Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	FUNDAMENTAL OF HEALTH PHYSICS
COURSE CODE	:	DAU 24102
PROGRAMME CODE	:	DAU
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTIONS	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

SOALAN DALAM BAHASA MELAYU

S1 (a) Takrifkan separuh hayat.

(2 markah)

(b) Radium-226 ($^{226}_{88}Ra$) menjalani siri pereputan yang menghasilkan lima zarah α dan empat zarah β^-. Dengan menulis persamaan tindak balas nuklear, kenal pasti produk akhir (nukleus anak) bagi siri reputan ini.

(3 markah)

(c) Terdapat dua jenis Pereputan Beta, iaitu Pereputan Positron dan Pereputan Beta minus. Jelaskan perbezaan antara kedua-dua jenis pereputan ini.

(6 markah)

(d) Radioisotop yang baru tersedia mempunyai aktiviti sebanyak 10 mCi. Selepas 4 jam, nilai aktivitinya berkurang kepada 8 mCi.

(i) Kirakan pekali pereputan, λ dan separuh hayat bagi radioisotop ini.

(5 markah)

(ii) Kirakan bilangan atom, N dari radioisotop, dalam unit Becquerel (*Bq*) yang hadir selepas 4 jam.

(4 markah)

S2 (a) Tuliskan nama penuh bagi satu Badan Kawal Selia yang bertanggungjawab terhadap perlindungan sinaran di Malaysia.

(1 markah)

(b) Terangkan fungsi utama Badan Kawal Selia seperti yang dinyatakan di **Q2(a)**.

(2 markah)

(c) Sebarang kegiatan yang melibatkan sinaran radiasi perlu dijalankan mengikut keperluan perundangan di bawah Akta Perlesanan Tenaga Atom 1984 (Akta 304). Terangkan secara ringkas Akta 304.

(3 markah)

(d) Yusuf telah bekerja sebagai ahli terapi sinaran di Pusat Perubatan Subang Jaya selama sebelas bulan. Terangkan langkah-langkah (merangkumi prinsip dan kaedah) yang boleh diambil oleh Yusuf untuk mengoptimumkan perlindungan radiasi luaran supaya tidak melebihi takat dos tahunan.

(14 markah)

S3 (a) Berikan perbezaan terhadap bahan perisai sinaran yang bersesuaian bagi zarah alfa, zarah beta, dan sinaran gama dari segi kuasa pengionan dan penembusan zarah atau sinaran tersebut.

(9 markah)

(b) Tuliskan **satu (1)** aplikasi tiub sinar katod (CRT).

(1 markah)

(c) Terdapat beberapa jenis interaksi foton terhadap bahan. Setiap interaksi akan menentukan aplikasi hasil dari interaksi tersebut, bergantung kepada tenaga kinetik foton. Bincangkan **dua (2)** interaksi foton bertenaga tinggi terhadap bahan.

(10 markah)

S4 (a) Seorang pekerja sinaran dengan jisim 65 kg secara tidak sengaja terdedah kepada sinaran gama dan menerima dos efektif sebanyak 5.5 rem. Diberi faktor pemberat bagi tisu W_T adalah 0.12 dan faktor kualiti bagi sinaran gama, Q adalah 1.

(i) Takrifkan dos efektif dan faktor pemberat.

(2 markah)

(ii) Kira dos diserap yang diterima oleh pekerja sinaran dalam unit Gray (Gy).

(4 markah)

(b) Lakarkan graf Dos-Tindak balas dan huraikan hubungan diantara Dos-Tindak balas.

(6 markah)

(c) Berikan perbezaan antara kesan stokastik dan kesan deterministik.

(8 markah)

S5 (a) Sinaran radiasi ialah suatu proses yang mana zarah energetik atau gelombang bergerak melalui suatu media atau pun ruang. Sinaran radiasi boleh dikesan dengan menggunakan pengesan sinaran. Huraikan 'pengesan sinaran'.

