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## Grade 12 Physics

## Class 15: Quantum Mechanics

- \_\_\_\_\_ 1. As a glowing black body gets cooler, what happens to its colour and what happens to the brightness of the light it emits?
- (a) colour gets more blue; doesn't change brightness.
  - (b) colour gets more blue; emits less light.
  - (c) colour gets more blue; emits more light.
  - (d) colour gets more red; emits more light.
  - (e) colour gets more red; emits less light.
- \_\_\_\_\_ 2. A uniform ultraviolet light source shines on two metal plates, causing electrons to be emitted from both plates. The two plates are made of different materials but have the same surface area. Plate A emits more electrons than plate B. However, the electrons emitted from plate B have a higher kinetic energy. Which of the following describe plausible explanations for the differences in electron emissions? *Select two answers.*
- (a) Plate A has a larger work function than plate B.
  - (b) Higher energy electrons from plate B would be produced by placing the plate closer to the light source, where it would receive more ultraviolet photons from the source.
  - (c) More electrons would be produced from plate A by placing the plate closer to the light source, where it would receive more ultraviolet photons from the source.
  - (d) Plate A emits more electrons of lesser energy, while plate B emits fewer electrons of higher energy, but the total combined energy of the emitted electrons is the same.
- \_\_\_\_\_ 3. Light shines on a metallic surface causing electrons to be ejected. Increasing its *intensity*
- (a) causes ejected electrons to have more kinetic energy
  - (b) causes ejected electrons to have less velocity
  - (c) causes even more electrons to be ejected
  - (d) causes no change to the ejected electrons or to the number of ejected electrons
  - (e) none of the above
- \_\_\_\_\_ 4. Light shines on a metallic surface causing electrons to be ejected. Increasing its *frequency*
- (a) causes ejected electrons to have more kinetic energy
  - (b) causes ejected electrons to have less velocity
  - (c) causes even more electrons to be ejected
  - (d) causes no change to the ejected electrons or to the number of ejected electrons
  - (e) none of the above
- \_\_\_\_\_ 5. The greater the work function for a metal,
- (a) the greater the speed of the ejected electron
  - (b) the smaller the speed of any ejected electron for a given incident light
  - (c) the more electrons are ejected per unit time
  - (d) the lower the threshold frequency
  - (e) none of the above

- \_\_\_\_\_ 6. Blue light has a wavelength which is half that of red light. Therefore, photons of blue light each carry \_\_\_\_\_ as much energy as is carried by photons of red light.
- (a) half
  - (b) four times
  - (c) one fourth
  - (d) twice
- \_\_\_\_\_ 7. Which of the following statements about photons is *false*?
- (a) Higher energy photons have a higher frequency.
  - (b) In a vacuum, photons always travel at the speed of light.
  - (c) Low energy photons move more slowly than high energy photons.
  - (d) Photons behave like particles.
  - (e) A gamma-ray photon is more energetic than a visible light photon.
8. A 65.0 kg person is moving at 12.5 m/s has a wavelength of:
9. The momentum of a radio-wave photon with a wavelength of 1.55 m is:
10. What would be the frequency of a photon with a momentum of  $2.45 \times 10^{-32} \text{ kg} \cdot \text{m/s}$ ?
11. An electron that has a wavelength of  $3.32 \times 10^{-10} \text{ m}$  is travelling at a speed of:
12. The wavelength of a proton that is moving at  $3.79 \times 10^6 \text{ m/s}$  is:

13. The maximum electron energy in a photoelectric experiment is 2.8 eV. When the wavelength of the illuminating radiation is increased by 50 %, the maximum electron energy drops to 1.1 eV. Find
- (a) The work function of the emitting surface, and
  - (b) The wavelength of the *original* radiation.
14. Is it possible to measure an electron's velocity to an accuracy of  $\pm 10$  m/s while simultaneously finding its position to an accuracy of  $\pm 10$   $\mu\text{m}$ ? Explain. What about a proton?
15. An electron is trapped in an infinitely deep "quantum well" 20 nm wide. What is the minimum speed that it could have?
16. A **positron** is an antimatter particle with the same mass as the electron but the opposite electric charge. When an electron and positron meet, they annihilate and produce a pair of identical gamma ray photons. Find the energy and wavelength of the gamma ray. The resulting gamma ray is used in PET (positron emission tomography) scan to image processes inside the body.