

# 352 Modern Physics

Student Name: \_\_\_\_\_

**Model Answer**

Student ID no.: \_\_\_\_\_

“All reality consists of hard indivisible particles moving and colliding in empty space.”

— Leucippus (c.450 BC).

**Choose the correct answer:**

1. (0.5 Point) The star Bellatrix is blue, whereas Betelgeuse is red. Which star has a hotter surface temperature?

- Bellatrix.
- Betelgeuse.
- They both have the same temperature.

2. (0.5 Point) When light is directed at a metal surface, the energies of the emitted electrons...

- Varies with the intensity of the light.
- Varies with the frequency of the light.
- Varies with the speed of the light.

3. (0.5 Point) A phenomenon that cannot be understood with the help of the quantum theory of light is...

- X-ray production.
- The spectrum of an element.
- Interference of light.

4. (0.5 Point) Classically, an electron revolving around an atomic nucleus radiates energy. In reality the electron can revolve around the nucleus without losing energy provided that the orbit...

- Is perfectly circular.
  - Is a whole number of de Broglie wavelengths in circumference.
  - Has a radius bigger than the Bohr radius:  $r \geq a_0$ .
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5. (0.5 Point) According to Bohr's atomic model, the electrons are allowed to occupy orbits whose radii are proportional to...

- $n$ .
- $n^2$ .
- $\sqrt{n}$ .

6. (0.5 Point) Which of the following types of radiation is not emitted by the electronic structures of atoms?

- Infrared.
- Visible light.
- Gamma rays.

7. (1 Point) A  $\pi^0$  meson at rest decays into two photons of equal energy. What is the wavelength of the photons? The rest energy of the  $\pi^0$  is  $135 \text{ MeV}$ . (Show your work)

- 18.36 fm.
- 10.78 fm.
- 13.56 fm.

8. (1 Point) Use the uncertainty principle to make an order of magnitude estimate for the kinetic energy (in eV) of an electron in a hydrogen atom, knowing that the Bohr radius is  $0.529 \text{ \AA}$ . (Show your work)

- 14.23 eV.
  - 12.89 eV.
  - 13.61 eV.
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