(3 markah)

(b) Huraikan dosimeter peribadi berikut dan tuliskan sekurang-kurangnya **tiga (3)** kelebihan dan kekurangan bagi setiap dosimeter tersebut.

(i) Pemantau Lencana Filem

(7 markah)

(ii) *Thermo-luminescent Dosimeter* TLD

(7 markah)

(c) Peranti radiasi pengesanan sinaran yang lebih baru telah dibuat untuk mengatasi kekurangan dosimeter peribadi sebelumnya. Tuliskan kelebihan-kelebihan peranti baru ini.

(3 markah)

S6 (a) Huraikan langkah-langkah umum yang perlu diambil oleh pekerja sinaran yang berkerja dengan bahan-bahan radioaktif.

(12 markah)

(b) Teknik pemantauan pendedahan sinaran dalaman dikenali sebagai BIOASSAY. Jelaskan berkenaan program BIOASSAY merangkumi fungsi dan prosedur yang terlibat dalam program tersebut.

(8 markah)

- SOALAN TAMAT-

QUESTION IN ENGLISH

Q1 *(a) Define half-life.*

(2 marks)

(b) Radium-226 ($^{226}_{88}Ra$) undergoes series of decays that produce five α particles and four β^- particles. By writing the nuclear reaction equation, identify the final product (daughter nucleus) of the decay series.

(3 marks)

(c) There are two types of Beta Decay, named as Positron Decay and Beta-minus Decay. Explain the differences between this two decay processes.

(6 marks)

(d) A newly prepared radioisotope has activity 10 mCi. After 4 hours, its activity is reduced to 8 mCi.

(i) Calculate the decay constant, λ and half-life for this radioisotope.

(5 marks)

(ii) Calculate number of atoms, N of the radioisotope, in Becquerel (Bq) that are present after 4 hours.

(4 marks)

Q2 *(a) Write a full form of Regulatory Body responsible for radiation protection in Malaysia.*

(1 mark)

(b) Describe the main function of the Regulatory Body stated in ***Q2(a)****.*

(2 marks)

(c) Any activity involving radiation should be conducted according to the legislative requirements of Atomic Energy Licensing Act 1984 (Act 304). Briefly describe Act 304.

(3 marks)

(d) Yusuf has been worked as radiation therapist in Subang Jaya Medical Centre for about eleven months. Explain how Yusuf can optimize the protection (in terms of principle and method) of his external radiation so that he will not exceed his annual dose limit.

(14 marks)

Q3 (a) *Distinguish the suitable radiation shielding material of alpha particles, beta particles and gamma radiation in terms of ionizing and penetration power of each particle or radiation.*

(9 marks)

(b) *Write **one (1)** application of Cathode Ray Tube (CRT)*

(1 mark)

(c) *There are several types of photon interactions with matter. Each interaction will define its application, depends on the kinetic energy of the photon. Discuss **two (2)** interactions of high energy photons with matter.*

(10 marks)

Q4 (a) *A 65-kg radiation worker is accidentally exposed to gamma radiation and receives an effective dose 5.5 rem. Given the tissue weighting factor, W_T is 0.12 and the quality factor of gamma radiation, Q is 1.*

(i) *Define effective dose and weighting factor.*

(2 marks)

(ii) *Calculate the absorbed dose received by the radiation worker in Gray (Gy).*

(4 marks)

(b) *Sketch a Dose-Response graph and describe the relationships of Dose-Response.*

(6 marks)

(c) *Differentiate between stochastic effect and deterministic effect.*

(8 marks)

Q5 (a) *Radiation is a process in which energetic particles or wave travel through a medium or space. Radiation can be detected using a radiation detectors. Describe 'radiation detector'.*

(3 marks)

(b) *Describe the following personal dosimeters and write at least **three (3)** advantages and disadvantages of each dosimeters.*

(i) *Film Badge Monitoring*

(7 marks)

