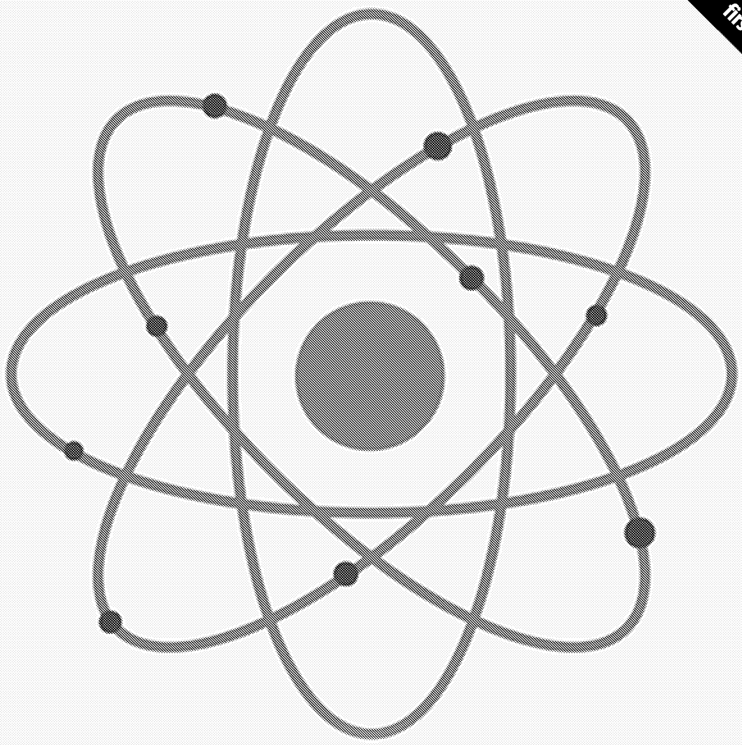
Zig Zag Education

Physics AS and A Level | AQA | 7407/7408

2015 specification
first exams in 2017 (2016 for AS)



Revision Grids
for A Level AQA Physics
Section 8: Nuclear Physics

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POD 8076

Contents

Teacher's Introduction

These Revision Grids are a tool designed to help you deliver **A Level AQA Physics Section 3.8: Nuclear Physics**. The concept is that your students are assigned a set of pages to read from their notes or a textbook, possibly for homework, and then asked to complete the relevant Revision Grids. These activities may be particularly useful for your weaker learners, who may benefit from both the requirement to read all their notes to find the information, and a structured approach to their revision.

The grids are designed to ask questions in sufficient detail that your students are able to study the relevant sections and find the correct answers. Completed grids are provided so that your students' answers can be marked or checked. It may also be useful to hand them out to students during their revision to assist them with answers they do not know.

> This resource directly references:
>
> AQA Physics A Level Year 2 Student Book;
> 2nd edition;
> Breithaupt;
> Oxford, 2015
>
> AQA A Level Physics Year 2 Student Book;
> Pharoah, Bishop and Gidzewicz
> HarperCollins, 2016

Advantages of using these Revision Grids are:

- Many students will find this structured method of studying of great value, particularly if they find it difficult to absorb information in class.
- Resulting grids contain a bullet-point summary that is useful for revision.
- They are an easy-to-set yet valuable homework.
- They are a useful catch-up tool to help students who have missed a lesson.
- They can be used as a basis for cover lessons that require minimal preparation and no interaction from the cover teacher.
- They are an independent learning resource.

You may want to photocopy the sheets onto A3 paper, particularly for students with reading or writing difficulties.

