KOLEKSI SOALAN-SOALAN KERTAS 2 FIZIK PERCUBAAN SPM 2024
BAB 6 TINGKATAN 5: FIZIK NUKLEAR / *NUCLEAR PHYSICS*

PAHANG JUJ SET 2 2024

1. Rajah 1 menunjukkan suatu proses reputan yang berlaku secara rawak dan spontan.
Diagram 1 shows a decay process that occurs randomly and spontaneously.

$$^{226}_{A}Ra \longrightarrow {}^{B}_{86}Rn + {}^{4}_{2}He$$

Rajah 1
Diagram 1

(a) (i) Namakan jenis reputan radioaktif itu.
Name the type of radioactive decay.

.....

[1 markah]
[1 *mark*]

(ii) Nyatakan **satu** sebab reputan radioaktif itu berlaku.
Give **one** *reason why the radioactive decay occur.*

.....

[1 markah]
[*1 mark*]

(b) Berdasarkan Rajah 1, tentukan nilai A dan B.
Based on Diagram 1, determine the value of A *and* B

A : .....

B : .....

[2 markah]
[*2 marks*]

KEDAH 2024

1 Satu tindak balas nuklear diwakili oleh persamaan berikut:

A nuclear reaction is represented by the following equation:

$$^{2}_{1}\mathrm{H} + ^{3}_{1}\mathrm{H} \longrightarrow \square\mathrm{He} + ^{1}_{0}\mathrm{n} + \text{Tenaga / } \textit{Energy}$$

(a) Apakah jenis tindak balas yang ditunjukkan oleh persamaan di atas?

What is the type of reaction shown on above equation?

.....

[1 markah]

[1 *mark*]

(b) Lengkapkan persamaan di atas.

Complete the above equation.

[1 markah]

[1 *mark*]

(c) Tanda (✓) pada pernyataan yang betul menerangkan tindak balas di atas.

Tick (✓) for the correct statement that explained the above reaction.

☐ Nukleus berat dipecahkan kepada dua nukleus ringan dan memancarkan neutron dan tenaga

Heavier nucleus split into two lighter nuclei and emitting neutrons and energy.

☐ Dua nukleus yang kecil bercantum membentuk satu nukleus yang berat dengan membebaskan tenaga yang banyak

Two lighter nuclei combine to form a heavier nucleus and release huge amount of energy.

[1 markah]

[1 *mark*]

(d) Nyatakan **satu** keadaan yang membolehkan tindak balas ini berlaku.

*State **one** condition that allows this reaction to occur.*

.....

[1 markah]

[1 *mark*]

PAHANG JUJ SET 1 2024

2 Rajah 2 menunjukkan persamaan satu tindak balas nuclear.
Diagram 2 shows a nuclear reaction equation.

$$^{235}_{92}\text{U} + ^{1}_{0}\text{n} \rightarrow ^{137}_{52}\text{Te} + ^{97}_{40}\text{Zr} + 2\,^{1}_{0}\text{n} + \text{E}$$

Di mana E = Tenaga
Where E = *Energy*

Rajah 2/ *Diagram* 2

(a) Apakah jenis tindak balas nuklear di atas.
What is the type of nuclear reaction above.

.....
[1 markah / 1 *mark*]

(c) Mengapa $^{235}_{92}\text{U}$ menghasilkan dua nukleus yang lebih ringan setelah dibedil oleh neutron? Jelaskan.
Why does $^{235}_{92}\text{U}$ *produces two lighter nuclei after bombarded by a neutron? Explain.*

.....

.....

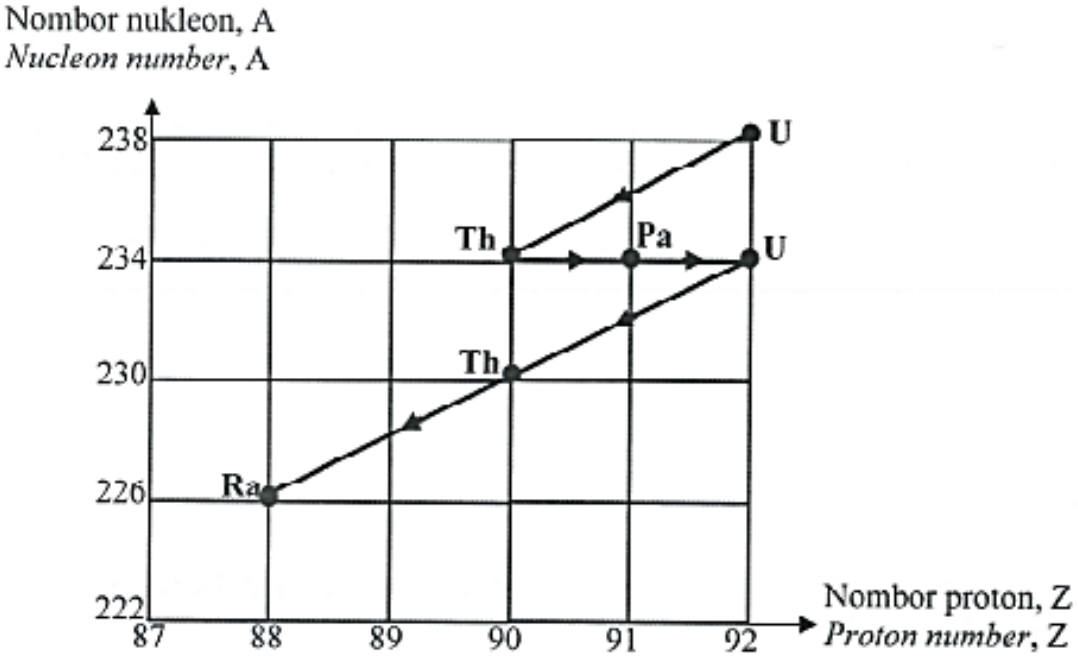
[2 markah / 2 *marks*]

(d) Jika cacat jisim dalam tindak balas ini ialah 0.39585 u.j.a. Hitungkan tenaga yang dibebaskan oleh tindak balas tersebut.
If the mass defect in this reaction is 0.39585 *a.m.u. Calculate the energy released by the reaction.*

[2 markah / 2 *marks*]

MRSM 2024

2 Rajah 2 menunjukkan siri reputan radioaktif nukleus Uranium-238 kepada Radium-226.
Diagram 2 shows the radioactive decay series for nucleus of Uranium-238 to Radium-226.



Rajah 2
Diagram 2

(*a*) Apakah maksud reputan radioaktif?
What is the meaning of radioactive decay?

.....

.....

[1 markah]
[1 *mark*]

(*b*) Mengapakah reputan U-238 berlaku?
Why does U-238 *decayed?*

.....

[1 markah]
[1 *mark*]

(*c*) Berapakah bilangan zarah alfa dan zarah beta yang dipancarkan dalam proses ini?
How many alpha particles and beta particles are emitted in this process?