(ii) *Thermo-luminescent Dosimeter TLD*

(7 marks)

(c) *The newer detection radiation devices has been created to overcome the disadvantages of previous personal dosimeters. Write the advantages of the new devices.*

(3 marks)

Q6 *(a)* *Describe a general precautions for radiation worker that is working with radioactive materials.*

(12 marks)

(b) *An internal exposure monitoring technique is known as BIOASSAY. Explain the BIOASSAY program including the function and the procedure of the program involved.*

(8 marks)

- END OF QUESTION-

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LIST OF FORMULA

$D = \frac{A_\circ}{\sqrt{2}} t_1$	$\frac{dN}{dt} = -\lambda N$
$E = \frac{hc}{\lambda}$	$V = \frac{Q}{C}$
$A = \frac{dN}{dt}$	$ln\frac{N}{N_\circ} = kt$
$k = \frac{ln2}{T_{½}}$	$\frac{I_1}{I_2} = \frac{d_2{}^2}{d_1{}^2}$
$A = A_\circ e^{-\lambda t}$	$t_{½} = \frac{ln2}{\lambda}$
$N = N_\circ e^{-\lambda t}$	$X = \frac{dQ}{dm}$
$N = \frac{\frac{-dN}{dt}}{\lambda}$	$D = \frac{E}{m}$
$D = D_\circ e^{-\mu x}$	$D_W = D_G$
$H(Sv) = D(Gy)Weight$ $H_T(Sv) = \sum_R W_R D$ $E(Sv) = \sum_T W_T H$ $H = H_1 + H_2$	$D_W = \frac{N_g E}{m}$

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LIST OF CONSTANT

$$Avogadro's\ Number, N_A = 6.023 \times 10^{23}\ atoms$$
$$Electron\ charge, e = 1.6 \times 10^{19}\ C$$
$$Electron\ mass, m_e = 9.109 \times 10^{-31}\ kg$$
$$Neutron\ mass, m_n = 1.675 \times 10^{-27}\ kg$$
$$Proton\ mass, m_p = 1.673 \times 10^{-27}\ kg$$
$$Atomic\ mass\ number, u = 1.6605 \times 10^{-27}\ kg$$
$$= 931.5\ MeV$$
$$Plank's\ Constant, h = 6.626 \times 10^{-34}\ J$$
$$Speed\ of\ light, c = 3 \times 10^{8}\ ms^{-1}$$
$$1\ Curie\ (Ci) = 3.7 \times 10^{10}\ Becquerel\ (Bq)$$
$$1\ Rad\ (Rad) = 10^{-2}\ Grays\ (Gy)$$
$$1\ Rem(rem) = 10^{-2} Sieverts\ (Sv)$$
$$1\ Roentgen\ (R) = 2.58 \times 10^{-4}\ C/kg$$
$$\frac{Coulomb}{kilogram}\left(\frac{C}{kg}\right)$$
$$1\ Gy = 100\ rad = 1\ Jkg^{-1}$$
$$1\ R = 8.77 \times 10^{3}\ Grays\ (Gy)$$
$$Absorbed\ Dose, D$$
$$Equivalent\ Dose, H$$
$$Effective\ Dose, E$$
$$Exposure, X$$
$$Radiation, R$$
$$Tissue, T$$
$$Charge, Q$$
$$Number\ of\ ionized, N_g$$
$$Dose\ to\ the\ wall, D_w = dose\ to\ the\ gas, D_G$$

