.2×10^{-19} J
- C. 3.3×10^{-19} J
- D. 2.4×10^{-18} J

21. Determine Planck's constant from the data provided in the graph.

- A. 6.1×10^{-34} Js
- B. 6.3×10^{-34} Js
- C. 6.4×10^{-34} Js
- D. 6.8×10^{-34} Js

Free Response:

KPI 6.1.4

1. True or false?

- a. Light with a frequency below the threshold can eject electrons if its intensity is high enough.
- b. The energy of emitted electrons depends only on the brightness of the light.
- c. Increasing the intensity of light increases the number of ejected electrons but not their energy.
- d. Electrons are ejected with a time delay after light exposure, as predicted by wave theory.

KPI 6.1.2

2. Which has more energy, a photon of ultraviolet radiation or a photon of yellow light?

KPI 6.1.4

3. List the features of the photoelectric effect that can't be explained with classical physics or with the wave theory of light.

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KPI 6.1.8, 6.1.11

4. The work function for zinc is 4.31 eV .

- a. Find the cutoff wavelength for zinc.
- b. If photons of energy 5.50 eV are incident on zinc, what is the maximum kinetic energy of the ejected photoelectrons?

KPI 6.1.2, 6.1.7, 6.1.9, 6.1.11

5. When a light beam of wavelength $2.0 \times 10^{-7} \text{ m}$ falls on a metallic plate of a photoelectric cell, electrons with a maximum kinetic energy of $3.9 \times 10^{-19} \text{ J}$ are emitted.

- a. Find the energy of each incident photon.
- b. Find the work function of the metal.
- c. Find the threshold wavelength of light that causes the metal to release photoelectrons.

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KPI 6.1.3, 6.1.9, 6.1.7, 6.1.11

6. The work function for two metals X and Y are given in the table below.

	Metal X	Metal Y
Work function/ J	3.3×10^{-19}	13.2×10^{-19}

- a. Calculate the threshold wavelength for the metals X and Y .
- b. Light of wavelength $3.0 \times 10^{-7} \text{ m}$ is incident on the surface of the metals.
 - i. Which of the metals X or Y exhibit photoelectric effect?
 - ii. For the metal which exhibits photoelectric effect, calculate the maximum kinetic energy of the photoelectrons.

KPI 6.1.4, 6.1.7, 6.1.11, 6.1.12

7. Two light sources are used in a photoelectric experiment. When green light of energy $2.64 \times 10^{-18} \text{ J}$ is used, photoelectrons with a maximum kinetic energy of $3.2 \times 10^{-19} \text{ J}$ are released.

- a. Find the frequency of the incident light.
- b. Find the stopping potential.
- c. Find the work function of the metal used in the photocell.

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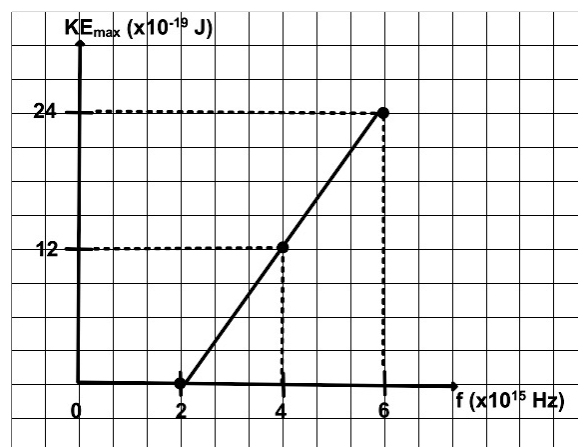
KPI 6.1.12

8. If the stopping potential required to halt photoelectrons is 1.5 V, what is the maximum kinetic energy of the emitted electrons in joules and in eV?

KPI 6.1.13

9. During a photoelectric effect experiment, a student plotted the the maximum **kinetic energy** versus **frequency** graph as shown below.

- Use the graph to find the threshold frequency.
- Use the data from the graph to calculate Planck's constant.
- Calculate the work function of the cathode.

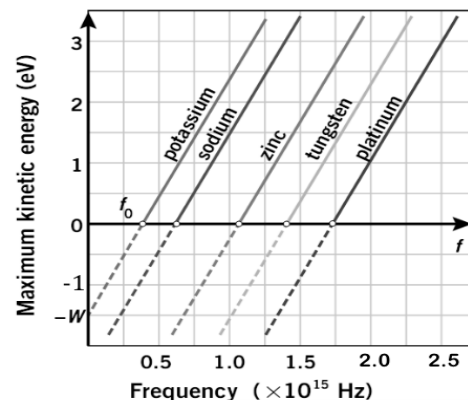


KPI 6.1.13

10. The maximum kinetic energy versus frequency graph for five different metals is as shown below. Use the graph to complete the table below.

- Use the graph to complete the table below.

Metal with highest threshold wavelength	
The stopping potential for platinum when light of frequency 2.25×10^{15} Hz is incident on the metal	
Metal with a threshold frequency of approximately 1.1×10^{15} Hz	



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- Find the Planck's constant from the graph.

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Subtopic 6.2: The Compton's Effect

KPI 6.2.1

1. What is Compton Scattering?

- A. The scattering of light by particles
- B. The scattering of electrons by photons
- C. The scattering of photons by electrons
- D. The scattering of neutrons by protons

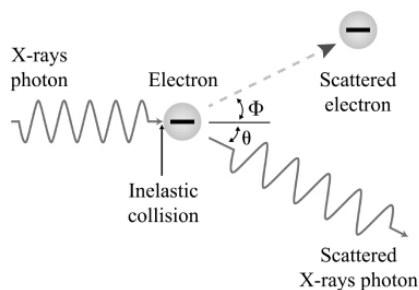
KPI 6.2.2

2. Which of the following phenomena does Compton Scattering explain?

- A. Reflection of light
- B. Polarization of light
- C. Refraction of light
- D. Change in wavelength of X-rays when they collide with matter

KPI 6.2.2

3. The figure below represents the Compton scattering.



Which of the following is true regarding the **wavelength** of the scattered photon?

