Year 11 Physics Revision Checklist - Ionising Radiation and Nuclear Reactions

Science as a Human Endeavour:

Qualitative and quantitative analyses of relative risk (including half-life, absorbed dose, dose equivalence) are used to inform community debates about the use of radioactive materials and nuclear reactions for a range of applications and purposes, including:

- radioisotopes are used as diagnostic tools and for tumour treatment in medicine
  Nelson pp. 100-101
  WACE Study Guide pp. 44-45
  Exploring Physics pp. 68-69
- nuclear power stations employ a variety of safety mechanisms to prevent nuclear accidents, including shielding, moderators, cooling systems and radiation monitors
  Nelson pp. 117-122
  WACE Study Guide pp. 55-57
  Exploring Physics pp. 86-87
  Heinemann pp. 191-195
  Hamper pp. 340-341
- the management of nuclear waste is based on the knowledge of the behaviour of radiation.
  Nelson pp. 123
  WACE Study Guide pp. 49, 57
  Hamper p. 342

Science Understanding:

- the nuclear model of the atom describes the atom as consisting of an extremely small nucleus which contains most of the atom's mass, and is made up of positively charged protons and uncharged neutrons surrounded by negatively charged electrons
  Nelson pp. 77-84
  WACE Study Guide pp. 33-34
  Heinemann p. 160
  Hamper pp. 278-280; 294-297
  Exploring Physics p. 50 Set 5: 5.1, 5.2
- nuclear stability is the result of the strong nuclear force which operates between nucleons over a very short distance and opposes the electrostatic repulsion between protons in the nucleus
  Nelson p. 108
  WACE Study Guide pp. 33,36
  Heinemann p. 162, 167-168; 5.1 Questions 1-8, 5.2 questions
  Hamper p. 297
  Exploring Physics p.50
- some nuclides are unstable and spontaneously decay, emitting alpha, beta (+/-) and/or gamma radiation over time until they become stable nuclides
  Nelson pp. 85-88
  WACE Study Guide pp. 31-37
  Heinemann pp. 164-165; 5.1 Question 9; 5.2 questions
  Hamper p. 300
  Exploring Physics Set 5: 5.5, 5.7, 5.9, 5.11, 5.13, 5.15, 5.17
- each species of radionuclide has a half-life which indicates the rate of decay
  This includes applying the relationship

  $$N = N_0 \left(\frac{1}{2}\right)^n$$

  Nelson pp. 95-97
  WACE Study Guide pp. 39-42
  Heinemann pp. 174-176; 5.4 questions
  Hamper pp. 309-310
  Exploring Physics p. 61 Set 6: 6.1, 6.3, 6.5, 6.7, 6.9, 6.11, 6.13, 6.15, 6.17
- alpha, beta and gamma radiation have different natures, properties and effects
  Nelson pp. 90-93
  WACE Study Guide p. 34-35
  Heinemann pp. 169-171; 5.3 questions
  Hamper p. 302-306
- the measurement of absorbed dose and dose equivalence enables the analysis of health and environmental risks
  This includes applying the relationships

  $$\text{absorbed dose} = \frac{E}{m}, \qquad \text{dose equivalent} = \text{absorbed dose} \times \text{quality factor}$$

  Nelson pp. 131-133
  WACE Study Guide pp. 47-48
  Exploring Physics p. 70 Set 7: 7.1, 7.3, 7.5, 7.7, 7.9, 7.11, 7.13, 7.15, 7.17
- Einstein's mass/energy relationship relates the binding energy of a nucleus to its mass defect
  This includes applying the relationship

  $$\Delta E = \Delta m\, c^2$$

  Nelson pp. 108-111

WACE Study Guide pp. 51-53
Heinemann p. 181-182; 5.5 questions
Hamper p.297-300
Exploring Physics pp. 79-80 Set 8: 8.1, 8.3, 8.5, 8.7

- Einstein's mass/energy relationship also applies to all energy changes and enables the energy released in nuclear reactions to be determined from the mass change in the reaction
  This includes applying the relationship

$$\Delta E = \Delta m\, c^2$$

  Nelson pp. 108-111
  WACE Study Guide pp. 51-53
  Heinemann pp. 181-182; 5.5 questions
  Hamper p.297-300
  Exploring Physics pp. 79-80 Set 8: 8.9, 8.11, 8.13, 8.15, 8.17, 8.19
- alpha and beta decay are examples of spontaneous transmutation reactions, while artificial transmutation is a managed process that changes one nuclide into another
  Nelson pp. 85-88, 98-99
  WACE Study Guide p. 44, 53
  Heinemann pp. 162, 165-167; 5.1 question 10; 5.2 questions
- neutron-induced nuclear fission is a reaction in which a heavy nuclide captures a neutron and then splits into smaller radioactive nuclides with the release of energy
  Nelson pp. 113-114
  WACE Study Guide p. 51-54
  Heinemann pp. 179-182, 185; 5.5 questions
  Hamper p. 312
- a fission chain reaction is a self-sustaining process that may be controlled to produce thermal energy, or uncontrolled to release energy explosively if its critical mass is exceeded
  Nelson pp. 113-114, 117, 126-127
  WACE Study Guide p. 53-55
  Heinemann pp. 185-188; 5.6 questions
  Hamper pp. 312, 339-340
- nuclear fusion is a reaction in which light nuclides combine to form a heavier nuclide, with the release of energy
  Nelson pp. 128-131
  WACE Study Guide pp. 56-57
  Heinemann pp. 195-196; 5.7 questions
  Hamper p. 311
- more energy is released per nucleon in nuclear fusion than in nuclear fission because a greater percentage of the mass is transformed into energy
  Nelson pp. 111-115; 128-131
  WACE Study Guide pp. 56-57

WACE Study Guide – Chapter 2 Review Questions pp. 58-61
WACE Study Guide – Trial Test 2 pp. 163-168
Heinemann Chapter 5 Review questions pp. 198-199

Past Stage 2 Physics WACE Exam Questions:

Year	**Questions**
2010	2,4,9,10,13,14,21
2011	1,13,16,21,23
2012	3,5,21,24
2013	1,6,10,15,16,20
2014	2,4,6,10,11,16,21