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Atomic no.	*Atomic weight*	*Name*	*Symbol*	*Atomic no.*	*Atomic weight*	*Name*	*Symbol*
1	1.01	Hydrogen	H	31	69.72	Gallium	Ga
2	4.00	Helium	He	32	72.64	Germanium	Ge
3	6.94	Lithium	Li	33	74.92	Arsenic	As
4	9.01	Beryllium	Be	34	78.96	Selenium	Se
5	10.81	Boron	B	35	79.90	Bromine	Br
6	12.01	Carbon	C	36	83.80	Krypton	Kr
7	14.01	Nitrogen	N	37	85.47	Rubidium	Rb
8	16.00	Oxygen	O	38	87.62	Strontium	Sr
9	19.00	Fluorine	F	39	88.91	Yttrium	Y
10	20.18	Neon	Ne	40	91.22	Zirconium	Zr
11	22.99	Sodium	Na	41	92.91	Niobium	Nb
12	24.31	Magnesium	Mg	42	95.94	Molybdenum	Mo
13	26.98	Aluminum	Al	43	98.00	Technetium	Tc
14	28.09	Silicon	Si	44	101.07	Ruthenium	Ru
15	30.97	Phosphorus	P	45	102.91	Rhodium	Rh
16	32.07	Sulfur	S	46	106.42	Palladium	Pd
17	35.45	Chlorine	Cl	47	107.87	Silver	Ag
18	39.95	Argon	Ar	48	112.41	Cadmium	Cd
19	39.10	Potassium	K	49	114.82	Indium	In
20	40.08	Calcium	Ca	50	118.71	Tin	Sn
21	44.96	Scandium	Sc	51	121.76	Antimony	Sb
22	47.87	Titanium	Ti	52	127.60	Tellurium	Te
23	50.94	Vanadium	V	53	126.90	Iodine	I
24	52.00	Chromium	Cr	54	131.29	Xenon	Xe
25	54.94	Manganese	Mn	55	132.91	Cesium	Cs
26	55.85	Iron	Fe	56	137.33	Barium	Ba
27	58.93	Cobalt	Co	57	138.91	Lanthanum	La
28	58.69	Nickel	Ni	58	140.12	Cerium	Ce
29	63.55	Copper	Cu	59	140.91	Praseodymium	Pr
30	65.39	Zinc	Zn	60	144.24	Neodymium	Nd

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Atomic no.	*Atomic weight*	*Name*	*Symbol*	*Atomic no.*	*Atomic weight*	*Name*	*Symbol*
61	145.00	Promethium	Pm	91	231.04	Protactiniu	Pa
62	150.36	Samarium	Sm	92	238.03	Uranium	U
63	151.96	Europium	Eu	93	237.00	Neptunium	Np
64	157.25	Gadolinium	Gd	94	244.00	Plutonium	Pu
65	158.93	Terbium	Tb	95	243.00	Americium	Am
66	162.50	Dysprosium	Dy	96	247.00	Curium	Cm
67	164.93	Holmium	Ho	97	247.00	Berkelium	Bk
68	167.26	Erbium	Er	98	251.00	Californium	Cf
69	168.93	Thulium	Tm	99	252.00	Einsteinium	Es
70	173.04	Ytterbium	Yb	100	257.00	Fermium	Fm
71	174.97	Lutetium	Lu	101	258.00	Mendeleviu	Md
72	178.49	Hafnium	Hf	102	259.00	Nobelium	No
73	180.95	Tantalum	Ta	103	262.00	Lawrencium	Lr
74	183.84	Tungsten	W	104	261.00	Rutherfordi	Rf
75	186.21	Rhenium	Re	105	262.00	Dubnium	Db
76	190.23	Osmium	Os	106	266.00	Seaborgium	Sg
77	192.22	Iridium	Ir	107	264.00	Bohrium	Bh
78	195.08	Platinum	Pt	108	277.00	Hassium	Hs
79	196.97	Gold	Au	109	268.00	Meitnerium	Mt
80	200.59	Mercury	Hg				
81	204.38	Thallium	Tl				
82	207.20	Lead	Pb				
83	208.98	Bismuth	Bi				
84	209.00	Polonium	Po				
85	210.00	Astatine	At				
86	222.00	Radon	Rn				
87	223.00	Francium	Fr				
88	226.00	Radium	Ra				
89	227.00	Actinium	Ac				
90	232.04	Thorium	Th				