Zarah alfa : ..... Zarah beta : .....
Alpha particle *Beta particle*

[2 markah]
[2 *marks*]

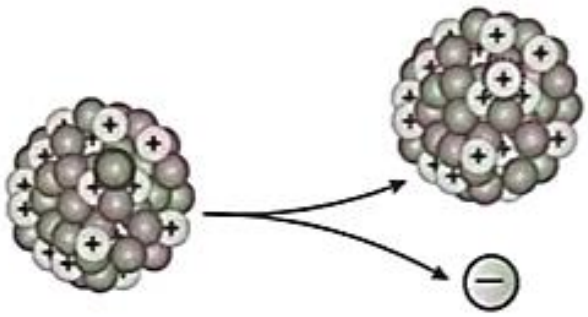
(*d*) Tulis satu persamaan reputan bagi U-238 kepada Ra-226.
Write the decay equation of U-238 *to* Ra-226.

.....

[1 markah]
[1 *mark*]

NEGERI SEMBILAN 2024

3 Rajah 3.1 menunjukkan satu reputan radioaktif.
Diagram 3.1 *shows one radioactive decay.*



Rajah 3.1
Diagram 3.1

(*a*) Apakah yang dimaksudkan dengan reputan radioaktif?
What is meant by radioactive decay?

.....

[1 markah]
[1 *mark*]

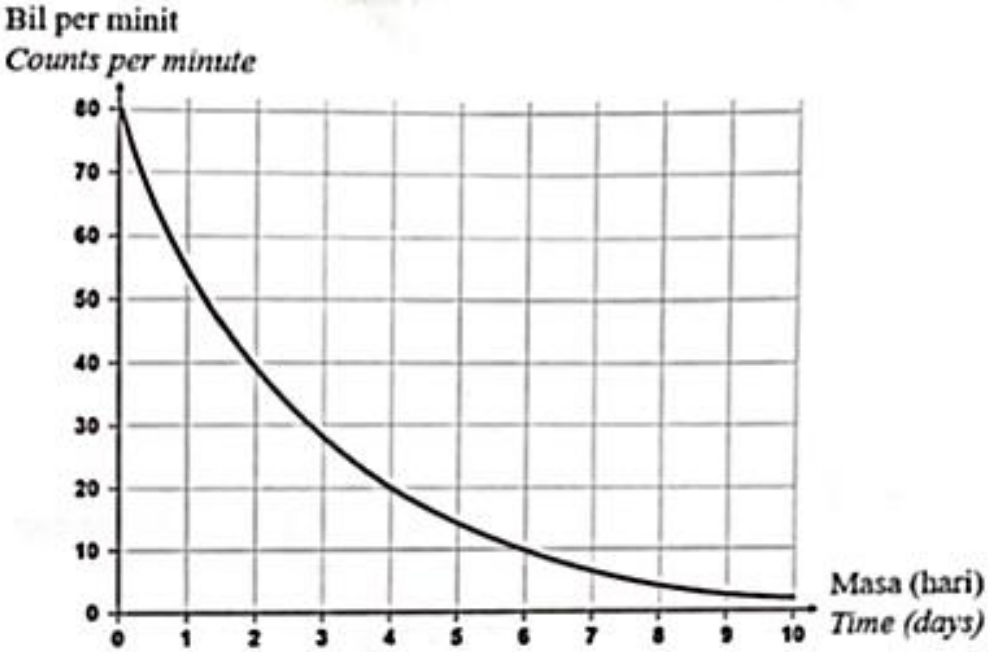
(*b*) Berdasarkan Rajah 3.1, terangkan jenis pereputan yang berlaku.
Based on Diagram 3.1, *explain the type of decay that occurs.*

.....

.....

[2 markah]
[2 *marks*]

(c) Rajah 3.2 menunjukkan graf pereputan bagi strontium-90.
Diagram 3.2 shows the decay graph for strontium-90.



Rajah 3.2
Diagram 3.2

(i) Tentukan separuh hayat bagi strontium-90.
Determine the half-life of strontium-90.

.....

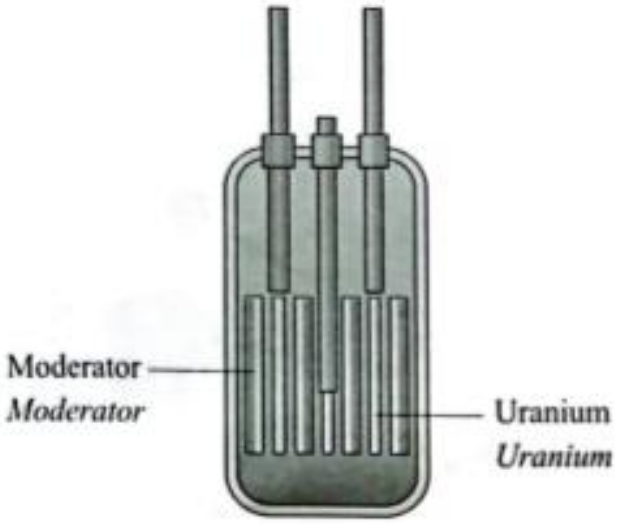
[1 markah]
[1 *mark*]

(ii) Jika 80 g strontium-90 telah mereput selepas 6 hari. Berapakah jisim awal sampel tersebut?
If 80 g of strontium-90 has decayed after 6 days. What is the initial mass of the sample?

[2 markah]
[2 *marks*]

SBP 2024

3 Rajah 3.1 menunjukkan struktur asas sebuah reaktor nuklear. Tindak balas nuklear yang berlaku di dalam reaktor nuklear adalah pembelahan nukleus.
Diagram 3.1 shows the basic structure of a nuclear reactor. The nuclear reaction that takes place in a nuclear reactor is nuclear fission.



Rajah 3.1
Diagram 3.1

(*a*) Apakah pembelahan nukleus?
What is nuclear fission?

.....

.....

[1 *markah*]
[1 *mark*]

(*b*) Bagaimanakah moderator digunakan untuk mengawal kadar pembelahan nukleus dalam reaktor nuklear?
How are moderators used to control the rate of nuclear fission in a nuclear reactor?

.....

