Umm Al-Qura University
College of Applied Sciences
Physics Department

Exam:..... **Date:**.....

Program:	Course:	Course Code:

Name:..... Student I.D:.....

Academic year:..... Level /Semester .....

Question	Mark	Signature
Question 1	12/15	
Question 2	2/6	
Question 3	1/1.5	
Question 4		Dr. Tah
Question 5	10.5	
Question 6		
Question 7		
Question 8		
Question 9		
Total mark	25.5 / 50	Exam Committee

Kingdom of Saudi Arabia
Ministry of Education
Umm Al-Qura University
College of Applied Sciences

Final exam:1st semester 1439-1440H
Program: MMP
Course Name: Medical Radiation Physics (1)
Course Code: 4033285
Exam Time: Two Hr(s)
Exam Date: 16 / 4 /1440H
Number of Papers: [4] papers

0Student's Name: خالد عبد الرحيم الهذلي **Student ID:** 438009[illegible] **Group No.:** 1

Please answer Four questions only: (two questions from Part A and two question from Part B)

أجب عن أربعة أسئلة فقط (سؤاليين (اجبارى) من الجزأ (أ) وسؤالين (اختيارى) من الجزء (ب)

Total Exam Marks: 50

Part A : Please answer thr following two questions. (اجبارى)

Question One ***[14 Marks]***

1-Choose the Correct Answer

1. Tc-99m source has half life 6 hrs and its initial activity at certain moment is 100 MBq then the final activity after 24 hrs is

a. 6.25 MBq
c. 12.5 MBq
d. 50 MBq
e. 25 MBq

2. Isobaric transition: Given the atomic number of parent nucleus is Z , that of the daughter nucleus is ……. , if a beta particle is emitted or …….., If a positron is emitted . The atomic mass number of the daughter is same as that of the parent.

a. Z+1 , Z-1
b. Z-1 Z+1
c. Z-2, z-1
d. z+1, Z-2

3. Alpha particle is a highly energetic Helium Nucleus that is emitted from the nucleus of the radioactive isotope when the

a. neutron to proton ratio is too low
b. neutron to proton ratio is too high
c. Proton to neutron ratio low
d. Proton to neutron ratio is too high

4.One of the interactions of radiation with matter related to diagnostic radiology

a. Photoelectric effect
b. Compton scattering
c. Pair production
d. All of the above

5. The atomic number of anode of X-ray tube is ---- and the melting point of it is about -----

a. 74 and 3400 ^{0}C
b. 82 and 4000 ^{0}C

c. 13 and 5000 ^{0}C
d. 82 and 3400 ^{0}C

6- Percentage of a given amount of radium , will decay during a period of 1000 years, decay rate constant equals 4.38 x 10^{-4} $^{-}$yr to be

a. 67%
b. 23 %
c. 33 %
d. 25 %

7. The probability of photoelectric absorption is proportional to

a. Z^3/E → Z^3/E^3
b. Z^2/E^3
c. Z/E
d. Z/E^2

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8. Atoms that having nuclei with the same number of protons but different number of neutrons called.

a. Isotopes
b. Isomer
c. Isobar
d. Isotonic

9. 0.5 Ci is equivalent to :

a. 1.85 x 10^{12} Bq
b. 1.85 x 10^4 MBq
c. 1.85 x 10^5 MBq
d. 1.85 x 10^6 kBq

10. Indirect measurements of entrance skin dose to patients is calculating using the following equation:

a. ESD = O/P X $(kV/80)^2$ x mAs $(100/FSD)^2$ X BSF
b. ESD = O/P X $(kV/80)^2$ x mAs $(100/FSD)^2$
c. ESD = O/P X $(kV/80)^2$ x$(100/FSD)^2$ X BSF
d. ESD = O/P X $(kV/80)^2$ x mAs $(100/FSD)^2$ X BSF x Field size

11. Alpha emission: Z number of Daughter nuclides decrease by …….and atomic mass number decrease by ……compared of parent nuclides.

a. Two , four
b. Four , two
c. Two, two
d. Zero , four

12.--------is defined as to the difference between the maximum energy and the energy of certain beta particle

a. a neutrino
b. photelectric phenomena
c. Compton scattering effect
d. pair production

13. Tc-99m is preferred to use in some nuclear medicine imaging instead I-31.
a. because Tc-99m emits gamma and beta radiation
b. to prevent absorption of beta energy in skin
c.I-31 emits gamma energy only
d. because Tc-99m emits gamma energy only .

