UNIVERSITI KUALA LUMPUR
ROYAL COLLEGE OF MEDICINE PERAK

FINAL EXAMINATION
MARCH SEMESTER 2026

COURSE CODE	: RXD12903
COURSE NAME	: RADIATION PHYSICS
PROGRAMME NAME	: DIPLOMA IN MEDICAL IMAGING
DATE	: 22 JUNE 2026
TIME	: 9.00 AM – 11.00 AM
DURATION	: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read CAREFULLY the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of TWO (2) section; Section A and Section B.
4. Answer ALL questions in Section A. For Section B, answer THREE (3) questions ONLY.
5. Please mark/write your answers on the OMR answer script and answer booklet provided.
6. Answer ALL questions in English language ONLY.

THERE ARE 9 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A : MULTIPLE CHOICE QUESTIONS (Total: 25 marks)

INSTRUCTION: Answer ALL questions.
Please use the objective answer sheet provided.

1. Which subatomic particle has no electrical charge?
   A. Proton
   B. Electron
   C. Neutron
   D. Positron

2. Which shell is closest to the nucleus?
   A. K shell
   B. L shell
   C. M shell
   D. N shell

3. Which of the following particles has the smallest mass in an atom?
   A. Proton
   B. Neutron
   C. Electron
   D. Nucleus

4. A photon is defined as _____.
   A. a particle with mass and charge
   B. a packet of energy with no mass
   C. a type of electron
   D. a charged atom

5. **"Electromagnetic radiation consists of two fields that oscillate perpendicular to each other."**
   These fields are:
   A. Electric field and magnetic field.
   B. Electric field and gravitational field.
   C. Magnetic field and nuclear field.
   D. Thermal field and electric field.

6. The period (T) of a wave is defined as the _____.
   A. time required to complete ionisation
   B. time required to complete energy release
   C. time required to complete maximum height of the wave
   D. time required to complete one oscillation

7. The speed of electromagnetic radiation in a vacuum is approximately _____.
   A. 3×10^6 m/s
   B. 3×10^7 m/s
   C. 3×10^8 m/s
   D. 3×10^9 m/s

8. Incandescence is defined as _____.
   A. emission of light from a heated object
   B. emission of light from radioactive decay
   C. absorption of light by a material
   D. reflection of light from a surface

9. Thermoluminescence is characterised by _____.
   A. emission of light only after heating
   B. emission of light due to chemical reactions
   C. continuous emission of light for a long time
   D. immediate light emission that stops almost instantly after irradiation

10. Identify the **CORRECT** statement regarding radioisotope.
    A. It is a stable isotope of any element.
    B. It may emit particulate radiation.
    C. It has more protons than electrons.
    D. It will increase in mass after undergo decay process.

11. Identify the **CORRECT** statement regarding the decay constant (λ).
    A. Determining the half value layer of an attenuator.
    B. Measuring the attenuation activity.
    C. Measuring the penetrating levels.
    D. Calculating the half-life of a radionuclide.

12. **"A radioactive sample decreases in activity over time but never reaches zero."**
This is because _____.

A. radioactive decay follows an exponential pattern
B. the decay process stops completely
C. the detector cannot measure small activity
D. the radionuclide becomes stable instantly

13. The law describing radioactive decay is known as the _____.

A. Newton's law
B. inverse square law
C. exponential law
D. Lenz's law

14. The positive side of the x-ray tube is called the _____.

A. anode
B. cathode
C. conduction band
D. forbidden zone

15. Most of the energy of projectile electrons striking the x-ray tube target is converted into _____.

A. x-rays
B. heat
C. light
D. magnetic energy

16. Why are rotating anodes used in modern x-ray tubes?

A. To increase photon wavelength.
B. To spread heat over a larger surface area.
C. To increase the speed of electrons.
D. To reduce tube voltage.

17. Why does bremsstrahlung radiation produce a continuous spectrum?

A. All electrons produce photons with identical energy.
B. Electrons remain stationary.
C. Only one energy transition occurs.
D. Electrons lose different amounts of energy during interactions.