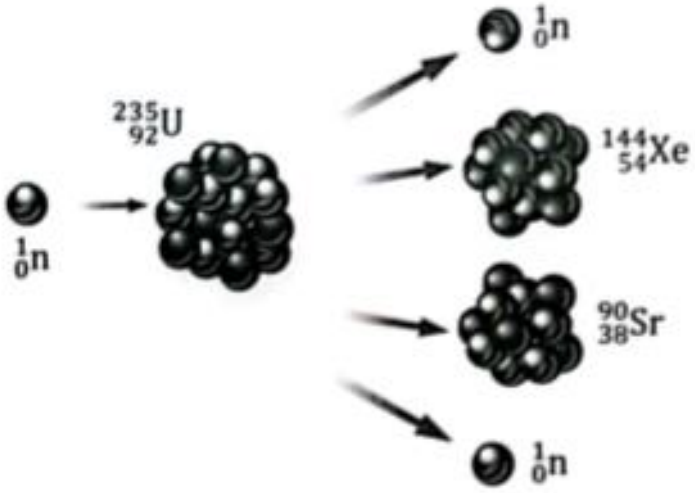
[1 *markah*]
[1 *mark*]

(*c*) Nyatakan perubahan tenaga yang berlaku dalam reaktor nuklear.
State the change of energy that occurs in the nuclear reactor.

.....

[1 *markah*]
[1 *mark*]

(*d*) Rajah 3.2 menunjukkan pembelahan nukleus Uranium-235 yang berlaku di dalam reaktor nuklear tersebut.
Diagram 3.2 shows the fission of the Uranium-235 nucleus that occurs in the nuclear reactor.



Rajah 3.2
Diagram 3.2

Diberi,	jisim $^{235}_{92}U$	= 235.0439 u. j. a.
	jisim $^{144}_{54}Xe$	= 143.9385 u. j. a.
	jisim $^{90}_{38}Sr$	= 89.9077 u. j. a.
	jisim $^{1}_{0}n$	= 1.0087 u. j. a.
Given,	*mass* $^{235}_{92}U$	= 235.0439 a. m. u.
	mass $^{144}_{54}Xe$	= 143.9385 a. m. u.
	mass $^{90}_{38}Sr$	= 89.9077 a. m. u.
	mass $^{1}_{0}n$	= 1.0087 a. m. u.

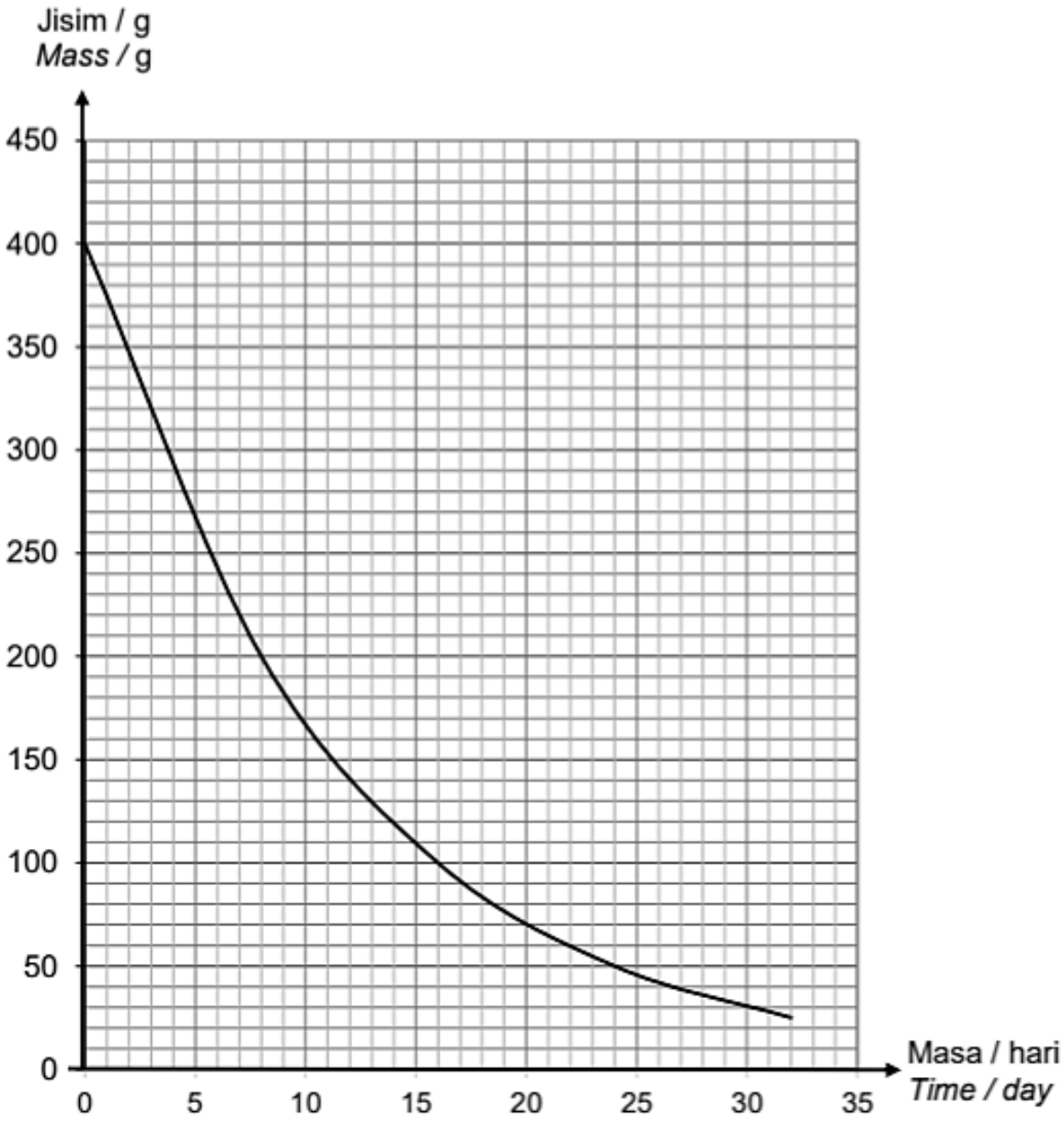
Hitung tenaga nuklear yang dihasilkan dalam Joule.
Calculate the nuclear energy produced in Joule.

Tenaga nuklear = ... J
Nuclear energy

[3 *markah*]
[3 *marks*]

YIK 2024

4. Rajah 4 menunjukkan graf jisim melawan masa bagi reputan Iodin-131.
Diagram 4 shows the graph of mass against time for Iodine-131 decay.



Rajah 4 / *Diagram 4*

a) Apakah yang dimaksudkan dengan separuh hayat?
What is meant by half-life?

.....

.....

[1 markah/1 *mark*]

b) Berdasarkan Rajah 4, tentukan separuh hayat Iodin-131.
Tunjukkan pada graf bagaimana anda menentukan separuh hayat itu.
Based on the Diagram 4, determine the half-life of Iodine-131.
Show on a graph how you determined the half-life.

Separuh hayat Iodin-131: .....

Half-life of Iodine-131: .....

[2 markah/2 *marks*]

c) Tentukan jisim Iodin-131 selepas empat separuh hayat.
Determine the mass of Iodine-131 after four half-life.

[2 markah/2 *marks*]

d) Mengapakah reputan radioaktif tersebut terus berlaku?
Why does the radioactive decay continues to occur?