14. The energy of ---------- is equal to the difference in energy between the x-ray energy and L shell energy (E_{EK}-E_L).
a. Auger electron
b. Excitation
c. Ionization
d. Ionization

Question Two ***[6 Marks]***

2.1. Discuss with drawing the Alpha absorption curve , define and deduce range of alpha particle.

2.2 Calculate and compare between radiation risk resulted from shielding of beta source using Al and lead thickness.

Part 2 : Please answer two questions only
Question Three ***[15 Marks]***

Mark true (√) or wrong (x) and correct the false

1-The energy of ejected photoelectron is equal to the difference in energy between the gamma ray photon emitted by the radioisotope and the binding energy of the electron.
2- the density of a sheet of Al, 1 cm thick is 2.7 g/cm3, so the density thickness of aluminium is 2.7 g/cm^3
3. the minimum possible atomic number materials are used for gamma shielding.
4. the thickness of lead (pb) to reduce the fluence rate of a beam of 0.5 MeV gamma rays to 10% of its initial intensity is 3.1 cm
5. 80 mCi equivalent to 2.96 MBq
6. Nucleus consists of two main parts; the protons and neutrons and called hydron
7. $^{226}_{88}$Ra transformed by alpha emission to an excited state of Rn-222 then emits 0.186 MeV

8. The unit of absorbed dose is defined as the joule per kilogram J/Kg, termed the Rad

9. the annual dose limit for workers are 1mSv and for public is 20 mSv

10. Delta rays are defined as it is a beta particles travel a long distance and are easily deflected during collision and follow tortuous paths as they pass through absorbing media

Question Four ***[15 Marks]***

4.1 Discuss the radiation quantities and units

4.2 The dose rates outside the shielding of a cyclotron are found to be 4 μGy/h for gammas , 3 μGy/h for thermal neutrons, and 2 μGy/h for fast neutrons with energies greater than 2 MeV . What is the equivalent dose rate of the combined radiations according to ICRP values for W_R? WR for gamma = 1 , for thermal neutrons = 5 and fast neutrons = 10

