HOLY CROSS COLLEGE

Life to the Full

Western Australian Certificate of Education
ATAR course examination, 2019

Question/Answer Booklet

11 PHYSICS

Name SOLUTIONS

Evaluation 2 - Radioactivity

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

Mark: ___/18

In words _____

_____

Time allowed for this paper

Reading time before commencing work: 5 minutes
Working time for paper: 50 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

one A4 page of notes - handwritten

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	4	4	50	18	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.

A sample of thorium-234 was placed in storage in a medical facility. While it was in storage, its activity was monitored regularly by an automatic sensor that was placed 10 cm from the sample. the data collected is shown below.

Time, *t* (days)	No. of nuclei of radioactive isotope (*N*)
0	8.0×10^{10}
5	5.9×10^{10}
17	2.4×10^{10}
25	1.3×10^{10}
38	5.5×10^{9}
44	3.0×10^{9}
50	2.0×10^{9}
54	1.0×10^{9}

1. On graph paper provided, plot the data. (4 marks)

2. What is the name for a curve of the shape shown in your graph? (1 mark)

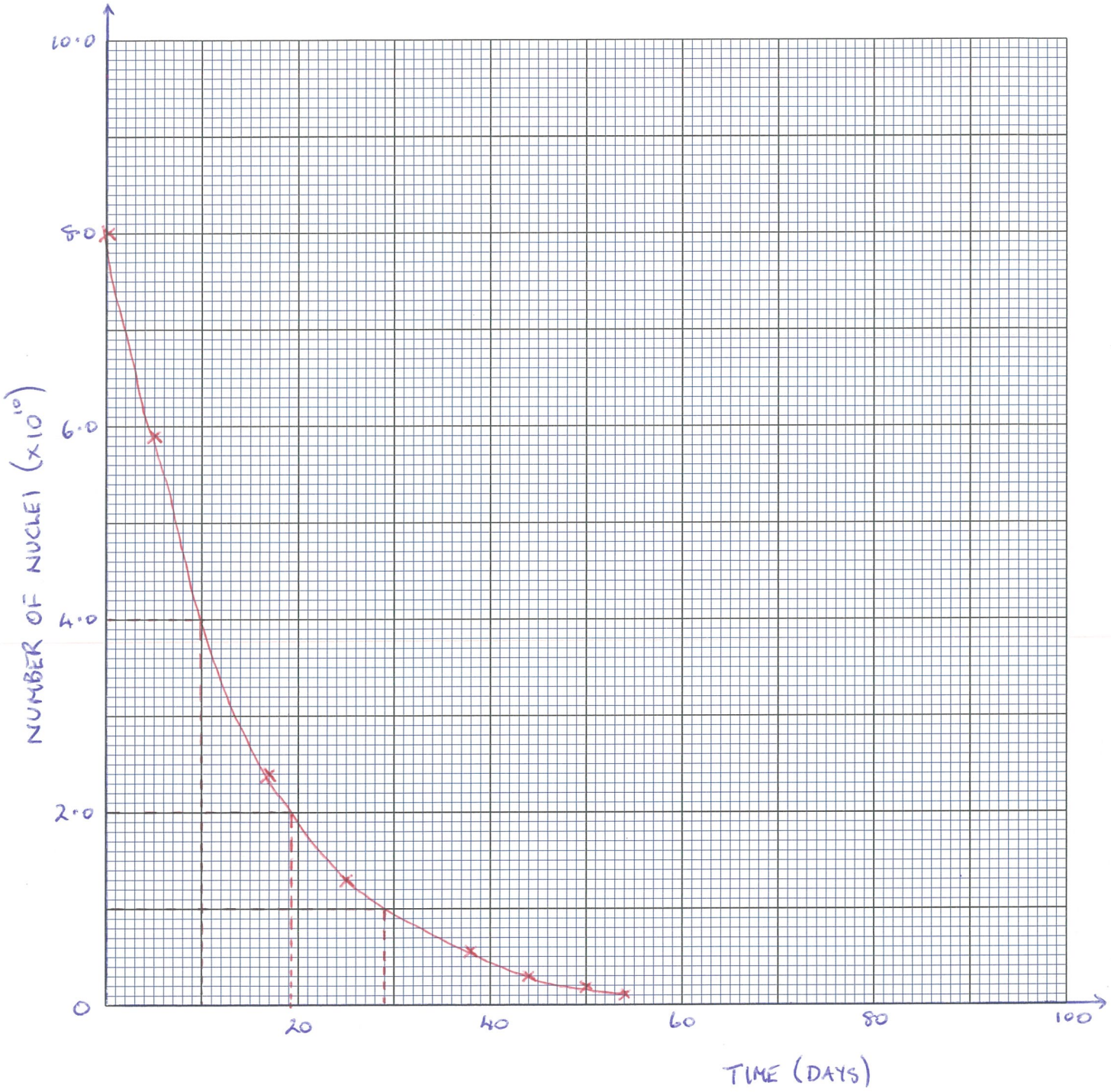
Exponential decay curve. (1)

3. What is the average half-life of thorium-234? _____ (3 marks)

Average $t_{\frac{1}{2}} = \frac{10.0 + 9.2 + 9.8}{3}$

$= 9.7$ days $(\pm 0.2$ days)

2-3 values (1)
Sig. fig. (1)
Working (1)



