Neap

Trial Examination 2022

VCE Physics Unit 1

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Student's Name: ______________________________

Teacher's Name: ______________________________

Structure of booklet

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	10	10	10
B	13	13	80
			Total 90

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, pre-written notes (one folded A3 sheet or two A4 sheets bound together by tape) and one scientific calculator.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied

Question and answer booklet of 22 pages

Formula sheet

Answer sheet for multiple-choice questions

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

At the end of the examination

Place the answer sheet for multiple-choice questions inside the front cover of this booklet.

You may keep the formula sheet.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Take the value of g to be 9.8 m s^{-2}.

Question 1

The term(s) for the transfer of thermal energy through a liquid or gas through flow is

A. conduction.

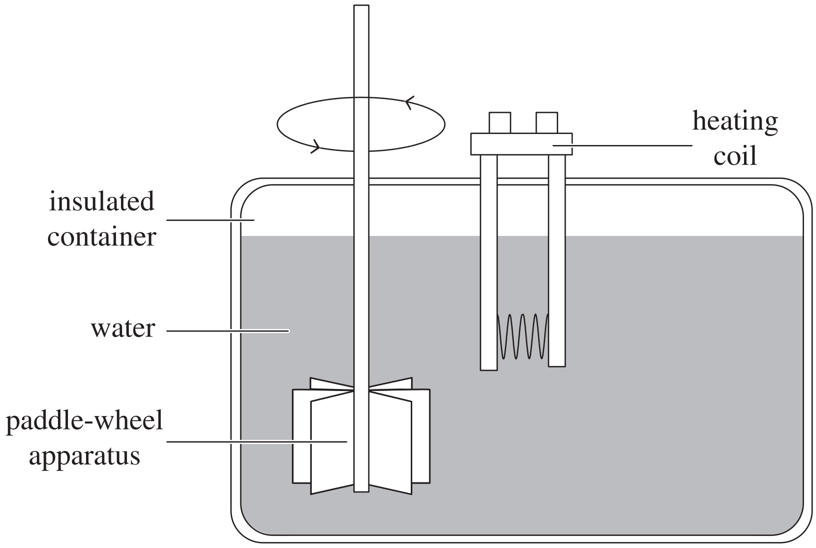
B. convection.

C. radiation.

D. convection and radiation.

Question 2

A student places a heating element and a paddle-wheel apparatus in an insulated container of water, as shown in the diagram below.



The internal energy of this system increased by 1125 J when it absorbed 840 J of heat.

Which one of the following statements is correct?

A. 285 J of work was done on the system.

B. 285 J of work was done by the system.

C. 1965 J of work was done on the system.

D. 1965 J of work was done by the system.

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Question 3

The Sun is a yellow-white star with a peak intensity of about 0.5 μm. It is known that $\sigma_{\text{Wien}} = 2.9 \times 10^{-3}$ m K.

Using Wien's Law, what is the temperature of the surface of the Sun?

A. 5.8×10^{3}°C

B. 5.5×10^{3}°C

C. 5.8×10^{-3}°C

D. -2.7×10^{3}°C

Question 4

The charge of one electron is -1.6×10^{-19} coulombs.

The number of electrons needed to make one coulomb of charge is approximately

A. 1.6×10^{-19}

B. 6.3×10^{-19}

C. 1.6×10^{18}

D. 6.3×10^{18}

Question 5

A current of 4.0 A flows across a heating element for two minutes and 28.8 kJ of heat energy is produced.

The potential difference across the heating element is closest to

A. 0.060 V

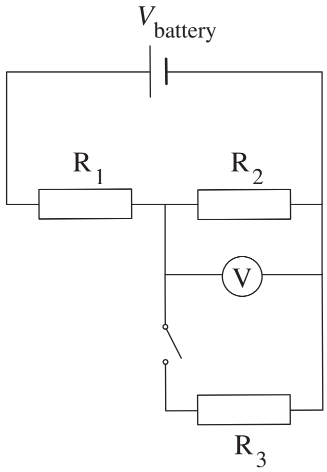
B. 3.6 V

C. 60 V

D. 3600 V

Question 6

A supply voltage, *V*, is connected to a voltmeter, a switch and three resistors, as shown in the diagram below. The three resistors have the same resistance.



