RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

Bachelor of Science in Applied Sciences

First Year - Semester II Examination – Jan/Feb 2023

PHY 1104 – MODERN PHYSICS

Time: One (01) hour

Instructions:

1. Answer **all** the questions
2. A non-programmable calculator is permitted.

Values of constants

speed of light in a vacuum	$c = 3.00 \times 10^{8}\ \mathrm{ms}^{-1}$
electron charge	$e = 1.60 \times 10^{-19}\ \mathrm{C}$
the Plank constant	$h = 6.63 \times 10^{-34}\ \mathrm{J\,s}$
mass of electron	$\mathrm{m}_e = 9.11 \times 10^{-31}\ \mathrm{kg}$
mass of proton	$\mathrm{m}_p = 1.67 \times 10^{-27}\ \mathrm{kg}$
acceleration of free fall on the Earth's surface	$g = 9.81\ \mathrm{m\,s}^{-1}$
electron volt	$1\ \mathrm{eV} = 1.60 \times 10^{-19}\ \mathrm{J}$
Rydberg constant	$R_H = 1.097 \times 10^{7}\ \mathrm{m}^{-1}$
Atomic mass unit	$1\ \mathrm{u} = 931.6\ \mathrm{MeV}$
Angstrom	$1\text{Å} = 1 \times 10^{-10}\ \mathrm{m}$

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1. a) State Einstein's Postulates of Special Relativity. (4 marks)

b) A law enforcement officer in an intergalactic "police car" turns on a red flashing light and sees it generate a flash every 1.5 s. A person on earth measures that the time between flashes is 2.5 s. How fast is the "police car" moving relative to the earth? (6 marks)

c) In the earth's reference frame, a clock tower is at the origin and a hotel is 50 km away in the x direction. Simultaneously lightning strikes both the clock tower and the hotel at 10 μs. The light strikes are observed by a jet traveling in the positive x direction at $0.5C$.

i. At what time does the lightning strikes take place in the jet's reference frame? (15 marks)

ii. Are the events simultaneous in the jet's reference? (5 marks)

2. a) A sensitive device observes a 6.0 MeV electron using its sensors.

i. What is the Kinetic energy of the electron (5 marks)

ii. What is the total energy of the electron (5 marks)

iii. Calculate the momentum of the electron (5 marks)

iv. Find the (γ) relativistic factor. (5 marks)

v. Find the velocity of the electron (5 marks)

b) What are the two kinds of x-rays that are generated during x-ray production? Briefly explain. (10 marks)

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