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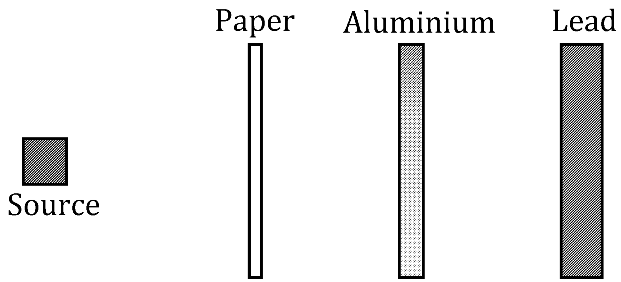
Selected Question and Answer Pages

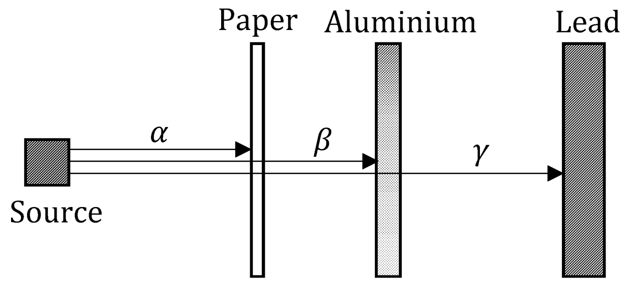
For demonstration only, the sample answer pages immediately follow their corresponding question pages

Oxford: pp. 171–181
Collins: pp. 177–186

3.8.1.2 α, β and γ radiation

Questions	Answers
Draw arrows on the diagram opposite showing how α, β and γ radiation will penetrate the different materials.	
Describe an experiment which could be used to identify α, β and γ radiation.	
Describe the dangers posed by radiation to the human body.	
Explain why β-particles are more dangerous than α-particles when the source of the particles is outside the human body.	
Explain why α-particles are more dangerous than β-particles if the source is placed inside the human body.	

3.8.1.2 α, β and γ radiation

Questions	Answers
Draw arrows on the diagram opposite showing how α, β and γ radiation will penetrate the different materials.	
Describe an experiment which could be used to identify α, β and γ radiation.	• Set up Geiger–Muller tube facing source • Place paper, aluminium and lead between source and Geiger–Muller tube • Type of radiation can be determined from which material(s) it is stopped by
Describe the dangers posed by radiation to the human body.	• Radiation absorbed by tissues and cells • Tissues and cells are ionised • Cell damage and mutations in genetic material lead to cell death or cancers
Explain why β-particles are more dangerous than α-particles when the source of the particles is outside the human body.	• α-particles are readily absorbed by skin, clothing or even a few cm of air • β-particles will penetrate into the human body and
Explain why α-particles are more dangerous than β-particles if the source is placed inside the human body.	• α-particles heavily absorbed by body tissues • β-particles are more penetrating, so deposit their e tissue • α-particles are more strongly ionising than β-partic

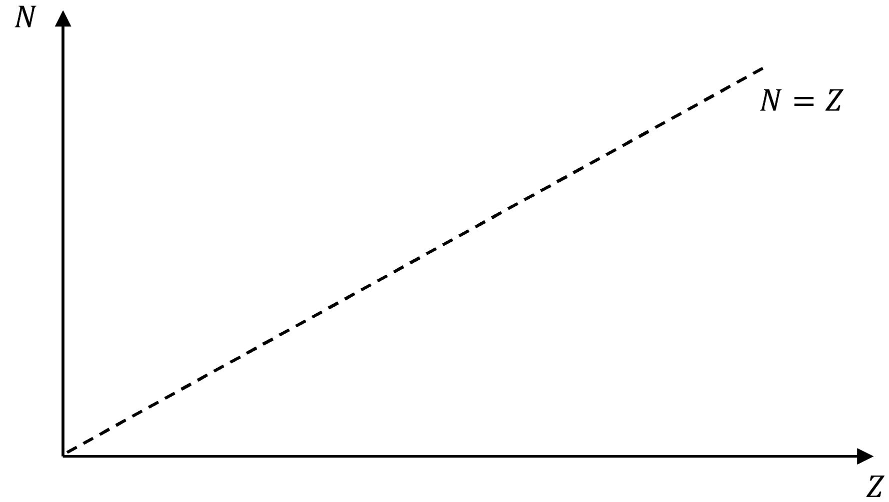
	Questions	Answers
3.8.1.3 Radioactive decay	**State the equation for the number of undecayed atoms left in a radioactive sample after a time *t*, and state the meaning of any variables.**	
	In a sample of ^{35}S: **There are initially 43,900 atoms of ^{35}S.** **The decay constant of ^{35}S is 9.19×10^{-8} s^{-1}.** **How many atoms of ^{35}S are present in the sample after 100 days?**	
	Rearrange $N = N_0 e^{-\lambda t}$ to find *t*.	
	The decay constant of a radioactive sample is 5.74×10^{-3}. **Calculate the amount of time until $\frac{5}{6}$ of the atoms in the sample have decayed.**	

