Christ Church Grammar School

Science Department
Year 11 Physics

Semester 1 Examination, 2019

Question/Answer booklet

PHYSICS

UNIT 1

SECTION ONE

SHORT ANSWER

Fix student label here

Student Name: _____

Time allowed for this paper

Reading time before commencing work: ten minutes
Working time for paper: two hours

Materials required/recommended for this paper

To be provided by the supervisor

Three Question/Answer booklets
Formulae and Data booklet

To be provided by the candidate

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

Special items: non-programmable calculators approved for use in the WACE examinations

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	Percentage achieved
Section One: Short Answer	7	7	30		33	25	
Section Two: Problem Solving	5	5	60		73	56	
Section Three: Comprehension	1	1	30		24	19	
						100	

Instructions to candidates

1. The rules of conduct of Christ Church Grammar School assessments are detailed in the Reporting and Assessment Policy. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. Answer the questions according to the following instructions.

   Section One: Answer all questions. Show all calculations clearly in the space marked. Workings for questions where calculations are applicable. Marks will be awarded principally for the relevant physics content.

   Section Two: Answer all questions. Show all calculations clearly in the space marked. Workings for questions where calculations are applicable. Marks will be awarded principally for the relevant physics content.

   Section Three: Answer all questions.

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. Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space.

6. Information for questions has been repeated on the removable Information Booklet which has been inserted inside the front cover of this booklet so that you can refer more easily to it while answering the questions. Do not write your answers in the Information Booklet.

See next page

YEAR 11
PHYSICS ATAR
SEMESTER 1 EXAMINATION 2019

Section One: Short Response

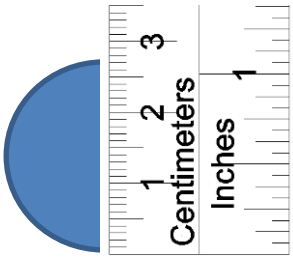
This section has **seven (7)** questions. Answer **all** questions. Write your answers in the space provided.

Suggested working time for this section is **30 minutes**.

See next page

Question 1 **(3 marks)**

Aiden is measuring the following shaded perfect circle and he places a ruler over the widest point of the circle, as shown on the right. Write the absolute and percentage uncertainties of the diameter of the circle below.



(a) Diameter with absolute uncertainty:

(b) Diameter with percentage uncertainty:

Space for working out:

Question 2 **(3 marks)**

The American Condor is a bird that often relies on “thermal updrafts”; a pocket of rising air that helps them generate lift and fly without using significant energy. Condors look for regions over large plain fields. As the field is heated by the sun, it is able to operate more efficiently. Explain the heating of the field enables the Condor to fly more efficiently.

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See next page

Question 3 **(5 marks)**

Sodium-24 has a half-life of 15.0 hours and decays via beta decay into magnesium-24. It has applications in medicine and engineering.

(a) How much of a 34.0 g sample of Sodium-24 will remain undecayed after two days? Show clear working.

(3 marks)

(b) Write a balanced nuclear equation of the decay of sodium-24

(2 marks)

Question 4 **(7 marks)**

A food shop sells hot beef soup. A number of slices of beef are put into a bowl, followed by pouring in a hot liquid vegetable stock. The soup is then ready to serve to customers.

Use the following information to answer the questions:

- Mass of vegetable stock: 0.800 kg
- Initial temperature of the stock: 96.0 ^{o}C
- Specific heat capacity of the stock: 4.00 x10^{3} Jkg^{-1}K^{-1}
- Mass of each beef slice: 50.0 g
- Initial temperature of beef: 6.00 ^{o}C
- Specific heat capacity of beef: 3.00 x10^{3} Jkg^{-1}K^{-1}

(a) According to safety regulations, the serving temperature of the soup should be below 60.0 ^{o}C. Estimate the minimum number of beef slices required to add to the stock to achieve this.

(6 marks)

(b) State one assumption in the calculation in part (a).

