Essential Pre-Uni Physics D7.9

A Level

This question has been reworded to make it clearer. It may look different to the question in your book, but it contains the same data and has the same correct answer.

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

Part A Wavelength and frequency

An electron is travelling at $2.0 \times 10^6\,\mathrm{m\,s^{-1}}$. Calculate its momentum and its kinetic energy. Now use the momentum to calculate its wavelength, and use the kinetic energy and the equation $E = hf$ (which you may have previously only used for photons) to calculate its frequency.

- $\lambda = 2.7 \times 10^{15}\,\mathrm{m}$ and $f = 3.7 \times 10^{-10}\,\mathrm{Hz}$
- $\lambda = 3.6 \times 10^{-10}\,\mathrm{m}$ and $f = 2.7 \times 10^{15}\,\mathrm{Hz}$
- $\lambda = 1.8 \times 10^{-24}\,\mathrm{m}$ and $f = 2.7 \times 10^{15}\,\mathrm{Hz}$

Part B Using $c = f\lambda$

Use $c = f\lambda$ to 'calculate' the speed of the electron using the frequency and wavelength you calculated in Part A. What do you notice?

Essential Pre-Uni Physics D7.3

A Level

P P P

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

When an electron annihilates a positron, two photons are produced, each with an energy of $511\,\mathrm{keV}$. Calculate the frequency of each photon.

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Essential Pre-Uni Physics D6.6

A Level

P P P

Useful physical constants can be found in the hint tabs.

A material has a work function of $3.4\,\mathrm{eV}$, and is illuminated by $5.0\,\mathrm{eV}$ photons. Calculate the stopping potential of its photoelectrons.

Gameboard:

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Essential Pre-Uni Physics D9.2

A Level

Physical constants which may be necessary to answer the problems on this page can be found within the hint tabs.

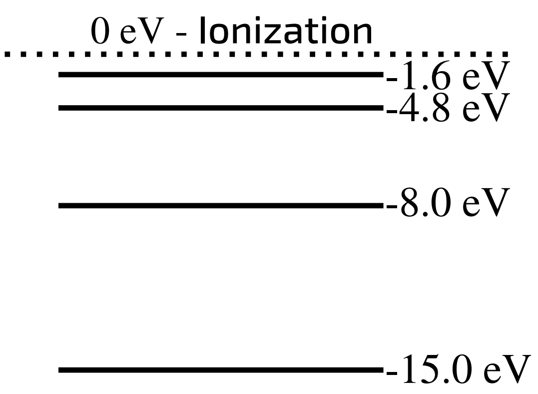

Figure 1: Energy level diagram of the atom this question is concerned with.

What wavelength of light would be emitted if an electron descended from the $-4.8\,\mathrm{eV}$ state to the ground state?

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Essential Pre-Uni Physics J1.6

GCSE C C C A Level P P P

Complete the nuclear equation. Don't forget the neutrino / antineutrino if it is a beta decay! A periodic table is available here, however you shouldn't need it.

$^{90}_{38}\mathrm{Sr} \rightarrow \quad ... \quad$ (Beta− decay)

- $^{89}_{38}\mathrm{Y} \ + \ ^{0}_{-1}\mathrm{e} \ + \ ^{1}_{1}\overline{\nu}$
- $^{90}_{39}\mathrm{Y} \ + \ ^{0}_{-1}\mathrm{e} \ + \ ^{0}_{0}\nu$
- $^{89}_{39}\mathrm{Y} \ + \ ^{0}_{-1}\mathrm{e} \ + \ ^{1}_{0}\overline{\nu}$
- $^{90}_{39}\mathrm{Y} \ + \ ^{0}_{-1}\mathrm{e} \ + \ ^{0}_{0}\overline{\nu}$
- $^{90}_{38}\mathrm{Y} \ + \ ^{0}_{-1}\mathrm{e} \ + \ ^{0}_{0}\overline{\nu}$

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Essential Pre-Uni Physics J1.8

GCSE C C C A Level P P P

Complete the nuclear equation. Don't forget the neutrino / antineutrino if it is a beta decay! A periodic table is available here, however you shouldn't need it.