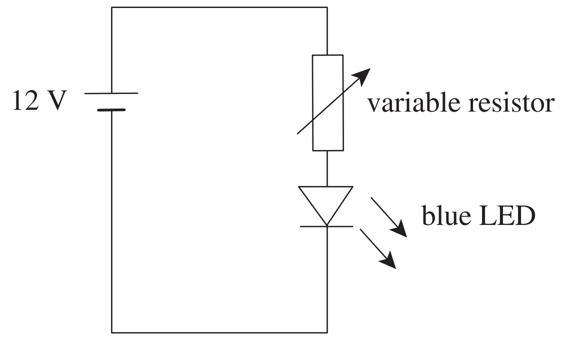
Assume the internal resistance of the battery is negligible.

What are the readings on the voltmeter when the switch is open and when the switch is closed?

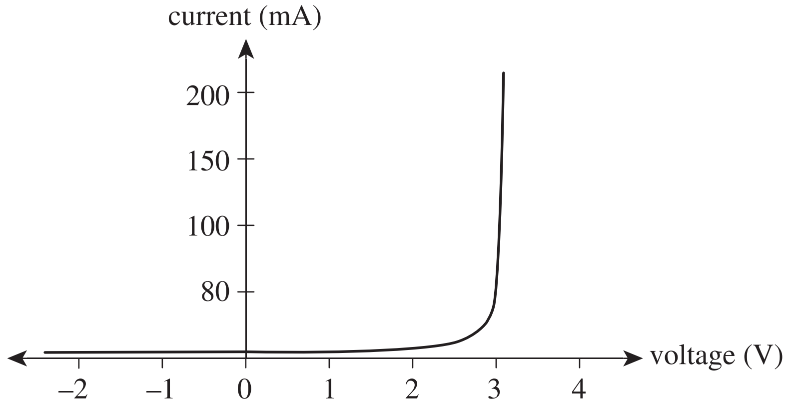
	Voltmeter reading when the switch is open	Voltmeter reading when the switch is closed
A.	0	$\frac{1}{3}$ the voltage of the battery
B.	0	$\frac{1}{2}$ the voltage of the battery
C.	$\frac{1}{2}$ the voltage of the battery	$\frac{1}{3}$ the voltage of the battery
D.	$\frac{1}{2}$ the voltage of the battery	$\frac{1}{2}$ the voltage of the battery

Question 7

A variable resistor and a forward-biased blue LED are connected in series to a 12 V battery, as shown in the diagram below.



The characteristics of the blue LED are shown in the following graph. The blue LED operates at full brightness with a current of 150 mA.



For the blue LED to operate at full brightness, the resistance of the variable resistor must be

A. $6.0 \times 10^{-2}\ \Omega$

B. $8.0 \times 10^{-2}\ \Omega$

C. $6.0 \times 10^{1}\ \Omega$

D. $8.0 \times 10^{1}\ \Omega$

Question 8

A radioactive source has a half-life of 25 s.

How long will it take for approximately $\frac{7}{8}$ of the source to decay?

