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# Daffodil International University

**Faculty of Science & Information Technology**
**Department of Computer Science & Engineering**
**Final Examination, Fall 2025**
**Course Code: PHY102, Course Title: Physics II**
**Level: 1 Term: 3 Batch: 68**

**Time: 02:00 Hrs** **Marks: 40**

## Answer ALL Questions

***[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]***

| | | | | |
|---|---|---|---|---|
| 1. | *a)* | **State** Heisenberg's Uncertainty Principle. | 1 | CO1 |
| | *b)* | What is the equivalent energy of 1 atomic mass unit (amu)? | 1 | |
| | *c)* | **Define** beta-plus ($\beta^+$) and beta-minus ($\beta^-$) decay. | 2 | |
| | *d)* | **Recall** the Lorentz-Fitzgerald length contraction formula and explain it with the proper equation. | 2 | |
| | *e)* | **Distinguish** between nuclear fission and nuclear fusion reactions. | 2 | |
| | *f)* | **List** the applications and disadvantages of X-rays. | 2 | |
| 2. | *a)* | A geologist observes that the number of radioactive atoms in a mineral sample decreases exponentially over time. **Demonstrate** the equation that describes the radioactive decay of these elements. | 3 | CO2 |
| | *b)* | To overcome the instability of the earlier atomic model, a new idea was proposed suggesting that electrons do not spiral into the nucleus but instead move in certain allowed circular orbits with fixed energy. **Explain** the main postulates of this atomic model and **show** how it resolved the shortcomings of the previous model. | 4 | |
| | *c)* | A particle moving at very high speed shows that its mass can convert into energy. Using Einstein's idea of relativity, **derive** the relation between mass and energy. | 4 | |
| | *d)* | In the physics lab KT-816, sunlight falls on a clean metal surface, and electrons are observed to be ejected. **Determine** the relationship between the energy of the incident light and the kinetic energy of the emitted electrons with proper diagram. | 4 | |
| 3. | *a)* | Calculate the mass defect (in kg), binding energy, and binding energy per nucleon of the $^{32}_{16}S$(Sulfur-32) nucleus.<br>[Atomic mass of hydrogen = 1.007825 amu; Mass of neutron = 1.008665 amu; Atomic mass of sulfur = 31.972071 amu] | 3 | CO3 |
| | *b)* | Three radioactive isotopes $X$, $Y$, and $Z$ have mean lives $\tau_X = 5$ days, $\tau_Y = 8$ days and $\tau_Z = 12$ days respectively. Which isotope takes the longest time to lose 68% of its original activity? | 3 | |
| | *c)* | A research astronaut, aged 28, travels on a deep-space mission aboard a spacecraft moving at 0.96c relative to Earth. According to the astronaut's own clock, the mission lasts 20 years before returning. Back on Earth, the astronaut's twin brother stayed behind and monitored the mission. How old will each twin be when the astronaut returns? | 3 | |

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|---|---|---|---|---|
| 3. | *d)* | A high-energy X-ray photon of wavelength 0.40 nm strikes a free electron at rest and is scattered through an angle of 150° relative to its initial direction. Using the Compton scattering relation, determine the wavelength, frequency, and velocity of the scattered photon. | 3 | CO3 |
| | *e)* | A violet LED emits light of wavelength $\lambda = 4200$ Å (420 nm). The light is incident on a clean potassium surface whose work function is $\phi_K = 2.00$ eV. Will photoelectrons be emitted from potassium? If yes, calculate the maximum kinetic energy of the emitted electrons. If no, explain why. | 3 | |

$\sqrt[0]{Good\ Luck}$

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