(1 mark)

_____

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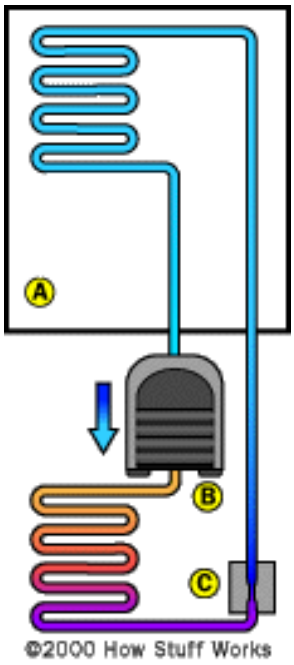
_____

See next page

Question 5 **(5 marks)**

The diagram below is a simple schematic diagram of a fridge. It consists of one long coil that goes through the inside compartment of the fridge and then flows outside. Fluid refrigerant is sealed inside this coil. The arrow, in the diagram below, shows the direction of the refrigerant. Part C is called an expansion valve.



(a) The pressure inside the pipe is reduced by the expansion valve, causing the refrigerant to evaporate. Explain how this helps to cool the fridge.

(3 marks)

When there is a power outage, a fridge can still keep the contents cold for as long as 2 hours.

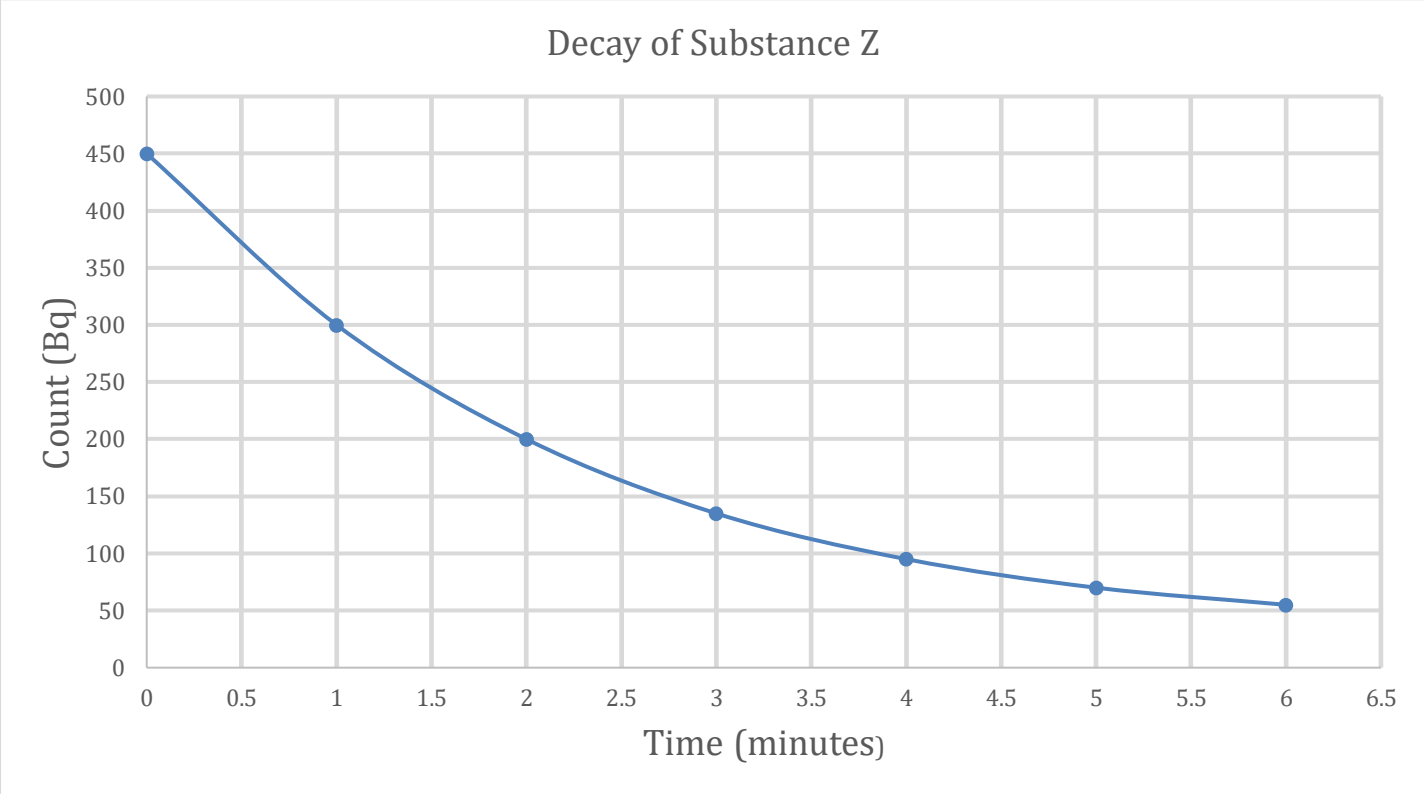
(b) Describe the features of a fridge which help to keep the fridge cold.