A. 22 s

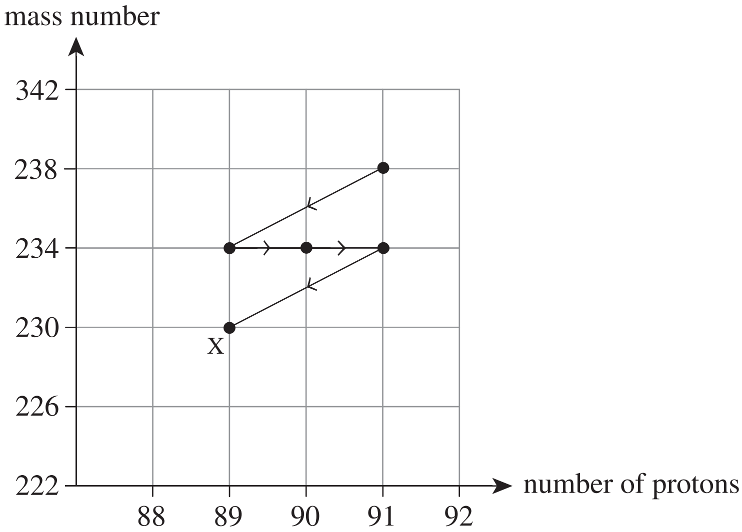
B. 50 s

C. 75 s

D. 200 s

Question 9

A uranium-238 nucleus undergoes a series of decays to produce nucleus X, as shown in the following series decay graph.



Which one of the following correctly shows the final type of decay and the name of nucleus X?

	Final type of decay	Nucleus X
A.	α	thorium-140
B.	α	thorium-230
C.	β	thorium-140
D.	β	thorium-230

Question 10

The following four events occurred in the earliest moments of the universe over 13.8 billion years ago.

1. stable atoms formed
2. nuclear fusion began
3. elementary particles such as quarks formed
4. rapid inflation occurred

Which one of the following correctly orders the events from earliest to latest?

A. 3, 4, 2, 1

B. 4, 3, 2, 1

C. 1, 2, 3, 4

D. 2, 3, 1, 4

END OF SECTION A

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided.
Where an answer box is provided, write your final answer in the box.
If an answer box has a unit printed in it, give your answer in that unit.
In questions where more than one mark is available, appropriate working **must** be shown.
Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.
Take the value of g to be 9.8 m s^{-2}.

Question 1 (8 marks)

A 250 g sample of an unknown substance was heated. The sample was initially a solid. Figure 1 shows the temperature versus heat added graph for the sample.

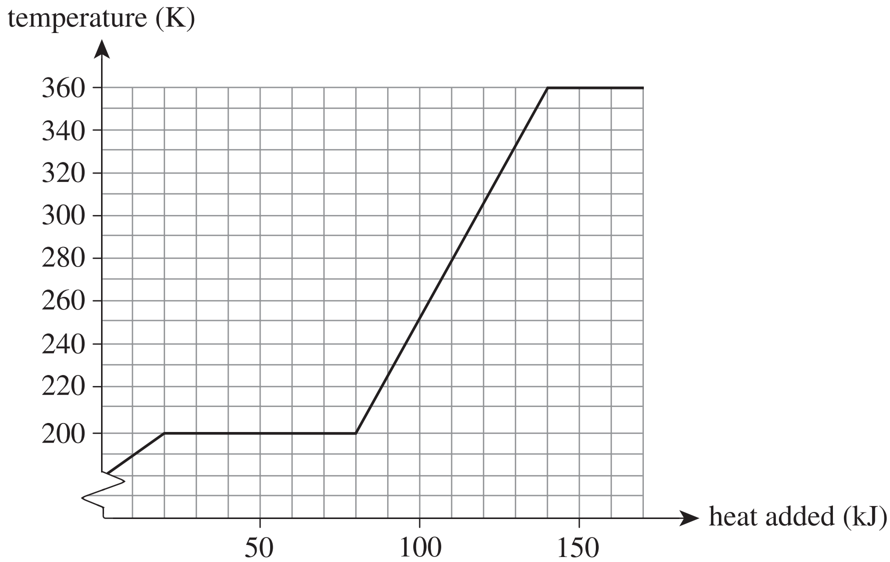


Figure 1

a. What is the melting point for the sample in degrees Celsius? Show your working. 2 marks

°C

b. What happened to the substance when it reached 360 K? 2 marks

c. Calculate the latent heat of fusion for the sample. Show your working. 2 marks

J kg^{-1}

d. Calculate the specific heat capacity of the substance when it is a liquid. Show your working. 2 marks

$\text{J kg}^{-1}\ \text{K}^{-1}$

Question 2 (6 marks)

A Bunsen burner is used to convert a 500 g sample of liquid ethanol into a gas at 78°C. The ethanol sample is initially at room temperature (25°C). The following data for ethanol is known.