Question Five ***[15 Marks]***

5.1. Explain the X-ray production with drawing.

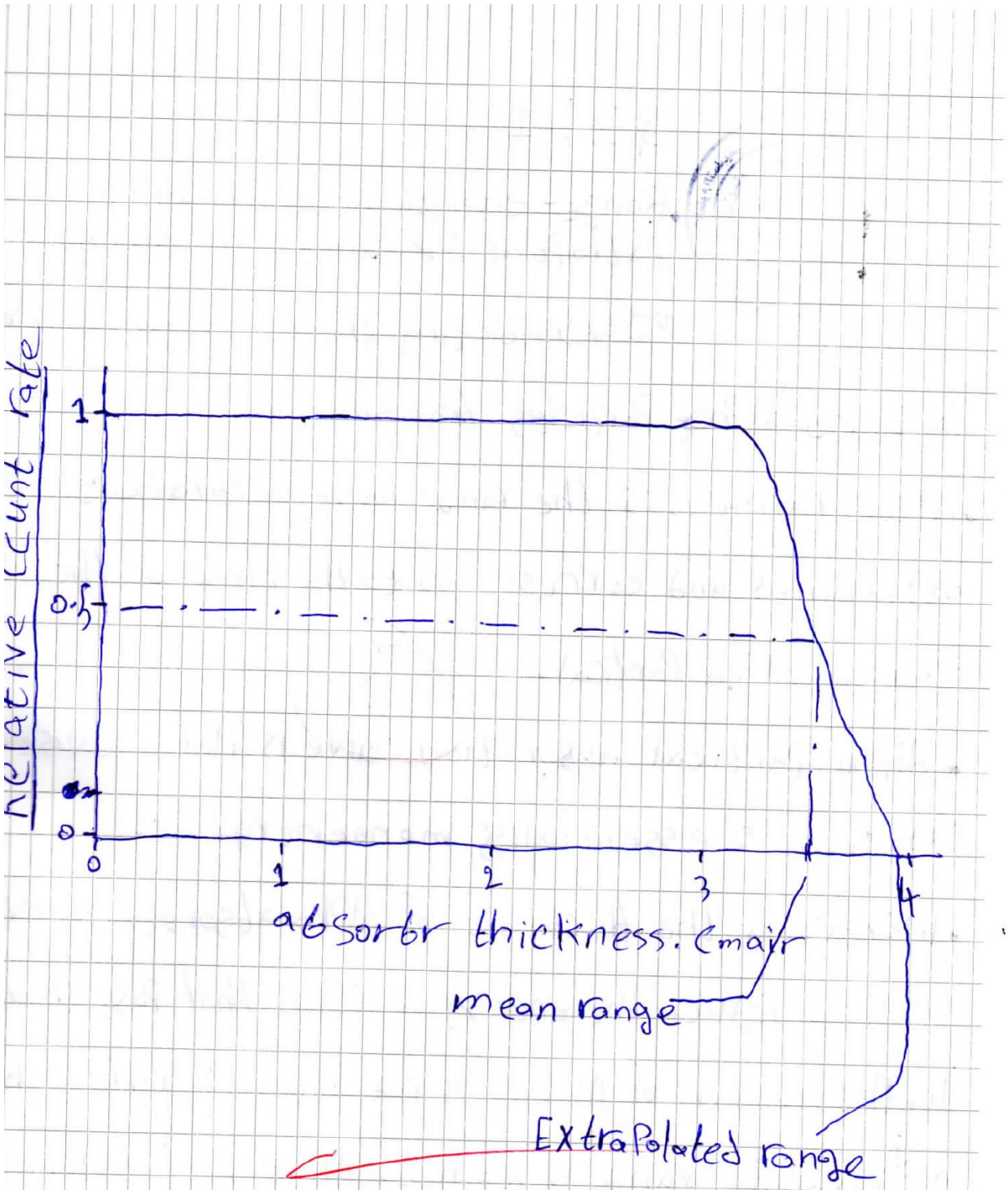
5.2. Discuss with drawing the phenomena of photoelectric effect and its relation to diagnostic

5.3 State and deduce the decay law of radionuclides

Q 2:-1:-

- Range-energy relationship:-
  Extrapolated range:- Is obtained by extrapolating the absorption curve to zero alpha Particles transmitted.
- Mean range:- is the range most accurately determined and corresponds to the range of the average alpha Partical.
- Alpha Partical absorption curve is flat because AlA radiation is essentially monoenergetic.
- Increasing the thickness of alpha absorber serves only to reduce the energy of Alphas that Pass thought it, the number of Alphas is not reduced unit the approximate range is reached. At this Point ther is a sharp decrease in the number of alphas that Pass through the absorber.

← الرسم



Alpha-Particle absorption curve.

Q3:- (✓) or (X)

1-(X)

2-(✓)

3-(✓)

4-(X)

5-(✓)

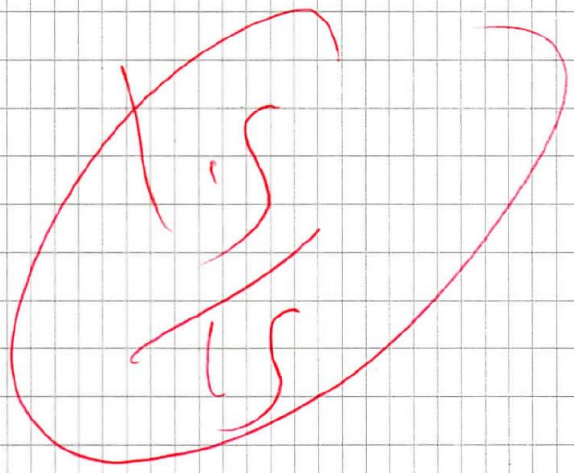
6-(X)