(2 marks)

See next page

Question 6 **(5 marks)**

The graph below shows the decay of radiative substance **Z**.



(a) Use the graph above to estimate the half-life of substance **Z**. Show your working on the graph above.

(2 marks)

(b) Hence, estimate how long it would take for substance **Z** to decrease to 28.125 Bq of activity.

(3 marks)

See next page

Question 7 **(5 marks)**

Find the binding energy, per nucleon in, MeV, for Uranium-236 atom.

Use the following data:

Mass of proton	=	1.007276 u
Mass of neutron	=	1.008665 u
Mass of electron	=	0.000548 u
Mass of Hydrogen-1	=	1.007825 u
Mass of Uranium-236	=	236.045568 u

End of Section One

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Christ Church Grammar School

Science Department
Year 11 Physics

PHYSICS

Semester 1 Examination, 2019

UNIT 1

Question/Answer booklet

SECTION TWO

PROBLEM SOLVING

NAME:_____

TEACHER: RLT JRM PCW
(please circle)

This section has **five (5)** questions. Answer **all** questions. Write your answers in the space provided.

Suggested working time for this section is **50 minutes**.

Question 8 **(16 marks)**

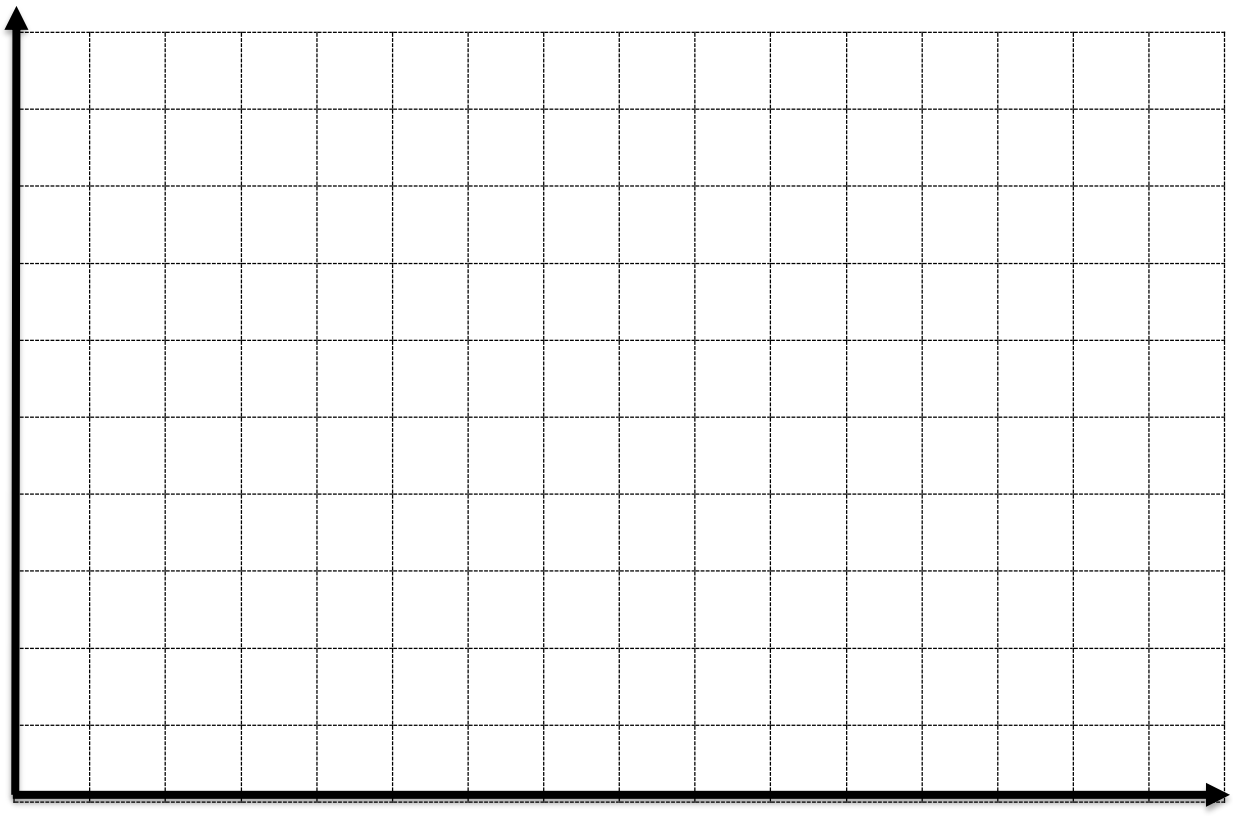
John carries out an experiment to investigate the cooling properties of Octadecan-1-ol. Octadecan-1-ol is one type of alcohol that can be used in anti-freeze products and lubricants. Its latent heat of fusion is 331 J kg^{-1}. John heats a glass test tube containing of 0.250 kg of liquid Octadecan-1-ol to 80.0 ^{o}C. He then puts the test tube immediately into a beaker of iced water.