Data

specific heat capacity	2.5×10^3 J kg^{-1} K^{-1}
latent heat of fusion	1.1×10^5 J kg^{-1}
latent heat of vaporisation	8.5×10^5 J kg^{-1}
melting point	–114°C
boiling point	78°C

Assume that the heat contributed from the surroundings is negligible.

a. Calculate the minimum amount of heat energy required by the Bunsen burner to change the temperature. Show your working. 2 marks

J

b. Calculate the minimum amount of heat energy required to change the state of the ethanol liquid. Show your working. 2 marks

J

c. Calculate the total minimum amount of heat energy required to convert the ethanol liquid at 25°C to ethanol gas at 78°C. Show your working. 2 marks

J

Question 3 (4 marks)

In an experiment, an iron cube of very high purity was heated to 85.0°C. It was then dropped into 200 g of water at 25.0°C. The final temperature of the mixture is 26.6°C. The following data is known.

Data

c_{water}	4.2×10^3 J kg^{-1} K^{-1}
c_{iron}	4.5×10^2 J kg^{-1} K^{-1}

Calculate the mass of the iron cube, correct to the nearest gram. Show your working.

g

Question 4 (3 marks)

Consider the absorption and emission of electromagnetic radiation at Earth's surface.

a. Circle the correct words to complete the following statement. 2 marks

Radiation absorbed by Earth's surface has a *(longer / shorter)* wavelength than radiation emitted by Earth's surface, which has a *(higher / lower)* frequency.

b. Only a very small percentage of radiation emitted by Earth reaches space.

What happens to the majority of the radiation emitted by Earth? 1 mark

Question 5 (10 marks)

An ammeter and voltmeter are connected across a variable supply. Figure 2 shows the current versus voltage graph for resistors A and B.

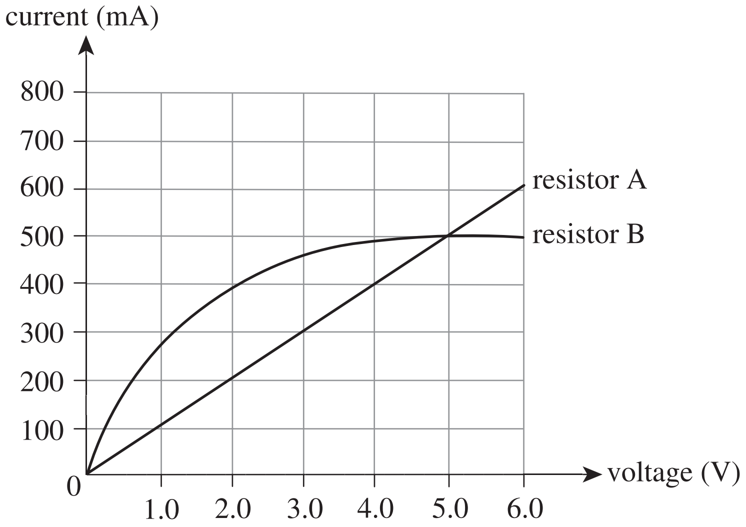


Figure 2

a. Is resistor A or resistor B ohmic? Explain your answer. 2 marks

Resistors A and B are connected to a variable DC supply, as shown in Figure 3. The two resistors are connected in series. The voltage drop across resistor A is 2.0 V.

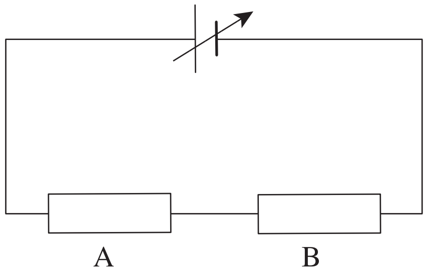


Figure 3

b. What is the magnitude of the current flowing through resistor B? Explain your answer. 2 marks

mA

Resistors A and B are then connected in parallel, as shown in Figure 4. The potential difference across resistor A is 2.0 V.