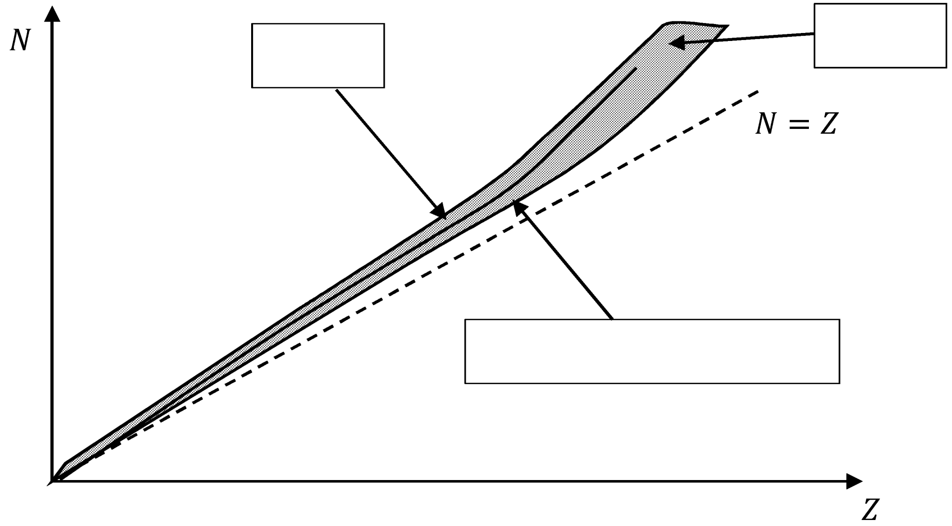
3.8.1.3 Radioactive decay	Questions	Answers
	State the equation for the number of undecayed atoms left in a radioactive sample after a time t, and state the meaning of any variables.	$N = N_0 e^{-\lambda t}$ N = number of undecayed atoms, N_0 = original number of atoms, λ = decay constant, t = time
	In a sample of ^{35}S: **There are initially 43,900 atoms of ^{35}S.** **The decay constant of ^{35}S is $9.19 \times 10^{-8}\ s^{-1}$.** **How many atoms of ^{35}S are present in the sample after 100 days?**	$t = 100$ days $= 100 \times 24 \times 60 \times 60 = 8.64 \times 10^6$ s. $N = N_0 e^{-\lambda t}$ $N = 43\ 900 \times e^{-9.19 \times 10^{-8} \times 8.64 \times 10^6}$ $N = 19\ 800$
	Rearrange $N = N_0 e^{-\lambda t}$ to find t.	$N = N_0 e^{-\lambda t}$ $\frac{N}{N_0} = e^{-\lambda t}$ $\ln\left(\frac{N}{N_o}\right) = -\lambda t$ $t = -\ln\left(\frac{N}{N_0}\right) \times \frac{1}{\lambda}$
	The decay constant of a radioactive sample is 5.74×10^{-3}. **Calculate the amount of time until $\frac{5}{6}$ of the atoms in the sample have decayed.**	$t = -\ln\left(\frac{N}{N_0}\right) \times \frac{1}{\lambda}$ $\frac{N}{N_o} = \frac{1}{6}$ ($\frac{5}{6}$ of the atoms have decayed, so only $\frac{1}{6}$ of the origi $t = -\ln\left(\frac{1}{6}\right) \times \frac{1}{5.74 \times 10^{-3}}$ $t = 312$ s