.....

[1 markah/1 *mark*]

e) Semasa tindak balas nuklear, jumlah tenaga yang dibebaskan ialah 1.65×10^{-13} J. Hitung cacat jisim dalam tindak balas nuklear itu dalam unit u.j.a.
[1 u.j.a = 1.66×10^{-27} kg]

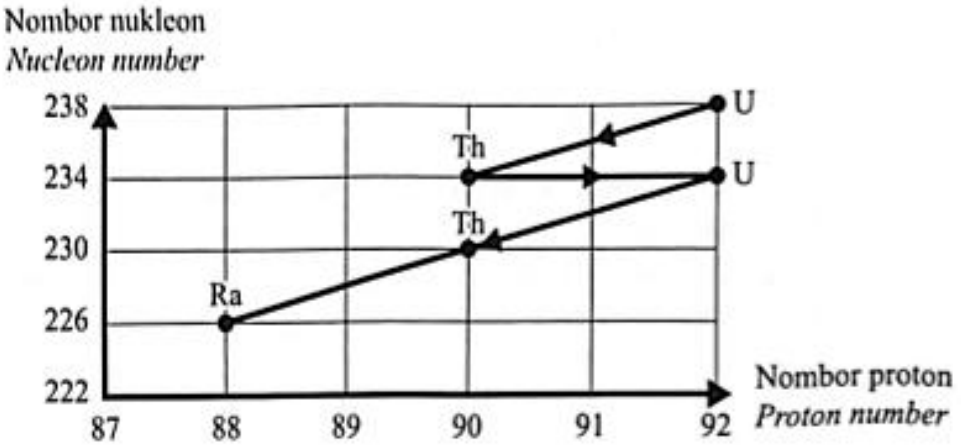
During a nuclear reaction, the total energy released is 1.65×10^{-13} J. *Calculate the mass defect in the nuclear reaction in units of* u.j.a.
[1 a.m.u = 1.66×10^{-27} kg]

[3 markah/3 *marks*]

SELANGOR (MODUL PINTAS) SET 1 2024

4 Rajah 4 menunjukkan sebahagian daripada siri reputan radioaktif bagi nukleus uranium-238 hingga radium-226.

Diagram 4 shows part of the series of radioactive decays for the nucleus of uranium-238 to that of radium-226.



Rajah 4
Diagram 4

(a) Apakah maksud reputan radioaktif?
What is meant by radioactive decay?

.....

.....

[1 *markah*]
[1 *mark*]

(b) Berdasarkan Rajah 4, tentukan bilangan zarah alfa dan zarah beta yang dikeluarkan sepanjang siri reputan itu.

Based on Diagram 4, determine the number of the alpha particles and beta particles emitted during the decay series.

[2 *markah*]
[2 *marks*]

(c) Reputan alfa yang berlaku apabila uranium-238 mereput menjadi thorium-234 adalah seperti berikut:

The alpha decay that occurs when uranium-238 decays into thorium-234 is as follows:

Tenaga
Energy

$$\underbrace{{}^{238}_{92}U}_{\text{Jumlah jisim} = x} \longrightarrow \underbrace{{}^{234}_{90}Th + \alpha}_{\text{Jumlah jisim} = 234.07389\ \text{u.j.a.}} + \overbrace{6.848 \times 10^{-13}\text{J}}^{\text{Tenaga / Energy}}$$

Jumlah jisim = x
Total mass = x

Jumlah jisim = 234.07389 u.j.a.
Total mass = 234.07389 a.m.u.

Diberi : 1 u.j.a. = 1.66×10^{-27} kg
Given : 1 a.m.u. = 1.66×10^{-27} kg

(i) Hitung cacat jisim yang terlibat.
Calculate the mass defect involved.

[2 *markah*]
[2 *marks*]

(ii) Tentukan jisim x dalam unit kg.
Determine the mass x *in* kg.

[2 *markah*]
[2 *marks*]

(iii) Jika cacat jisim dalam 4(*c*)(i) bertambah, apakah yang berlaku pada tenaga dan bilangan zarah alfa yang terhasil dalam tindak balas tersebut?
If the mass defect in 4(*c*)(i) *increases, what happens to the energy and number of alpha particles produced in the reaction?*

.....

.....

[2 *markah*]
[2 *marks*]

SELANGOR (MODUL PINTAS) SET 2 2024

4 Rajah 4 menunjukkan sebahagian siri reputan uranium-238.
Diagram 4 shows part of the uranium-238 decay series.

$$^{238}_{92}U \rightarrow {}^{234}_{90}Th \rightarrow {}^{234}_{91}Pa \rightarrow {}^{234}_{92}U \rightarrow {}^{230}_{90}Th \rightarrow {}^{226}_{88}Ra$$

Rajah 4
Diagram 4

(*a*) Apakah yang dimaksudkan dengan reputan radioaktif?
What is meant by radioactive decay?

.....

.....

[1 *markah*]
[1 *mark*]

(*b*) Berdasarkan Rajah 4, tentukan bilangan zarah alfa dan zarah beta yang dipancarkan apabila $^{238}_{92}U$ mereput menjadi $^{226}_{88}Ra$.
Based on Diagram 4, determine the number of alpha particles and beta particles emitted when $^{238}_{92}U$ *decays into* $^{226}_{88}Ra$.

Bilangan zarah alfa : .....
Number of alpha particle

Bilangan zarah beta : .....
Number of beta particle

[2 *markah*]
[2 *marks*]

(*c*) Apakah yang berlaku kepada bilangan zarah alfa yang dipancarkan dalam 4(*b*) jika suhu persekitaran berkurang menghampiri takat beku?
What happens to the number of alpha particles emitted in 4(*b*) *if the surrounding temperature is reduces to near freezing?*

.....

[1 *markah*]
[1 *mark*]

(*d*) $^{226}_{88}Ra$ mereput menjadi $^{222}_{86}Rn$ dengan memancarkan satu zarah alfa.

Diberi; Jisim $^{226}_{88}Ra$ = 226.54 u.j.a.
Jisim $^{222}_{86}Rn$ = 222.018 u.j.a.
Jisim zarah alfa = 4.003 u.j.a.

$^{226}_{88}Ra$ *decays to* $^{222}_{86}Rn$ *by emitting an alpha particle.*

Given; *Mass of* $^{226}_{88}Ra$ = 226.54 a.m.u
Mass of $^{222}_{86}Rn$ = 222.018 a.m.u
Mass of alpha particle = 4.003 a.m.u

(i) Hitung cacat jisim dalam u.j.a.
Calculate the mass defect in a.m.u.

.....

[1 *markah*]
[1 *mark*]

(ii) Hitung tenaga yang dibebaskan.
Calculate the energy released.