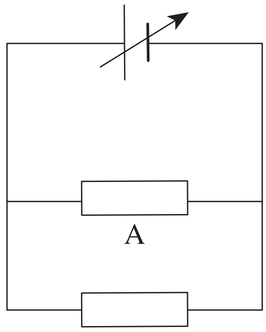


Figure 4

c. Calculate the current flowing through the variable DC supply. Show your working. 3 marks

mA

d. Calculate the total resistance of the circuit. Show your working. 3 marks

Ω

Question 6 (4 marks)

Figure 5 shows a combination circuit consisting of four resistors and a 12.0 V DC supply. The current flowing through the 4.0 Ω resistors is 1.0 A.

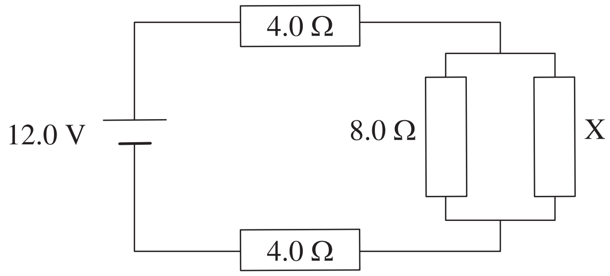


Figure 5

Calculate the value of the unknown resistor. Show your working.

Ω

Question 7 (6 marks)

The characteristics of a light-dependent resistor (LDR) are shown in Figure 6.

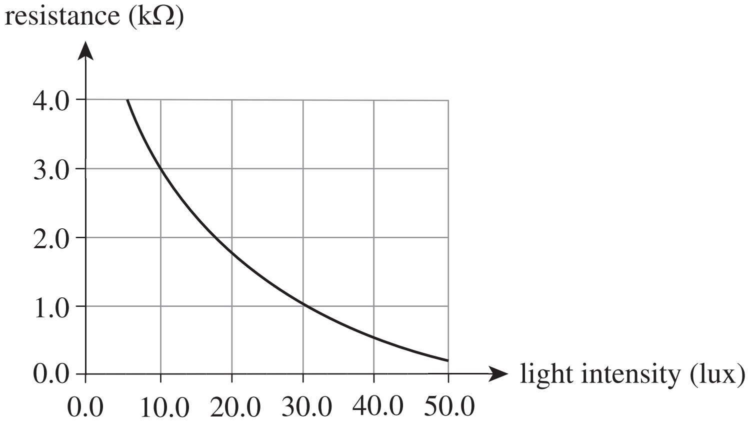


Figure 6

The LDR and a fixed resistor, R, are connected in a circuit, as shown in Figure 7.

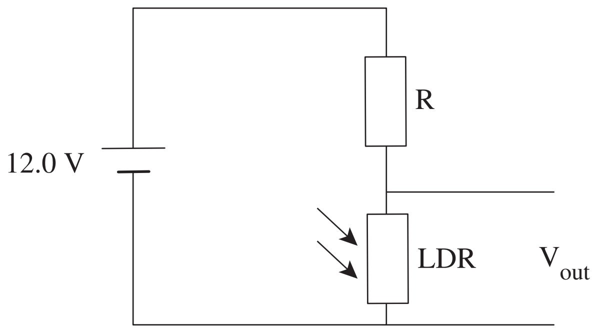


Figure 7

a. Assume that the magnitude of V_{out} is 3.0 V when the light intensity is 10 lux.

Calculate the resistance of resistor R. Show your working. 3 marks

____

____

____

____

____

kΩ

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b. Assume that the potential difference across the LDR is 1.2 V and the resistor is fixed.
Calculate the light intensity. Show your working. 3 marks

lux

Question 8 (7 marks)

A school staffroom has a kettle rated 240 V, 1600 W. It is used for approximately 90 minutes a day, five days a week.

a. How many kilowatt hours of energy are being transferred each week? Show your working. 2 marks

kWh

b. The electricity bill for the kettle was $32.51. The tariff per kilowatt hour is 25 cents.