$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow \ ...$ (Nuclear Fission)

- $^{147}_{57}\mathrm{La} + {}^{87}_{35}\mathrm{Br} + 2{}^{1}_{0}\mathrm{n}$
- $^{147}_{57}\mathrm{La} + {}^{87}_{35}\mathrm{Br} + {}^{1}_{0}\mathrm{n}$
- $^{147}_{57}\mathrm{La} + {}^{87}_{57}\mathrm{Br} + 2{}^{1}_{0}\mathrm{n}$

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Essential Pre-Uni Physics J2.7

A Level

A ‘mole’ of nuclei contains 6.02×10^{23} nuclei. The mass of one mole of nuclei (the ‘molar mass’) is approximately equal to $0.001\,\mathrm{kg}\times$ the mass number of the nucleus. Use this approximation wherever you have a question and are not given the molar mass explicitly.

Part A Number of nuclei

How many nuclei are there in $5.0\,\mathrm{mg}$ of ${}^{14}\mathrm{C}$? Give your answer to 2 significant figures (strictly the answer to this question should be given to 1 sig fig, but 2 sig figs allows us to check your method is correct)

Part B Activity

What is the activity of this sample if the half life is $5700\,\mathrm{years}$? Give your answer to 2 significant figures (strictly the answer to this question should be given to 1 sig fig, but 2 sig figs allows us to check your method is correct)

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Essential Pre-Uni Physics J3.7

A Level

P P P

Part A Time to decay at constant rate

A substance has a half life of $100\,\mathrm{s}$, and starts with 10^{20} unstable nuclei. Calculate the initial activity, and from this work out the time taken for all of the nuclei to decay if the activity did not decrease with time (instead of remaining proportional to the number of remaining unstable nuclei as it actually should). Give your answer to 2 significant figures.

Part B Fraction of nuclei remaining

Calculate what fraction of the nuclei remain after the time calculated as the answer to Part A. Give your answer as a decimal to 2 significant figures.

Gameboard:

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Essential Pre-Uni Physics J4.4

A Level

Mass defects, binding energies or energy yields in nuclear equations require high precision data as calculations involve subtracting two very similar numbers. Use the data here (and on page iv of the book) to all significant figures given. Take $c = 2.998 \times 10^{8}\,\mathrm{m\,s^{-1}}$, and the electronic charge as $1.602 \times 10^{-19}\,\mathrm{C}$.

Mass of neutron (m_n)	$1.67493 \times 10^{-27}\,\mathrm{kg}$
Mass of neutron (m_n)	$1.00867\,\mathrm{u}$
Mass of proton (m_p)	$1.67262 \times 10^{-27}\,\mathrm{kg}$
Mass of proton (m_p)	$1.00728\,\mathrm{u}$
Mass of electron (m_e)	$9.10938 \times 10^{-31}\,\mathrm{kg}$
Mass of electron (m_e)	$5.48580 \times 10^{-4}\,\mathrm{u}$
Atomic mass unit (u)	$1.66054 \times 10^{-27}\,\mathrm{kg}$

Calculate the binding energy per nucleon of $^{12}\mathrm{C}$ in MeV. Give your answer to 4 sig fig.

Gameboard:

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Physics. You work it out.

Essential Pre-Uni Physics J4.6

A Level

Mass defects, binding energies or energy yields in nuclear equations require high precision data as calculations involve subtracting two very similar numbers. Use the data here (and on page iv of the book) to all significant figures given. Take $c = 2.998 \times 10^8\,\mathrm{m\,s^{-1}}$, and the electronic charge as $1.602 \times 10^{-19}\,\mathrm{C}$.

Mass of neutron (m_n)	$1.67493 \times 10^{-27}\,\mathrm{kg}$
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Mass of electron (m_e)	$5.48580 \times 10^{-4}\,\mathrm{u}$
Atomic mass unit (u)	$1.66054 \times 10^{-27}\,\mathrm{kg}$

One nuclear fission reaction is ${}^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{147}_{57}\mathrm{La} + {}^{87}_{35}\mathrm{Br} + 2{}^{1}_{0}\mathrm{n}$. The masses of the **atoms** are given in the table below.

${}^{235}_{92}\mathrm{U}$	$3.90300 \times 10^{-25}\,\mathrm{kg}$
${}^{147}_{57}\mathrm{La}$	$2.43981 \times 10^{-25}\,\mathrm{kg}$
${}^{87}_{35}\mathrm{Br}$	$1.44335 \times 10^{-25}\,\mathrm{kg}$

Calculate the energy released by this reaction in MeV. Give your answer to 4 sig fig.