Labels + units (2)

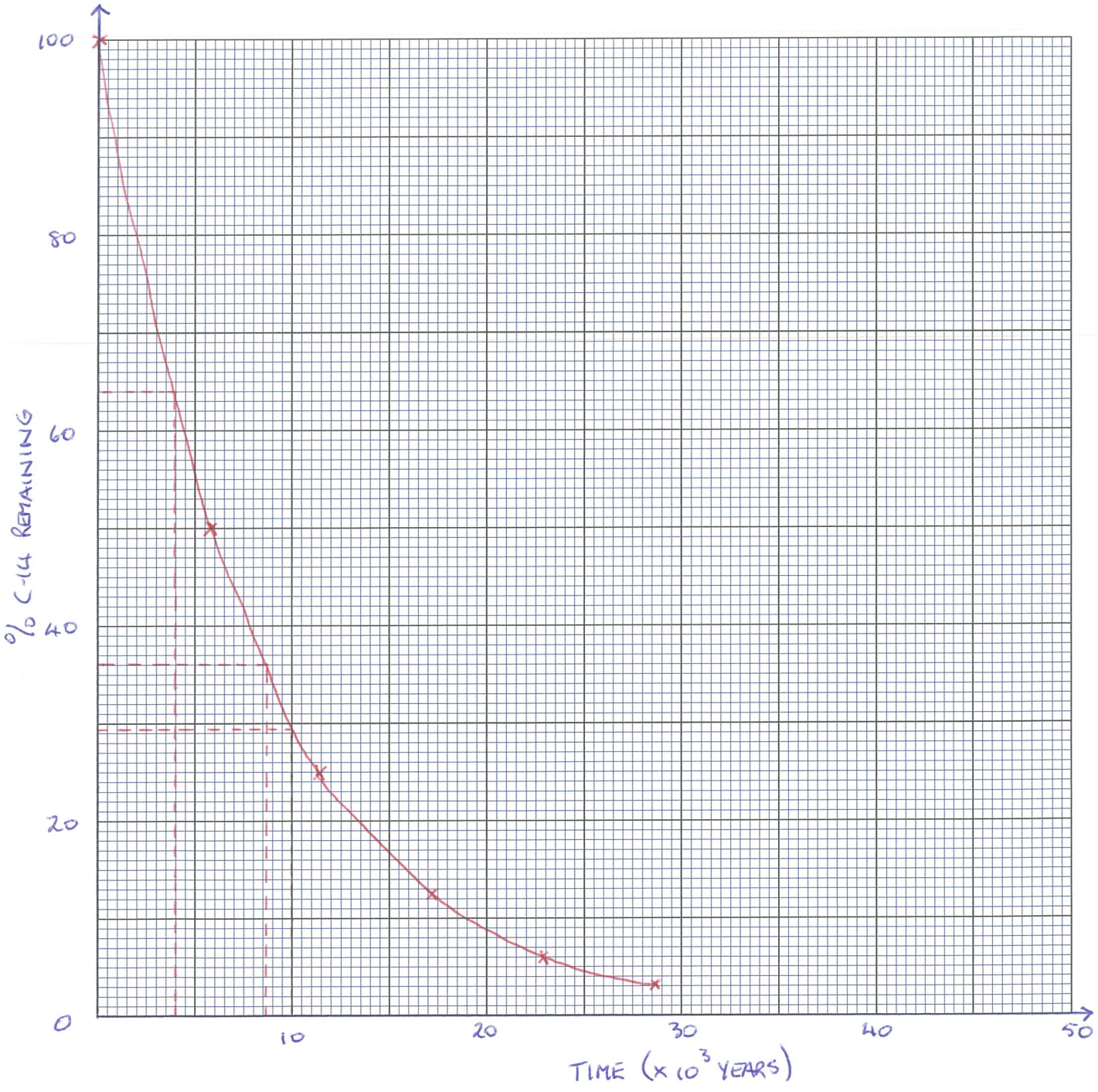
Plotting (1)

Line of best fit (1)

4. The absolute ages of recent carbonaceous fossils can be determined using radiocarbon dating. The half-life of carbon-14 (a radioactive isotope) is 5730 years. The following table shows how the percentage of C-14 present in a fossil decreases over time.

Time (years)	0	5730	11 460	17 190	22 920	28 650
% C-14 remaining	100	50	25	12.5	6.25	3.125

(a) Plot a line graph of this data on the grid below. (4 marks)



Labels + units (2)
Plotting (1)
Line of best fit (1)

(b) The C-14 content of a fossil was found to have decreased by 36% since the organism died. Determine the approximate age of the fossil from the graph.

(1 mark)

4000 yrs ($\pm$100) (1)

(c) A fossil is approximately 10 000 years old. What percentage of C-14 still remains, according to the graph?

(1 mark)

29.5 % ($\pm$ 0.5) (1)

(d) Do a calculation using the appropriate formula to check your answer to (c).

(3 marks)

$n = \frac{10,000}{5730}$

$= 1.745$ half-lives (1)

$N = N_0 \frac{1}{2^n}$

$= \frac{100}{2^{1.745}}$ (1)

$= 29.8\ \%$ (1)

(e) Explain why it is difficult to date fossils that are more than 60 000 years old using radiocarbon dating. (1 mark)

- The activity of C-14 becomes so low that it is lost in the background radiation. (1)