How many weeks was the bill charging for? Show your working. 2 marks

weeks

c. The circuit supplying the kettle has a 10.0 A fuse.

Will the kettle blow the fuse when operating normally? Support your answer with calculations. 3 marks

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Question 9 (3 marks)

A radioactive nucleus decays to form plutonium-239 and a beta particle, as shown in the following decay equation.

$$^{A}_{Z}X \rightarrow {}^{239}_{94}Pu + {}^{0}_{-1}\beta$$

a. What are the values of A and Z? 2 marks

____

____

A =
Z =

b. Identify element X in this equation. 1 mark

____

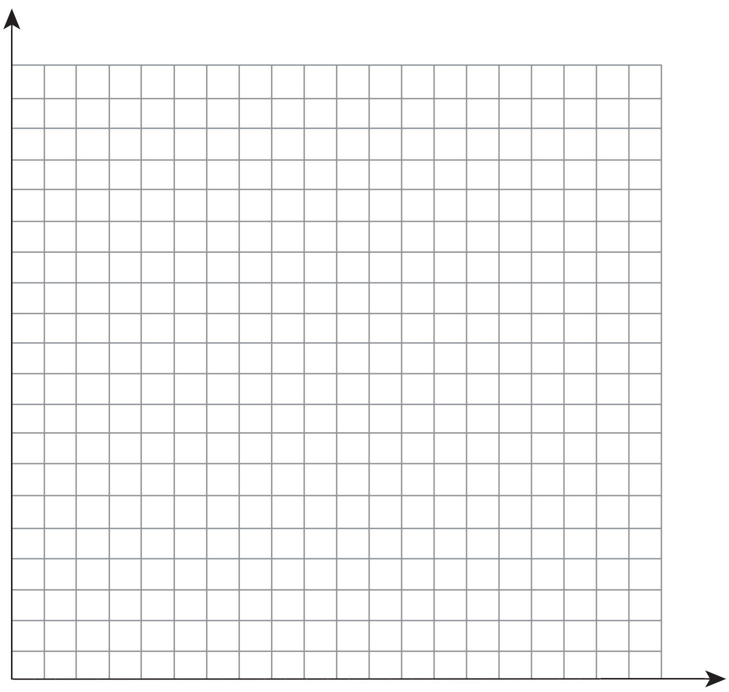
Question 10 (8 marks)

A Geiger counter was used to measure the decay of a sample of an unknown radioisotope over a period of 10 minutes. The results are shown in Table 1.

Table 1

Time (min)	Activity (counts per minute)
0.0	499
1.0	251
2.0	123
3.0	63
4.0	30
5.0	14
6.0	6
7.0	3
8.0	2
9.0	2
10.0	1

a. On the axes provided below, plot the activity versus time graph for the sample. 4 marks



b. What is meant by the term 'half-life'? 1 mark

____

____

c. Use the graph plotted in **part a.** to determine the half-life of the unknown radioisotope. 1 mark

____

____

minutes

d. What is the activity expected to be at 150 seconds? Show your working. 2 marks

____

____

____

counts per minute

Question 11 (4 marks)

Complete Table 2.

Table 2

Radiation	Mass (amu)	Charge (C)	Speed	Ionising ability
α		+2	10% of c	
β^-	$\frac{1}{1800}$			
γ				low

Question 12 (9 marks)

A typical stimulated nuclear fission reaction is shown in the equation below.

$$^{235}_{92}\text{U} + ^{1}_{0}\text{n} \rightarrow ^{236}_{92}\text{U} \rightarrow ^{144}_{56}\text{Ba} + ^{89}_{Z}\text{X} + \text{Y}\,^{1}_{0}\text{n}$$

a. What are the values of Y and Z? Show your working. 4 marks

Y =
Z =

b. Identify element X in this equation. 1 mark

c. Assume that 160 MeV is released in the fission reaction.
Calculate the mass defect. Show your working. 4 marks

kg

Question 13 (8 marks)
The energy levels of a hydrogen atom are shown in Figure 8.