7-(X)

8-(✓)

9-(X) 1 mSv → 50 mSv

10-(X)



Q5-2:- ~~Photon interaction mechanisms~~

~~Photoelectric absorption~~:-

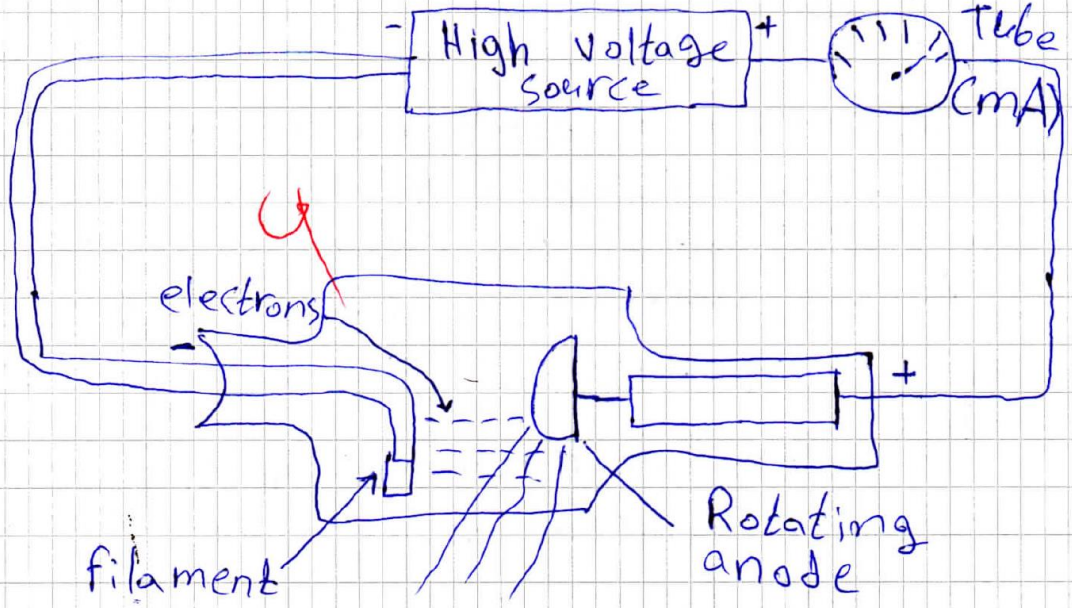
Photoelectric effect, Phenomenon in which electrically charged particles are released from or within a material when it absorbs electromagnetic radiation. The effect is often defined as the ejection of electron from a metal Plate when light falls on it In a broader definition, the radiant energy may be infrared, visible or ultraviolet light X-ray or gamma rays: the material may be a solid, liquid or gas: and the released partical may be ion (electrically charged atoms or molecules) as well as electrons. The Phenomenon was fundamen significant in the development of modern Physics because of the Puzzling question it raised about the nature of light-Partic versus wavelike behaviour-that were finally resolved by Albert Einstein in 1905. The effect remains important for research in areas from matrial science to astrophysics. as well as forming the basis for avariety of useful devices.

Q 5-1:- Production of X-ray beam.

- The main components of a modern X-ray unit are (1) a source of electrons - a filament or cathode (2) an evacuated space where to speed up the electrons.

(3) a high positive potential to accelerate the negative electrons and

(4) a target or anode which the electrons strike to produce X-ray as shown in fig



$N = N_0 e^{-\lambda t}$

Since $A = \lambda N$

substitute by $N = A/\lambda$ into $N = N_0 e^{-\lambda t}$ or multip

both side by λ

So the decay law is

$$A = A_0 e^{-\lambda t}$$

deduce the Physical half life $T_{1/2}$

Say $N/N_0 = e^{-\lambda t}$

= Say $N/N_0 = 0.5 = e^{-\lambda t}$

Ln $0.5 = -\lambda t$ So the Physical half life $T_{1/2}$

$$T_{1/2} = 0.693/\lambda$$