The temperature of the Octadecan-1-ol is then recorded over a time interval of 5.00 minutes. The results are shown below:

Time (s)	0	30	60	90	120	150	180	210	240	270	300
Temperature (^{o}C)	71.0	63.0	57.0	55.0	55.0	55.0	55.0	55.0	50.0	44.0	35.0

(a) Plot a cooling curve of Octadecan-1-ol in the graph below. A spare graph paper can be found on page 12.

(2 marks)



(b) Estimate the melting point of Octadecan-1-ol, in Kelvin.

(2 marks)

See next page

(c) Using terms of heat and internal energy, explain the shape of the curve between 90 seconds and 210 seconds.

(3 marks)

(d) Use the given information to calculate the rate of heat loss of the 0.250 kg of Octadencan-1-ol in between 90 seconds and 210 seconds.

(4 marks)

(e) Another student conducts the same experiment but with a thicker-walled glass test tube. State and explain whether your answer for part d) be higher or lower.

(3 marks)

(f) List one possible example of random error and one possible example of systematic error in this experiment.

(2 marks)

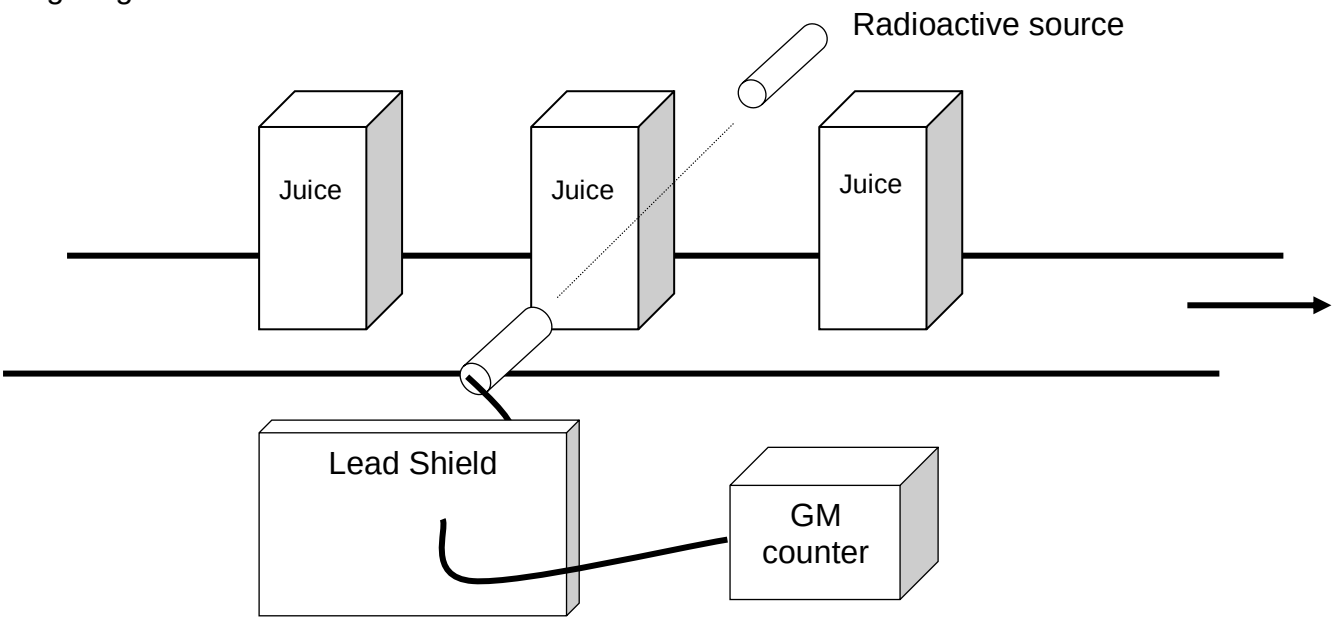
Random error:

Systematic error:

See next page

Question 9 **(13 marks)**

In a juice factory, a radioactive source and a Geiger-Muller (GM) counter are used to ensure each box of juice is full before delivering to the shops. The radiation emitted by the source penetrate through the top section part of each box and are then detected by the GM counter as shown in the following diagram.



The following table shows a sample of results recorded by the GM counter:

Box Number	**1**	**2**	**3**	**4**	**5**
Measured count rate (Bq)	645	652	648	729	654

(a) State and explain what type of radiation (alpha, beta or gamma) should be used for the radioactive source.

(2 marks)

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(b) Provide and explain a possible reason for why there was an increase in the measured count rate when the fourth box of juice passes through the detector.