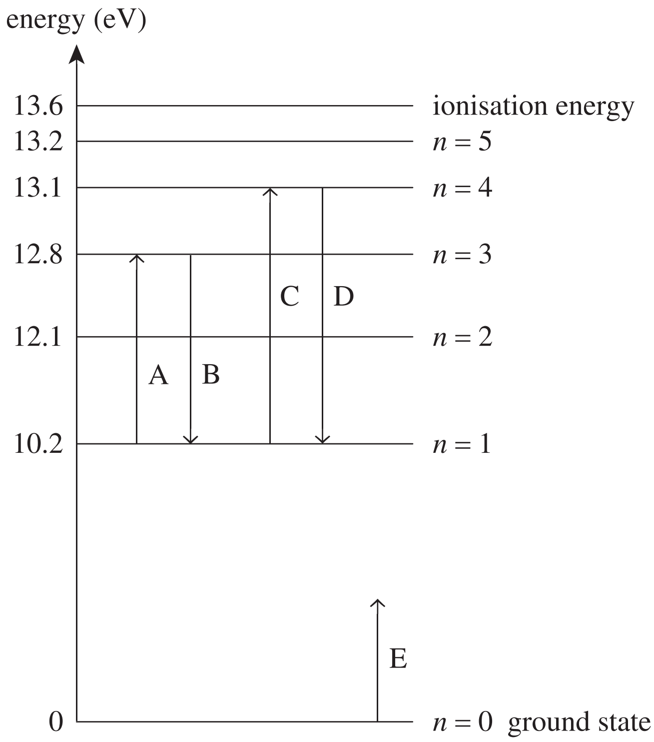


Figure 8

a. **i.** Which arrow (A–E) corresponds to an absorption of a photon of energy 2.6 eV? Use a calculation to support your answer. 2 marks

ii. Which arrow (A–E) corresponds to an emission of photon energy of 4.64×10^{-19} J? Use calculations to support your answer. 3 marks

b. Is arrow E possible? Explain your answer. 3 marks

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2022

VCE Physics Unit 1

Written Examination

Formula Sheet

Instructions

This formula sheet is provided for your reference.
A question and answer booklet is provided with this formula sheet.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

PHYSICS FORMULAS

specific heat	$Q = mc\Delta t$
latent heat	$Q = mL$
Wien's law	$\lambda_{max}T = 2.9 \times 10^{-3}$ mK
Stefan–Boltzmann law	$P = \sigma T^4$ where Stefan–Boltzmann constant $\sigma = 5.67 \times 10^{-8}$ W m^{-2} K^4
first law of thermodynamics	$\Delta U = Q - W$
mass–energy equation	$E = mc^2$
power	$P = \frac{E}{t}$ or $P = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t}$ or $P = Fv$
electrical charge	$Q = It$
electrical work	$W = QV$
voltage	$V = IR$
power	$P = VI$
resistors in series	$R_T = R_1 + R_2 \ldots$
resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \ldots$
efficiency	efficiency (%) $= \frac{\text{useful energy output}}{\text{energy input}} \times 100$

Data

speed of light in a vacuum	$c = 3.0 \times 10^8$ m s^{-1}
1 eV	1.6×10^{-19} J
charge on the electron	$e = 1.6 \times 10^{-19}$ C

Prefixes/Units

p = pico = 10^{-12}	n = nano = 10^{-9}	μ = micro = 10^{-6}	m = milli = 10^{-3}
k = kilo = 10^3	M = mega = 10^6	G = giga = 10^9	t = tonne = 10^3 kg

Periodic table of the elements

Key: atomic number — 79; symbol of element — Au; relative atomic mass — 197.0; name of elecment — gold