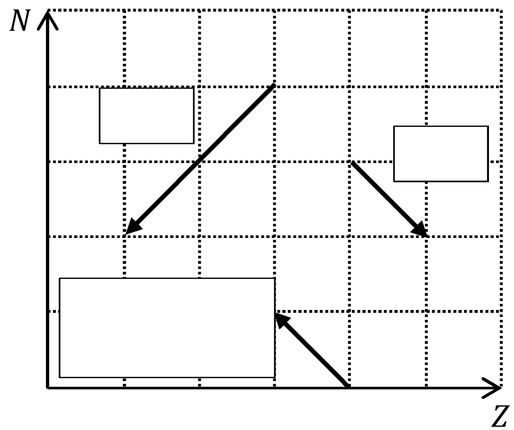
Additional Selected Question Pages

	Questions	Answers
3.8.1.3 Radioactive decay	**Describe the assumptions made in dating objects based on their carbon-14 content.**	
	Why is it so difficult to store waste from nuclear power generation?	

Oxford: pp. 192–195
Collins: pp. 197–204

	Questions	Answers
3.8.1.4 Nuclear instability	**Nuclei can be described in terms of the numbers N and Z.** **What do N and Z represent?**	
	On the axes opposite, sketch the graph of N against Z for stable nuclei. **The line $N = Z$ has been drawn.**	
	What does the graph of N against Z for stable nuclei show about nuclei of different isotopes?	

<table>
<tr><th></th><th>Questions</th><th>Answers</th></tr>
<tr><td rowspan="4">3.8.1.4 Nuclear instability</td><td>On the graph opposite, label the indicated regions with the type of radioactive decay that isotopes in that region undergo.</td><td>
</td></tr>
<tr><td>State the various decay modes by which a single nucleus can change its composition.</td><td></td></tr>
<tr><td>Why do nuclei undergo radioactive decay?</td><td></td></tr>
<tr><td>The grid opposite shows the change in the numbers of neutrons and protons in an isotope during different types of radioactive decay.

Label each arrow with the correct type of radioactive decay.</td><td>
</td></tr>
</table>

	Questions	Answers
3.8.1.4 Nuclear instability	Complete the equation opposite to show a nucleus undergoing α decay.	${}^{A}_{Z}X \rightarrow {}^{\boxed{A-4}}_{\square}Y + \square$
	Complete the equation opposite to show a nucleus undergoing β^- decay.	${}^{A}_{Z}X \rightarrow {}^{\square}_{\square}Y + \square$
	Complete the equation opposite to show a nucleus undergoing β^+ decay.	${}^{A}_{Z}X \rightarrow {}^{\square}_{\square}Y + \square$
	Complete the equation opposite to show a nucleus undergoing electron capture.	${}^{A}_{Z}X + \square \rightarrow {}^{\square}_{\square}Y$
	${}^{106}_{52}Te$ decays by α decay. Complete the equation opposite to show the α decay of ${}^{106}_{52}Te$.	${}^{106}_{52}\mathrm{Te} \rightarrow {}^{\square}_{\square}\mathrm{Sn} + \alpha$
	${}^{8}_{5}B$ decays to ${}^{8}_{6}C$. Write an equation showing this decay.	
	${}^{54}_{25}Mn$ can decay into ${}^{54}_{24}Cr$ via two different modes of decay. State these two different types of decay, and write out equations showing these decays.	
	${}^{194}_{76}Os$ decays to ${}^{194}_{77}Ir$ by β^- decay with a maximum kinetic energy of 0.097 MeV. ${}^{194}_{77}Ir$ then decays to ${}^{194}_{78}Pt$ by β^- decay with a maximum kinetic energy of 2.25 MeV. Represent this process in a nuclear energy level diagram.	