(2 marks)

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See next page

(c) It is claimed that as long as the radiation penetrates through the top part of the juice box and are detected by the GM counter, then the distance between the source and the detector is **NOT** critical. Comment on the accuracy of this statement.

(2 marks)

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(d) The manager of the factory has a choice of radioactive source with their half-lives shown below.

(i) Circle the most suitable source.

(1 mark)

10 seconds **10 hours** **10 years**

(ii) Briefly explain your answer of your above choice.

(1 mark)

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(e) Comment on the purpose of the lead shield.

(1 mark)

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All factory workers who work in this juice factory must wear radiation monitoring badges. These badges monitor the radiation exposure to a factor worker. A person whose mass is 75.0 kg receives an average of 3.00 J a day according to the badge.

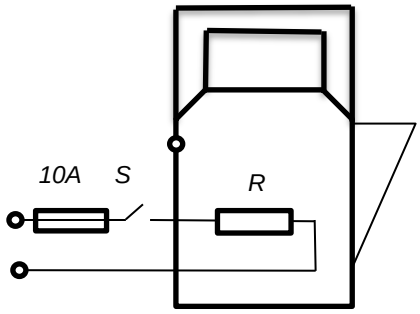
(f) Estimate the dose equivalent this person receives every day. Use your answer in part (a) for the calculation.

(4 marks)

See next page

Question 10 **(15 marks)**

The schematic diagram on the right shows how wires are connected to an electric kettle. The main source of resistance in the kettle is the heating element. The rating of this kettle is "240V, 2.00 kW". Note: **S** is a switch and **R** is the resistance.



(a) Describe the main energy transformation taking place in the kettle. (1 mark)

(b) Calculate the current that flows through the heating element when it is operating.

(3 marks)

(c) Calculate the resistance of the heating element given the rating values provided.