[3 *markah*]
[3 *marks*]

(iii) Jika cacat jisim dalam 4(*d*)(i) berkurang, apakah yang berlaku pada tenaga yang terhasil dalam tindak balas tersebut?
If the mass defect in 4(*d*)(i) *decreases, what happens to the energy produced in the reaction?*

.....

[1 *markah*]
[1 *mark*]

JOHOR 2024

6 Rajah 6.1 menunjukkan tindak balas nuklear P
Rajah 6.2 menunjukkan tindak balas nuklear Q
Diagram 6.1 *shows nuclear reaction for* P.
Diagram 6.2 *shows nuclear reaction for* Q.

$^{3}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$ + tenaga *energy*		$^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3{}^{1}_{0}n$ + tenaga *energy*	
Nuklear P *Nuclear* P		Nuklear Q *Nuclear* Q	
Cacat jisim *Mass defect*	Tenaga *Energy*	Cacat jisim *Mass defect*	Tenaga *Energy*
0.018 uja 0.018 amu	16.81 MeV 16.81 MeV	0.186 uja 0.186 amu	173.68 MeV 173.68 MeV

Rajah 6.1 / *Diagram* 6.1 Rajah 6.2 / *Diagram* 6.2

(a) Lengkapkan ayat berikut dengan menggariskan jawapan yang betul.
Complete the sentence by underline the correct answer.

Tindak balas nuklear yang berlaku pada matahari adalah **pelakuran / pembelahan** nukleus.
The nuclear reaction that occurs in sun is nuclear ***fusion / fission.***

[1 markah/ 1 *mark*]

(b) Perhatikan Rajah 6.1 dan Rajah 6.2. Bandingkan,
Observe Diagram 6.1 *and Diagram* 6.2. *Compare*

(i) tenaga nuklear yang dibebaskan.
nuclear energy released.

.....

[1 markah/ 1 *mark*]

(ii) cacat jisim.
the mass defect.

.....

[1 markah/ 1 *mark*]

(iii) Jenis tindak balas
Type of reaction

.....

[1 markah/ 1 *mark*]

(c) Menggunakan jawapan anda dalam **6**(b), hubungkaitkan,
Using your answer in **6**(b), *relate*,

(i) cacat jisim dengan tenaga yang dibebaskan.
the mass defect and the energy released.

.....

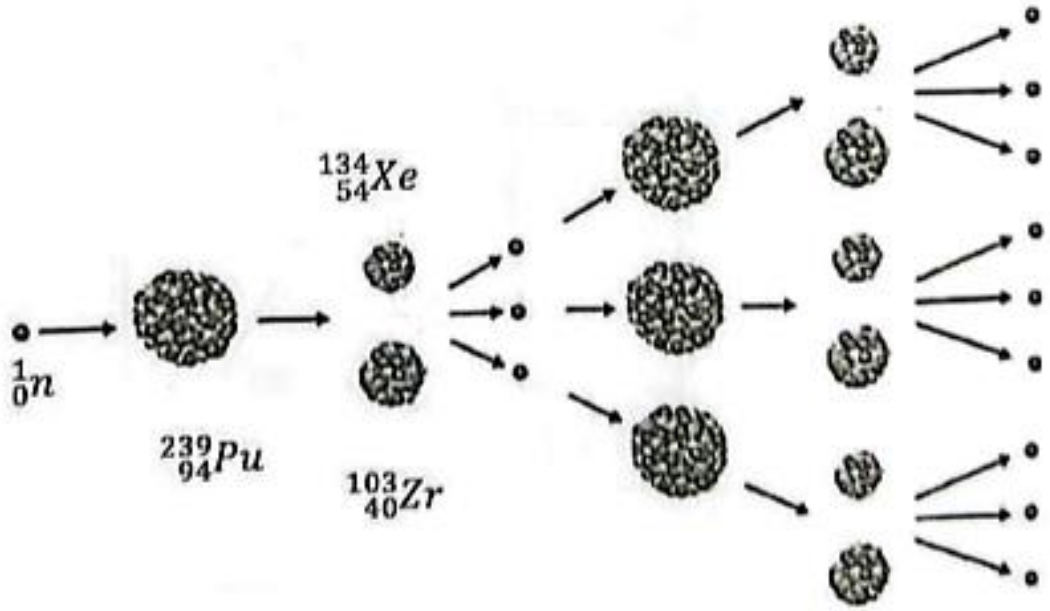
[1 markah/ 1 *mark*]

(ii) tenaga yang dibebaskan dengan jenis tindak balas
the energy released and type of reaction

.....

[1 markah/ 1 *mark*]

(d) Rajah 6.3 dibawah menunjukkan tindak balas suatu bahan radioaktif
Diagram 6.3 *below shows the reaction of a radioactive substance*



Rajah 6.3 / *Diagram* 6.3

Berdasarkan Rajah 6.3,
Based on Diagram 6.3,

(i) Tuliskan persamaan bagi tindak balas yang terlibat.
Write the equation of the reaction involved.

.....

[2 markah/ 2 *marks*]

(ii) Tindak balas itu berlaku secara berterusan. Namakan tindak balas itu.
The reaction occurs continuously. Name the reaction.

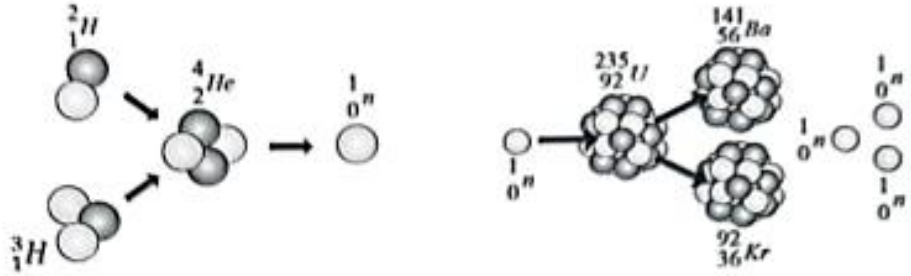
.....

[1 markah/ 1 *mark*]

PERAK 2024

6 Rajah 6 menunjukkan dua tindak balas nuklear berlainan, P dan Q, yang menghasilkan jumlah tenaga yang besar.

Diagram 6 shows two different nuclear reactions P and Q, which produce large amount of energy.



Tindak balas nuklear P
Nuclear reaction P

Tindak balas nuklear Q
Nuclear reaction Q

Rajah 6
Diagram 6

Jadual 1 menunjukkan jumlah jisim bagi nuklid-nuklid yang terlibat sebelum dan selepas tindak balas P dan Q

Table 1 shows the total mass of the nuclides involved before and after the reactions P and Q.

Tindak balas nuklear *Nuclear reaction*	Jumlah jisim / unit jisim atom, u *Total mass / atomic mass unit, u*		Tenaga dihasilkan / *Energy produced* / MeV
	Sebelum tindak balas *Before reaction*	Selepas tindak balas *After reaction*	
P	5.0301	5.0113	17.5
Q	236.05259	235.86653	164.48

Jadual 1
Table 1

(a) Apakah yang dimaksudkan dengan tenaga nuklear?
What is meant by nuclear energy?

