

**Western Australian Certificate of Education**

**ATAR course examination, 2019**

**Question/Answer Booklet**

11 PHYSICS

Name

**Test 6 - Nuclear Physics**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Student Number: In figures |  |  |  |  |  |  |  |  |  |  |

**Mark:**  In words

#### Time allowed for this paper

Reading time before commencing work: five minutes

Working time for paper: fifty minutes

**Materials required/recommended for this paper**

To be provided by the supervisor

This Question/Answer Booklet

Formulae and Data Booklet

***To be provided by the candidate***

Standard items: pens, (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators satisfying the conditions set by the School Curriculum and Standards Authority for this course

**Important note to candidates**

No other items may be taken into the examination room. It is your responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor before reading any further.

**Structure of this paper**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Section | Number of questions available | Number of questions to be answered | Suggested working time  (minutes) | Marks available | Percentage of exam |
| Section One:  Short Answers |  |  |  |  |  |
| Section Two:  Problem-solving | 7 | 7 | 50 | 39 | 100 |
| Section Three:  Comprehension |  |  |  |  |  |
|  |  |  |  | **Total** | 100 |

**Instructions to candidates**

1. The rules for the conduct of examinations at Holy Cross College are detailed in the College Examination Policy*.* Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer Booklet.

3. Working or reasoning should be clearly shown when calculating or estimating answers.

4. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.

5. Spare pages are included at the end of this booklet. They can be used for planning your

responses and/or as additional space if required to continue an answer.

• Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.

• Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number.

Fill in the number of the question(s) that you are continuing to answer at the top of the page.

6. Answers to questions involving calculations should be ***evaluated and given in decimal***

***form*.** It is suggested that you quote all answers to ***three significant figures***, with the

exception of questions for which estimates are required. Despite an incorrect final result, credit may be obtained for method and working, providing these are ***clearly and legibly set out***.

7. Questions containing the instruction "estimate" may give insufficient numerical data for their solution. Students should provide appropriate figures to enable an approximate solution to be obtained. Give final answers to a maximum of two significant figures and include appropriate units where applicable.

8. Note that when an answer is a vector quantity, it must be given with magnitude and direction.

9. In all calculations, units must be consistent throughout your working.

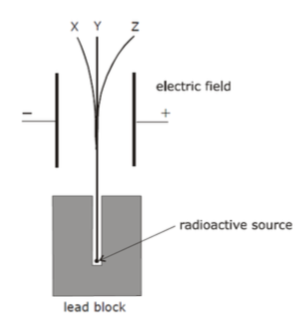
1. Complete the following nuclear equations. (3 marks)

(a)

(b)

(c)

2. The diagram illustrates that three types of radiation are emitted from a radioactive source.



(a) Name the radiations labelled in the diagram. (2 marks)

X:

Y:

Z:

(b) Which one is the most ionising? Explain your answer. (2 marks)

(c) Which one is the most penetrating? Explain your answer. (2 marks)

(d) Describe one use for a radioactive source. Include an explanation of why it is used this way. (2 marks)

3. (a) Explain what is meant by the term ***half-life***. (1 mark)

(b) 2.40 x 103 disintegrations per second are detected from a sample of Ra-224. If the half-life of Ra-224 is 3.40 days, what will be the count rate after 11.0 days?

(4 marks)

4. The mass of a Ne-20 atom is 19.992440u. Calculate its:

(a) mass defect. (3 marks)

Data = 1.007285 u = 1.008665 u = 0.000549 u

(b) binding energy per nucleon (in MeV). (2 marks)

5. One of the fusion reactions in the Sun is:

The atomic masses are: 1.007825u

3.016029u

4.002603u

Calculate the amount of energy released in the reaction in Joules (J). (5 marks)

6. A 90.0 kg person receives an equivalent dose of 9.00 x 102 mSv after exposure to slow neutrons.

(a) Explain what is meant by the term ***quality factor***. Use alpha and beta radiation to help explain the difference. (3 marks)

(b) Determine the absorbed dose received by the person. (2 marks)

(c) Calculate the amount of energy received by the person from the radiation. (2 marks)

7. (a) Describe the difference between fission and fusion. Include in your answer which elements typically undergo each type of reaction. (3 marks)

(b) Using U-235 as an example, explain what is meant by the term ***chain reaction***. a simple diagram may help your explanation. (2 marks)

(c) What is meant by the term ***critical mass***? (1 mark)