(3 marks)

See next page

(d) This kettle is now filled with 1.50 L of water. If the kettle has an efficiency of 40% and is turned on for 2.00 minutes, calculate the temperature rise of the water. Note: density of water is 1.00 kg L^{-1}.

(5 marks)

(e) When boiling water, placing the lid on the top of the kettle allows it to bring water to the boil faster than without a lid on. Explain, using kinetic theory, why using the lid increases the effectiveness of the kettle.

(3 marks)

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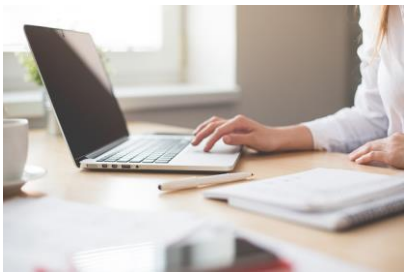
Question 11 **(13 marks)**



On average, a person, through perspiration, loses up to 0.400 L of water every hour even sitting in a comfortable office. The latent heat of vaporisation of water at a comfortable temperature is 2.26×10^6 J kg^{-1}. Note: density of water is 1.00 kg L^{-1}

(a) Explain how water assists heat loss for human bodies to prevent hyperthermia, a scientific term to describe a body temperature above 40.0 ^oC.

(3 marks)

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(b) Jane, whose mass is 55.0 kg, has been at work for 8.00 hours.

i) How much heat energy does Jane's body lose at work, through the evaporation of water? Assume the evaporating perspiration does not absorb heat from anywhere else.

(3 marks)

ii) Calculate the rise in Jane's body temperature if the same amount of water in part i) did not evaporate from her skin? Assume the specific heat capacity of a human body is 3500 J kg^{-1} K^{-1}.

(2 marks)

See next page

(c) Jane finds that using a fan which blows air across her skin helps her feel more comfortable while working in a hot office. Explain why this is the case.

(3 marks)

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(d) After work, Jane goes to a swimming pool. Explain why she often feels colder when she gets out of the water, even if the temperature of the air and the water are the same.

(2 marks)

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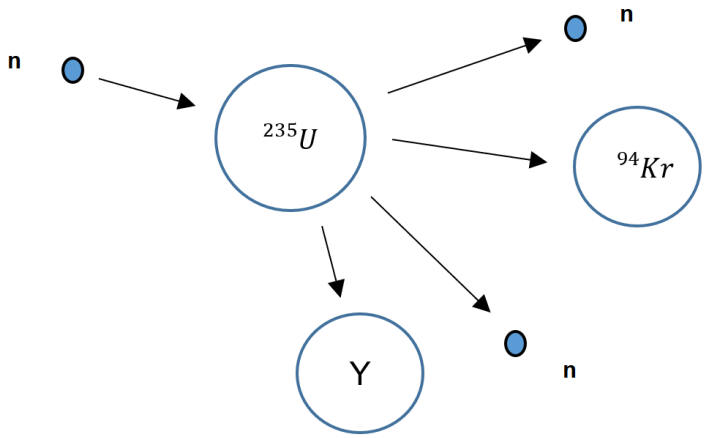
See next page

Question 12 **(16 marks)**

Nuclear reactors rely on energy being released from the splitting of heavy nuclei and releasing energy to generate electricity. The diagram below shows one possible event that can occur in a reactor: a neutron, **n**, being absorbed by a Uranium-235 atom. The remaining neutrons then continue to react with other Uranium-235 atoms.



(a) Complete the following table by writing the correct physical terms. The first term has been done for you.

(3 marks)

Descriptions	**Physical Term**
A neutron collides with a Uranium nucleus and is absorbed.	Neutron capture
The atom splits into different two atoms and two neutrons.	
The released neutrons continue to be absorbed by other Uranium-235 nuclei.	
The condition where one neutron is released for every one neutron being absorbed.	

(b) Predict what substance **Y** be. Write the symbol of the substance, its atomic number and mass number in a correct format.

(2 marks)

(c) If the Krypton-94 continues to decay and release a beta negative particle. Write the full nuclear equation for this decay.