18. Attenuation best refers to the _____.
    A. increase in the thickness of the attenuator
    B. reduction in the thickness of the attenuator
    C. increase in the number of primary photons in a beam
    D. reduction in the number of primary photons in a beam

19. The deviation of radiation from its original path is called _____.
    A. absorption
    B. attenuation
    C. scattering
    D. penetration

20. Why does increasing density increase attenuation?
    A. It increases the wavelength of the x-ray photons.
    B. It reduces the number of photons in the beam.
    C. It increases the number of electrons for interaction.
    D. It decreases the energy of the transmitted photons.

21. The transmitted intensity of an x-ray beam after passing through a material is represented by _____.
    A. I_x
    B. I_o
    C. μ
    D. Z

22. The interaction that converts photon energy into matter is known as _____.
    A. pair production
    B. photoelectric effect
    C. Compton scattering
    D. coherent scattering

23. Which of the following substances absorbs the least number of x-ray photons?
    A. Bone
    B. Muscle
    C. Fat
    D. Air

24. According to radiographic density shades, air appears _____.

A. white
B. light grey
C. dark grey
D. black

25. Why must patient positioning be carefully controlled during radiographic imaging?

A. To improve the penetration power of the x-ray beam.
B. To avoid misrepresentation of size or shape of structures.
C. To increase the number of photons reaching the detector.
D. To prevent excessive x-ray production during exposure.

SECTION B : MODIFIED ESSAY QUESTIONS (Total: 75 marks)

INSTRUCTION: This section consists of FOUR (4) modified essay questions (MEQ). You are required to answer ONLY THREE (3) questions in the answer booklet provided.

Question 1

(a) Define the following terms:

i. Isotope.

(2 marks)

ii. Binding energy.

(2 marks)

iii. Valence electron.

(1 mark)

(b) Describe how an element can be presented.

(6 marks)

(c) **"A neutrally charged element has a mass number (A) of 39 and 20 neutrons."** Describe about the element stated above.

(6 marks)

(d) Assume that an atom has five shells and the energy levels in keV for each electron is given by $E_n = - 63.5 / n^2$.

Calculate the following:

i. The highest electron energy that can be removed.

(2 marks)

ii. The wavelength of the photon emitted when an electron shifts from n = 3 to n = 1.

(6 marks)

Question 2

(a) List **FIVE (5)** properties of electromagnetic radiation.

(5 marks)

(b) Describe the relationship of frequency and wavelength of electromagnetic radiation waves.

(4 marks)

(c) An x-ray beam has a maximum energy of 90 keV.

i. Describe its x-ray spectrum.

(8 marks)

ii. Calculate the minimum wavelength of the beam.

(4 marks)

iii. Calculate the maximum frequency of the beam.

(4 marks)

Question 3

(a) List **TWO (2)** examples of radionuclides.

(2 marks)

(b) Referring to the effective half-life of a radioisotope sample:

i. Define effective half-life.

(2 marks)

ii. State the equation to calculate the effective half-life.

(1 mark)

(c) Differentiate alpha decay and electron capture in radioactive decay.

(6 marks)

(d) Describe about how a photon beam loss its energy during x-ray interaction with matters.

(6 marks)

(e) A radioactive sample had decayed for 75 hours and reduced its mass to 70%.

i. Calculate the decay constant.

(5 marks)

ii. Calculate the half-life of the radioactive sample.

(3 marks)

Question 4

(a) Regarding tenth value layer (TVL):

i. Define TVL.

(2 marks)

ii. State the equation to calculate TVL.

(1 mark)

iii. State the amount of photon being absorbed by the material it passes, in percentage (%).

(1 mark)

iv. State the equation that relates the TVL and half value layer (HVL).

(1 mark)

(b) Describe the mechanism of pair production in x-ray interaction with matters.

(6 marks)

(c) Describe the effects of regular filtration on x-ray spectrum.

(6 marks)

(d) A photon beam passed through a 3.3 cm medium with a linear attenuation coefficient of 0.1943 cm^{-1}.

Referring to the statement above, calculate:

i. The percentage of transmitted photons beam.

(5 marks)

ii. The half value layer of the medium.

(3 marks)

END OF EXAMINATION PAPER