.....

[1 markah / 1 *mark*]

(b) Berdasarkan maklumat dalam Rajah 1 dan Jadual 1,
Based on the information in Diagram 1 and Table 1,

(i) Bandingkan tenaga yang dihasilkan oleh kedua-dua tindak balas nuklear.
Compare the energy produced by the two nuclear reactions.

.....
.....

[1 markah / 1 *mark*]

(ii) Bandingkan kehilangan jisim nuklid selepas tindak balas bagi kedua-dua tindakbalas nuklear itu.
Compare the loss of mass of nuclides after reaction for the two nuclear reactions.

.....
.....

[1 markah / 1 *mark*]

(iii) Hubungkait tenaga yang dihasilkan dalam tindak balas nuklear dengan kehilangan jisim nuklid.
Relate the energy produced in the nuclear reaction to the loss of mass of nuclides.

.....
.....

[1 markah / 1 *mark*]

(c) Namakan konsep fizik yang terlibat di 6(b)(iii).
Name the physics concept involved in 6(b)(iii).

.....

[1 markah / 1 *mark*]

(d) Tulis persamaan nuklear bagi:
Write the nuclear equation for:

(i) tindakbalas nuklear P
the nuclear reaction P

.....

[1 markah / 1 *mark*]

(ii) tindakbalas nuklear Q
the nuclear reaction Q

.....

[1 markah / 1 *mark*]

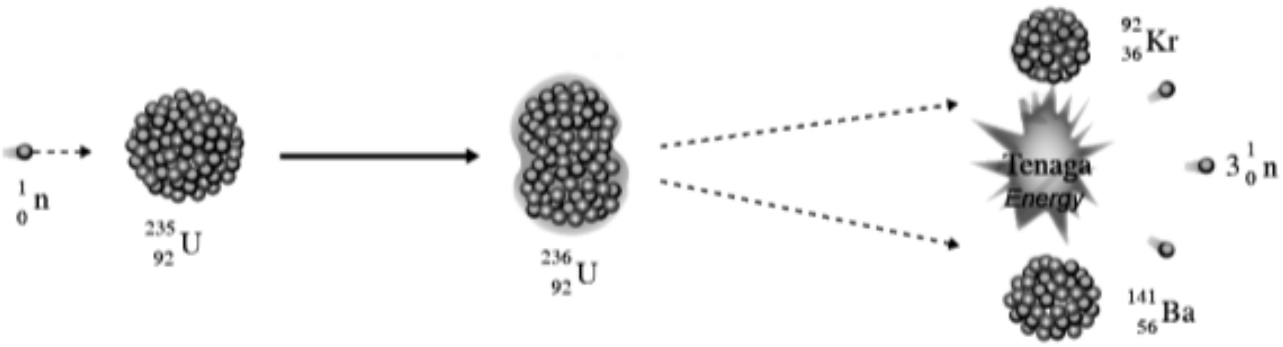
(e) Tindak balas nuklear manakah boleh menyebabkan tindak balas berantai? Beri sebab bagi jawapan anda.
Which nuclear reaction can cause a chain reaction? Give a reason for your answer.

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

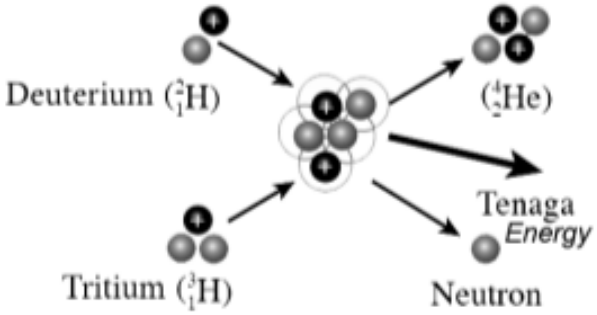
[2 markah / 2 *marks*]

KELANTAN 2024

6 Rajah 6.1 dan Rajah 6.2 menunjukkan dua tindak balas nukleus X dan Y masing-masing.
Kedua-dua tindak balas ini membebaskan sejumlah tenaga nuklear yang besar.
Diagram 6.1 *and diagram* 6.2 *shows two nuclear reactions* X *and* Y *respectively.*
Both nuclear reactions are releasing large amount of nuclear energy.



Rajah 6.1
Diagram 6.1



Rajah 6.2
Diagram 6.2

Jadual 1 menunjukkan jumlah jisim nuklid-nuklid yang terlibat sebelum dan selepas tindak balas nukleus, X dan Y.
Table 1 shows the total mass of the nuclides involved before and after the nuclear reaction, X and Y.

Tindak balas nukleus *Nuclear reaction*	Jumlah jisim / unit jisim atom, u *Total mass / automic mass unit,* u.		Tenaga dibebaskan / J *Energy released* / J
	Sebelum tindak balas *Before reaction*	Selepas tindak balas *After reaction*	
Tindak balas X *Reaction X*	236.05259	235.86653	2.78×10^{-11}
Tindak balas Y *Reaction Y*	5.030	5.012	2.69×10^{-12}

Jadual 1
Table 1

(a) Nyatakan nama lain bagi tenaga nuklear.
State another name for nuclear energy.

.....

.....

[1 *markah*]
[1 *mark*]

(b) Lengkapkan persamaan tindak balas X dan Y di bawah.
Complete the equations for nuclear reaction X and Y below.

(i) Tindak balas X
X *reaction*

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{92}_{36}\mathrm{Kr} + {}^{141}_{[\ ]}\mathrm{Ba} + 3\,{}^{1}_{0}\mathrm{n} + \text{tenaga/energy}$$

(ii) Tindak balas Y
Y *reaction*

$$^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{[\ ]}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n} + \text{tenaga/}energy$$

[2 *markah*]
[2 *mark*]

(c) Berdasarkan Jadual 1, bandingkan
Based on the Table 1, *compare*

(i) Tenaga yang dibebaskan
Energy released

.....

[1 *markah*]
[1 *mark*]

(ii) Cacat jisim selepas tindak balas.
Mass defect after reaction.

.....

[1 *markah*]
[1 *mark*]

(iii) Bilangan neutron selepas tindak balas.
Number of neutrons after the reaction.

.....

[1 *markah*]
[1 *mark*]

(d) Menggunakan jawapan anda di 6 (c), hubungkaitkan, tenaga nuklear yang dibebaskan dengan cacat jisim.
Using your answer in 6 (c), *relate, energy released with the mass defect.*

.....