(2 marks)

See next page

In the reactor, the neutrons need to be slowed down to increase the rate of energy being released.

(d) State the name of the part of the nuclear reactor that enables this to occur.

(1 mark)

_____

If too much energy is being released, there is a safety mechanism that can be inserted into the reactor to slow down the power being generated in the reactor.

(e) State the part of the nuclear reactor that enables this and explain how it functions.

(3 marks)

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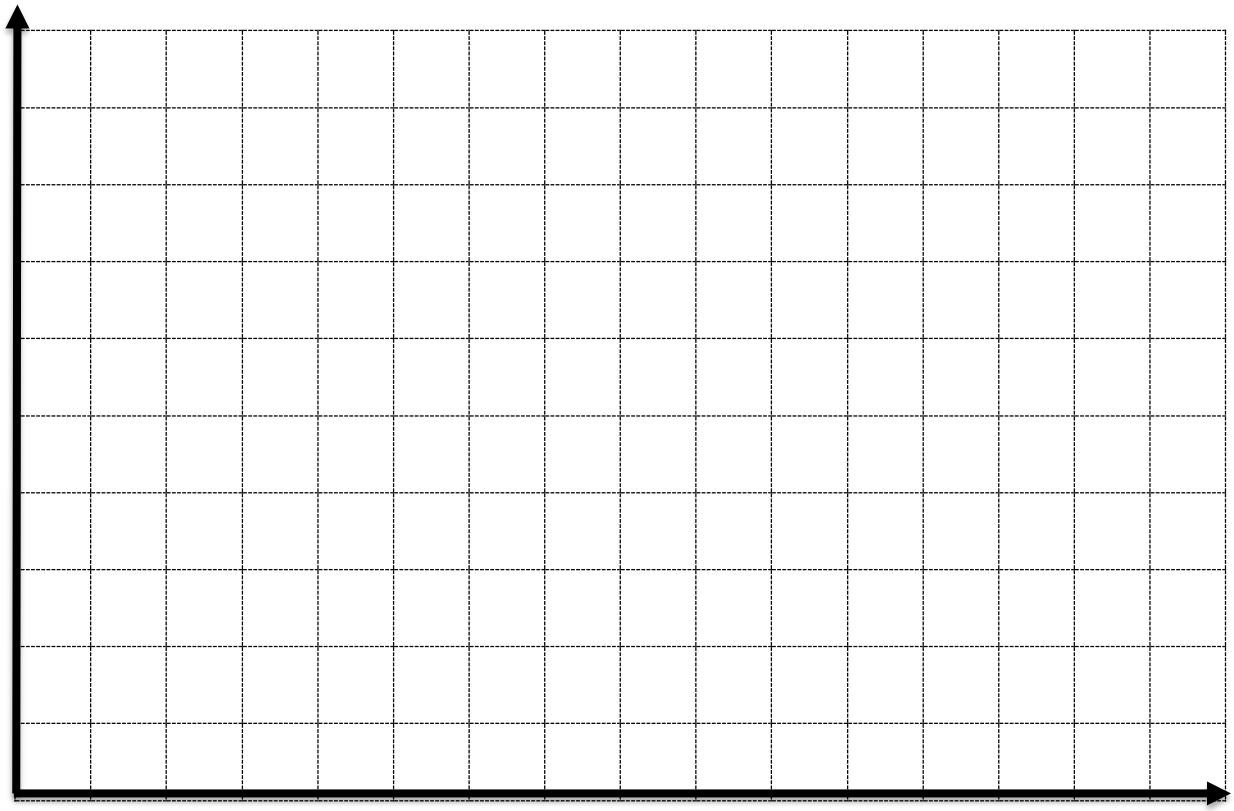
(f) A typical event releases an average 215 MeV. If the reactor is producing a power of 1.50 MW, determine the average number of events per second that must be occurring in the reactor.

