Candidate's Index Number
Signature:

UNIVERSITY OF CAPE COAST
COLLEGE OF EDUCATION STUDIES
SCHOOL OF EDUCATIONAL DEVELOPMENT AND OUTREACH
INSTITUTE OF EDUCATION

COLLEGES OF EDUCATION
FOUR-YEAR BACHELOR OF EDUCATION (B.ED)
THIRD YEAR, END-OF-FIRST SEMESTER EXAMINATION, AUGUST 2023

17TH AUGUST 2023   INTRODUCTORY ATOMIC PHYSICS,   9:00 AM – 9:30 AM
HEAT AND OPTICS

This paper consists of two sections, A and B. Answer ALL the questions in Section A and TWO questions from Section B. Section A will be collected after the **first 30 minutes.**

SECTION A
(20 MARKS)

Answer ALL questions in this Section.

For items 1 to 13, each stem is followed by four options lettered A to D. Read each item carefully and circle the letter of the correct or best option.

1. Which of these forces keep an electron orbiting round the nucleus of an atom in its orbit?
   A. Atomic force
   B. Coulombic force of attraction between the electron and the nucleus
   C. Nuclear force
   D. The repulsive forces between the electrons

2. Which of the following explains the dark lines observed in the characteristic line spectra of atoms?
   A. Nuclear transitions in atoms.
   B. The presence of isotopes.
   C. The presence of isotopes transitions of electrons from higher to lower energy levels.
   D. Transition of electrons from lower to higher energy levels.

3. An electron moves from $n = 1$ (Energy E_1) to $n = 3$. Express its energy E_1 in terms of E_3.
   A. $18 E_2$
   B. $3E_3$
   C. $9 E_3$
   D. $E_3/3$

4. The frequency of an ejected electron is 100 Hz. What is the kinetic energy of the electron if the binding energy is 3.00×10^{-32} J?
    A. 0.315×10^{-32} J
    B. 1.815×10^{-32} J
    C. 3.63×10^{-32} J
    D. 4.315×10^{-32} J

5. In connection with X-ray emission, which of the following **correctly** describes the K_α symbol?
    A. An alpha particle radiation.
    B. X-ray radiation associated with an electron going from n = 1 to n = 2.
    C. X-ray radiation associated with an electron going from n = 2 to n = 1.
    D. X-ray radiation from potassium.

6. Which of the laws of thermodynamics is the 'Law of Conservation of Energy'? .... law
    A. First
    B. Second
    C. Third
    D. Zeroth

7. A container has a sample of nitrogen gas. During a thermodynamics process, 150 J of heat enters the gas, and the gas does 300 J of work in the process. What was the change in internal energy of the gas?
    A. 150 J
    B. -150 J
    C. 450 J
    D. -450 J

8. Which of the following concepts describe the kinetic theory of gases?
    I.   It explains the transport properties of gases.
    II.   It accounts for related phenomena, such as Brownian motion.
    III. It relates the macroscopic to the microscopic property of gases.

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

9. A gas at 100 kPa at 25.0°C fills a flexible container with an initial volume of 2.50 L. If the temperature is raised by 30.0°C and the pressure increased by 150 kPa, what is the new volume?
    A. 0.85 L
    B. 1.10 L
    C. 1.69 L
    D. 2.20 L

10. An ideal gas at 25°C has a pressure of 1.5×10^5 Pa and is compressed isothermally until its volume is halved. Calculate the final temperature after the process.
    A. 12.5°C
    B. 25°C
    C. 50°C
    D. 75°C

11. An ideal gas is maintained at a constant pressure of 50.0 kPa during an isobaric process while its volume increases by 0.50 m³. What is the work done on the system by the environment?
    A. 25 J
    B. 25 kJ
    C. 250 J
    D. 250 kJ

12. A 600nm light is an incident on a diffraction grating with a ruling separation of 1.7×10^{-6} m. Calculate the diffraction angle at which the first order line occurs.
    A. 10°
    B. 21°
    C. 42°
    D. 45°

13. In destructive interference of two waves, the resultant amplitude is always ....
    A. greater than any of the waves.
    B. half the sum of the original amplitudes.
    C. smaller than any of the waves.
    D. zero.

For items 14 to 16, write the appropriate responses in the spaces provided.

14. Give **one** conclusion drawn from Rutherford's gold foil experiment.

    ....
    ....
    ....

15. Distinguish between an Open and Closed system.

    ....
    ....
    ....
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    ....

16. Briefly explain the principles responsible for light spreading as it passes through a slit.

    ....
    ....
    ....

Items 17 to 20 are statements followed by True and False options. Read each statement carefully and indicate whether it is True or False by circling the letter of the correct option.

17. An atom always moves from a higher energy level to a lower energy level whenever it emits a photon.
    A. True
    B. False

18. The internal energy of a gas always remains constant when the gas is compressed isothermally.
    A. True
    B. False

19. According to kinetic theory of gasses, at absolute zero temperature all molecular motions come to a stop.
    A. True
    B. False

20. Geometrical optics is ray optics while Physical optics considers light propagation as a wave.
    A. True
    B. False

Physical Constants

$c = 3 \times 10^8 \, ms^{-1}$

$e = 1.6 \times 10^{-19} \, C$.

$m_e = 9.11 \times 10^{-31} \, kg$

Rydberg constant $R = 1.097 \times 10^7 \, m^{-1}$

Planck's constant $h = 6.62 \times 10^{-34} \, Js = 4.14 \times 10^{-15} \, eV$