[1 *markah*]
[1 *mark*]

(e) Namakan
Name the

Tindak balas X : .....
X *reaction*

Tindak balas Y : .....
Y *reaction*

[2 *markah*]
[2 *mark*]

PERLIS 2024

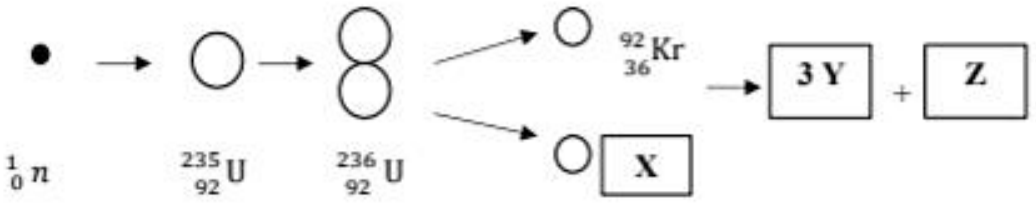
10. Rajah 10.1 menunjukkan tenaga cahaya dan haba terpancar ke permukaan Matahari apabila tindak balas nuklear berlaku di teras Matahari di bawah tekanan sangat tinggi.
Diagram 10.1 *shows light and heat energy radiated to the surface of the Sun when nuclear reaction occurs in the core of the Sun under very high pressure.*

Rajah / *Diagram* 10.1

(a) Apakah yang dimaksudkan dengan tenaga nuklear?
What is meant by nuclear energy?

[1 markah / *mark*]

(b) Rajah 10.2 menunjukkan pembelahan nukleus yang menghasilkan tenaga nuklear.
Diagram 10.2 *shows the nuclear fission that produce nuclear energy.*



Rajah / *Diagram* 10.2

Berdasarkan Rajah 10.2, lengkapkan persamaan berikut.
Based on Diagram 10.2, *complete the following equation.*

$$^{235}_{92}U + ^{1}_{0}n \longrightarrow ^{236}_{92}U \longrightarrow ^{92}_{36}Kr + \boxed{\text{X}} + \boxed{\text{3 Y}} + \boxed{\text{Z}}$$

[3 markah / *marks*]

(c) Persamaan berikut menunjukkan satu pereputan nuklear di mana jumlah jisim hasil pereputan sentiasa kurang daripada jumlah jisim nukleus radioaktif yang dikenali sebagai cacat jisim.

The equation shows a radioactive decay which the total mass of decay products is always less than the total mass of the radioactive nucleus which is known as mass defect.

$$^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + {}^{4}_{2}He$$

Diberi jisim bagi setiap bahan radioaktif adalah seperti berikut:

Given the mass of each radioactive substances are as follow:

Ra: 226.54 u.j.a / amu Rn: 222.018 u.j.a / amu He : 4.003 u.j.a / amu

(i) Hitung cacat jisim bagi tindak balas nuklear di atas.

Calculate the mass defect of the nuclear reaction above.

[2 markah / *marks*]

(ii) Hitung tenaga nuklear yang dihasilkan daripada tindak balas pereputan radioaktif tersebut.

Calculate the nuclear energy produced from the radioactive decay process.

Diberi 1 u.j.a = 1.66×10^{-27} kg dan laju cahaya dalam vakum, c = 3.00×10^{8} m s^{-1}

Given 1 amu = 1.66×10^{-27} kg *and speed of light in vacuum*, c = 3.00×10^{8} m s^{-1}

[3 markah/ *marks*]

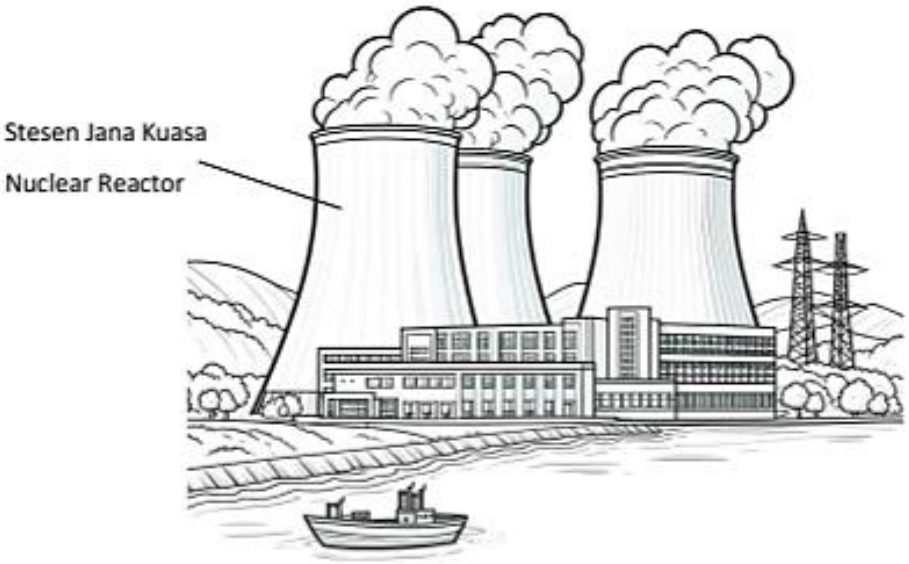
(d) Apakah tindak balas nuklear yang berlaku di dalam janakuasa nuklear untuk menghasilkan tenaga elektrik?

What is the nuclear reaction that takes place in nuclear reactor to generate electrical energy?

[1 markah/ *mark*]

(e) Rajah 10.3 menunjukkan janakuasa nuklear yang ingin dibina bagi menggantikan tenaga sedia ada sebagai tenaga alternatif di kawasan X.

Diagram 10.3 *shows a nuclear reactor is being built to replace the existence energy as an alternative energy in area* X.



Rajah / *Diagram* 10.3

Jadual 2 menunjukkan empat model janakuasa nuklear yang hendak dibina bagi menggantikan janakuasa tenaga sedia ada di kawasan X.

Table 2 *shows four nuclear reactors which will be built to replace the existing energy reactor in area* X.