(5 marks)

End of Section Two

Spare Graph Paper



Christ Church Grammar School

Science Department
Year 11 Physics

PHYSICS

UNIT 1

SECTION THREE

COMPREHENSION

Semester 1 Examination, 2019

Question/Answer booklet

NAME:_____

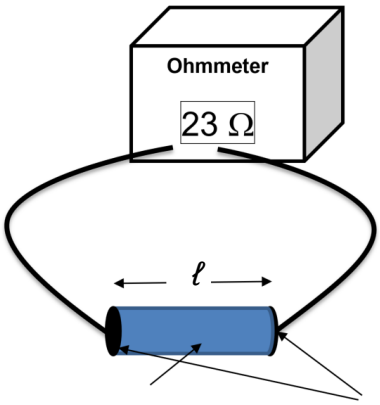
TEACHER: RLT JRM PCW
(please circle)

This section has **one (1)** question. Answer **all** questions. Write your answers in the space provided.

Suggested working time for this section is **30 minutes**.

Question 13 **(24 marks)**

An experiment is carried by Jamie to investigate how the resistance of a fixed volume of conducting putty varied with its length. This conducting putty is a soft material that be easily shaped into different lengths. The experiment apparatus is shown below.



Jamie conducts the experiment and records the result in the table below. Note that one column is deliberately left blank for further analysis.

$\boldsymbol{\ell}$ (cm)	$\boldsymbol{R}$ (Ω)	_____ (_____)
6.0	25	
11.0	60	
13.5	110	
17.0	180	
22.5	280	
25.0	370	

Jamie discovered that the suggested resistivity of the conducting putty, ρ (pronounced *rho*), is given by the formula:

$$\rho = \frac{(\boldsymbol{R} - R_o)V}{\boldsymbol{\ell}^2}$$

where $\boldsymbol{R_o}$ is the resistance of the connecting wires and $\boldsymbol{V}$ is the volume, in cm^3, of the conducting putty.

(a) For this experiment, state: (2 marks)

i) Dependent variable:

_____

ii) One controlled variable:

_____

See next page

The formula on the previous page can be rearranged as: $\boldsymbol{R} = \frac{\rho}{V}\boldsymbol{\ell}^2 + R_o$

(b) Show clear working to demonstrate how the formula can be established.

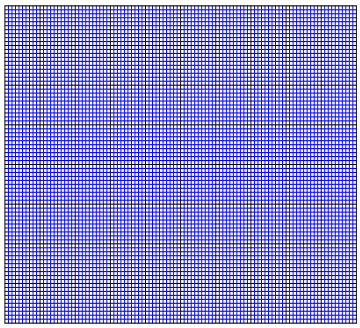
(3 marks)

(c) Calculate and record values of $\boldsymbol{\ell^2}$ in the table on the previous page. State your answer to appropriate number of significant figures.

(3 marks)

(d) Plot a graph of $\boldsymbol{R}$ vs $\boldsymbol{\ell^2}$ below. If you make a mistake, spare graph paper is on page 25

(5 marks)



Question 13 continued

(e) Use your data to obtain the line of best fit.

(1 mark)

(f) Hence, calculate the gradient of the line of best fit. Include the unit.

(4 marks)

(g) Assume the volume of the putty is 15.0 cm^3. Use your gradient in part (f) to calculate resistivity of the conducting putty, ρ. The unit of the conductivity is not required.

(3 marks)

(h) Describe and explain one possible source of error for this experiment.

(2 marks)

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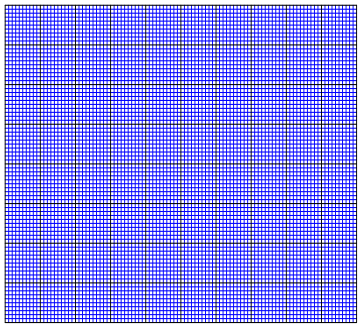
End of Section Three

Spare Graph Paper



Acknowledgments

Question 2
The Birds of North America, www.focusonnature.com
http://focusonnature.com/BirdListNorthAmericaCondorToShorebirds.htm [Accessed 1 May. 2019].

Question 5

Brain, M. and Elliott, S. (2019). *How Refrigerators Work*. [online] HowStuffWorks. Available at: https://home.howstuffworks.com/refrigerator.htm [Accessed 1 Feb. 2019].

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