- A. Increases as it loses energy
- B. Decreases as it loses energy
- C. Increases as it gains energy
- D. Decreases as it gains energy

KPI 6.2.3

4. What is the main principle behind Compton Scattering?

- A. Conservation of energy
- B. Conservation of momentum
- C. Conservation of charge
- D. Conservation of mass

KPI 6.2.3

5. Compton shift depends on which of the following?

- I. Wavelength
- II. Scattering angle
- III. Frequency

- A. I only
- B. II only
- C. III only
- D. I and III

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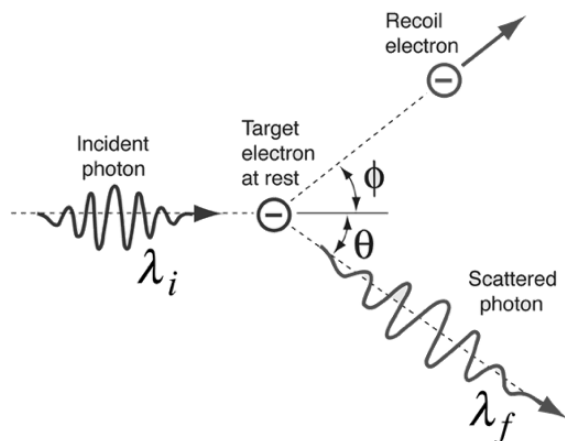
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Free Response:

KPI 6.2.1, 6.2.2

1. use the figure below to answer the questions.



- Describe the effect represented by the figure below and explain the main idea it supports.
 - What happens to the wavelength and frequency of an incident photon in a Compton effect experiment?
 - How does the wavelength of the scattered photon λ_f compare with that of the incident photon λ_i ?
 - How does the energy of the scattered photon E_f compare with that of the incident photon E_i ?
 - Tick (✓) the box(es) that correctly completes the sentence below.
The process shown in the figure above provided evidence for the ____.
- ☐ wave nature of light
 - ☐ particle nature of light
 - ☐ dual nature of light

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KPI 6.2.3

2. In a Compton scattering experiment, the incident X-rays have a wavelength of $3.00 \times 10^{-12} \text{ m}$ and are scattered by free electrons in graphite. If the scattering angle is 60.0° and $\left(\frac{h}{mc}\right)$ for an electron is $2.42 \times 10^{-12} \text{ m}$, what is the wavelength of the scattered X-rays?

KPI 6.2.3

3. X - rays of wavelength $2.00 \times 10^{-10} \text{ nm}$ are scattered from a block of material. The scattered x - rays are observed at an angle of 45.0° to the incident beam.

a. Calculate the shift in wavelength of the x - rays.

b. Calculate the wavelength of the x-rays.

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Subtopic 6.3: The Dual Nature of Light and Matter

KPI 6.3.1

Which of the following particles exhibit wave-like behavior according to de Broglie's hypothesis?

- A. Electrons
- B. Protons
- C. Neutrons
- D. All of the above

KPI 6.3.2

3. As the momentum of a particle of mass m increase, its wavelength increases.

- A. Increases
- B. Decreases
- C. Stays the same
- D. Goes to zero

KPI 6.3.1, 6.3.2

An electron and a proton are moving and have the same de Broglie wavelength. Which of the following are also the same for the two particles? (nonrelativistic particles)

- A. speed
- B. kinetic energy
- C. momentum
- D. frequency

KPI 6.3.2

1. Calculate the speed of a proton if it has a de Broglie's wavelength of $3.97 \times 10^{-14}m$.

- A. $1.00 \times 10^{-7}m/s$
- B. $1.00 \times 10^7m/s$
- C. $3.00 \times 10^8m/s$
- D. $2.52 \times 10^{13}m/s$

KPI 6.3.2

2. Calculate the de Broglie's wavelength of an electron moving at a speed of $2 \times 10^7m/s$.

- A. $3.64 \times 10^{-11}m$
- B. $7.28 \times 10^{-11}m$
- C. $14.5 \times 10^{-11}m$
- D. 2.74×10^4m

KPI 6.3.2

A proton, an ant, and a baseball each have the same kinetic energy. Rank their de Broglie wavelengths from smallest to largest.

- A. proton, ant, baseball
- B. baseball, ant, proton
- C. ant, proton, baseball
- D. baseball, proton, ant

KPI 6.3.3

According to the Einstein relationship for photons, what is the relationship between the energy (E) and frequency (f) of a photon?

- A. $E = hf$
- B. $E = h\lambda$
- C. $E = mc^2$
- D. $E = p^2/2m$

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Free Response:

KPI 6.3.2

1. Rank the de Broglie wavelengths from shortest to longest for the proton, electron and helium nuclei, all moving at the same speed. Justify your answer.

KPI 6.3.2

2. Louis de Broglie extended the idea of wave-particle duality to all of nature with his matter-wave equation. Using this equation, find the de Broglie wavelength of a helium nucleus of mass $6.6 \times 10^{-27} \text{ kg}$ moving with a speed of $2.0 \times 10^6 \text{ m/s}$.

KPI 6.3.2

3. Compare the de Broglie wavelength for an electron of mass $9.11 \times 10^{-31} \text{ kg}$ moving at a speed equal to $1.00 \times 10^7 \text{ m/s}$ with that of a baseball of mass 0.145 kg pitched at 45.0 m/s .

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