Janakuasa nuklear ***Nuclear Reactor***	**Keadaan radioisotope** ***State of radioisotope***	**Separuh hayat** ***Half – life***	**Rod Pengawal** ***Control Rod***	**Moderator/** ***Moderator***
P	Cecair *Liquid*	Panjang *Long*	Air masin *Saltwater*	Kadmium *Cadmium*
Q	Pepejal *Solid*	Panjang *Long*	Boron *Boron*	Grafit *Graphite*
R	Cecair *Liquid*	Pendek *Short*	Kadmium *Cadmium*	Air masin *Saltwater*
S	Pepejal *Solid*	Pendek *Short*	Grafit *Graphite*	Boron *Boron*

Jadual / *Table* 2

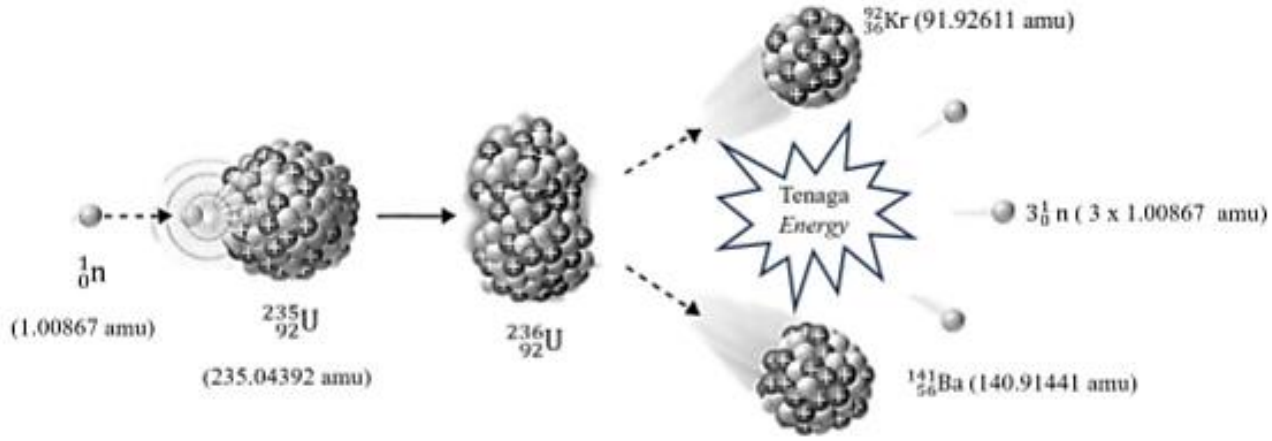
Anda selaku jurutera nuklear diminta untuk mengkaji ciri – ciri janakuasa yang selamat untuk menghasilkan jumlah tenaga elektrik yang besar. Tentukan janakuasa nuklear yang paling sesuai dan beri sebab kepada pilihan anda.

As a nuclear engineer, you are asked to investigate the characteristics of a reactor which is suitable to generate greater amount of electrical energy safely. Determine the most suitable nuclear reactor and give reasons for your choice.

[10 markah/ *marks*]

SMKA &SABK 2024

10. Rajah 10.1 menunjukkan suatu tindak balas nukleus.
Diagram 10.1 *shows a nuclear reaction.*



Rajah 10.1
Diagram 10.1

(a) Namakan jenis tindak balas nuklear yang berlaku.
Name the type of nuclear reaction that occurred.

[1 *markah*]
[1 *mark*]

(b) (i) Hitung cacat jisim dalam kilogram.
[1 u.j.a = 1.66×10^{-27} kg]
Calculate mass defect in kilogram.
[1 a.m.u = 1.66×10^{-27} kg]

[3 *markah*]
[3 *marks*]

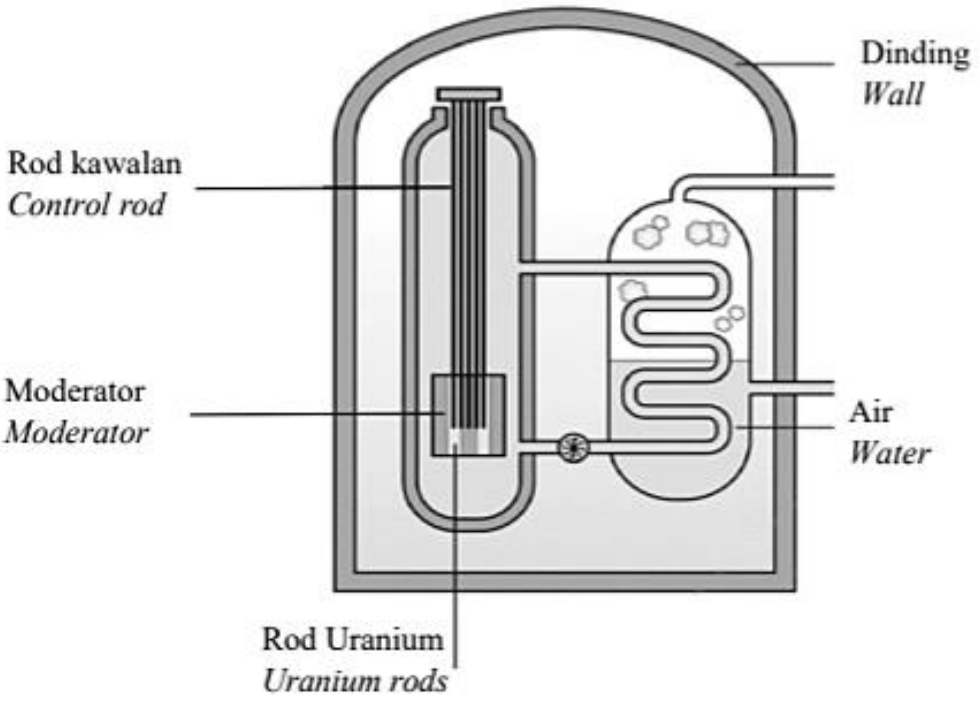
(ii) Hitung tenaga yang terhasil dalam tindak balas nuklear itu.
Calculate the energy produced in the nuclear reaction.

[2 *markah*]
[2 *marks*]

(c) Berdasarkan Rajah 10.1, terangkan bagaimana tindak balas berantai boleh terhasil.
Based on Diagram 10.1, *explain how a chain reaction can be produced.*

[4 *markah*]
[4 *marks*]

(d) Rajah 10.2 menunjukkan keratan rentas bagi sebuah model reaktor nuklear.
Diagram 10.2 *shows a cross section of a nuclear reactor model.*



Rajah 10.2
Diagram 10.2

Sebuah reaktor nuklear baharu akan dibina di tepi pantai. Jadual 4 menunjukkan ciri-ciri empat model reaktor nuklear R, S, T dan U dengan spesifikasi yang berbeza.
A new nuclear reactor is to be built near the seaside. Table 4 *shows the characteristics of nuclear reactor R, S, T and U with different specifications.*

Model	**Rod kawalan** ***Control rod***	**Moderator** ***Moderator***	**Bahan dinding** ***Wall material***	**Ketebalan dinding** ***Wall thickness***
R	Boron *Boron*	Grafit *Graphite*	Konkrit *Concrete*	Tebal *Thick*
S	Grafit *Graphite*	Air *Water*	Besi *Iron*	Nipis *Thin*
T	Boron *Boron*	Kadmium *Cadmium*	Konkrit *Concrete*	Tebal *Thick*
U	Grafit *Graphite*	Kadmium *Cadmium*	Besi *Iron*	Nipis *Thin*

Jadual 4
Table 4

Tentukan model reaktor nuklear yang paling sesuai dipilih. Justifikasikan sebab-sebab bagi pilihan anda.
Determine the most appropriate reactor model selected. Justify the reasons for your choice.

[10 *markah*]
[10 *marks*]