1 H 1.0 hydrogen																	2 He 4.00 helium
3 Li 6.9 lithium	4 Be 9.0 beryllium											5 B 10.8 boron	6 C 12.0 carbon	7 N 14.0 nitrogen	8 O 16.0 oxygen	9 F 19.0 fluorine	10 Ne 20.2 neon
11 Na 23.0 sodium	12 Mg 24.3 magnesium											13 Al 27.0 aluminium	14 Si 28.1 silicon	15 P 30.1 phosphorus	16 S 32.1 sulfur	17 Cl 35.5 chlorine	18 Ar 39.9 argon
19 K 39.1 potassium	20 Ca 40.1 calcium	21 Sc 45.0 scandium	22 Ti 47.9 titanium	23 V 50.9 vanadium	24 Cr 52.0 chromium	25 Mn 54.9 manganese	26 Fe 55.8 iron	27 Co 58.9 cobalt	28 Ni 58.7 nickel	29 Cu 63.5 copper	30 Zn 65.4 zinc	31 Ga 69.7 gallium	32 Ge 72.6 germanium	33 As 74.9 arsenic	34 Se 79.0 selenium	35 Br 79.9 bromine	36 Kr 83.8 krypton
37 Rb 85.5 rubidium	38 Sr 87.6 strontium	39 Y 88.9 yttrium	40 Zr 91.2 zirconium	41 Nb 92.9 niobium	42 Mo 96.0 molybdenum	43 Tc (98) technetium	44 Ru 101.1 ruthenium	45 Rh 102.9 rhodium	46 Pd 106.4 palladium	47 Ag 107.9 silver	48 Cd 112.4 cadmium	49 In 114.8 indium	50 Sn 118.7 tin	51 Sb 121.8 antimony	52 Te 127.6 tellurium	53 I 126.9 iodine	54 Xe 131.3 xenon
55 Cs 132.9 caesium	56 Ba 137.3 barium	57–71 lanthanoids	72 Hf 178.5 hafnium	73 Ta 180.9 tantalum	74 W 183.8 tungsten	75 Re 186.2 rhenium	76 Os 190.2 osmium	77 Ir 192.2 iridium	78 Pt 195.1 platinum	79 Au 197.0 gold	80 Hg 200.6 mercury	81 Tl 204.4 thallium	82 Pb 207.2 lead	83 Bi 209.0 bismuth	84 Po (210) polonium	85 At (210) astatine	86 Rn (222) radon
87 Fr (223) francium	88 Ra (226) radium	89–103 actinoids	104 Rf (261) rutherfordium	105 Db (262) dubnium	106 Sg (266) seaborgium	107 Bh (264) bohrium	108 Hs (267) hassium	109 Mt (268) meitnerium	110 Ds (271) darmstadtium	111 Rg (272) roentgenium	112 Cn (285) copernicium	113 Nh (280) nihonium	114 Fl (289) flerovium	115 Mc (289) moscovium	116 Lv (292) livermorium	117 Ts (294) tennessine	118 Og (294) oganesson

57 La 138.9 lanthanum	58 Ce 140.1 cerium	59 Pr 140.9 praseodymium	60 Nd 144.2 neodymium	61 Pm (145) promethium	62 Sm 150.4 samarium	63 Eu 152.0 europium	64 Gd 157.3 gadolinium	65 Tb 158.9 terbium	66 Dy 162.5 dysprosium	67 Ho 164.9 homium	68 Er 167.3 erbium	69 Tm 168.9 thulium	70 Yb 173.1 ytterbium	71 Lu 175.0 lutetium
89 Ac (227) actinium	90 Th 232.0 thorium	91 Pa 231.0 protactinium	92 U 238.0 uranium	93 Np (237) neptunium	94 Pu (244) plutonium	95 Am (243) americium	96 Cm (247) curium	97 Bk (247) berkelium	98 Cf (251) californium	99 Es (252) einsteinium	100 Fm (257) fermium	101 Md (258) mendelevium	102 No (259) nobelium	103 Lr (262) lawrencium

The value in the brackets indicates the mass number of the longest-lived isotope.

END OF FORMULA SHEET

Neap

Trial Examination 2022

VCE Physics Unit 1

Written Examination

Multiple-choice Answer Sheet

Student's Name: ______________________________

Teacher's Name: ______________________________

Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out.
Marks will **not** be deducted for incorrect answers.
No mark will be given if more than **one** answer is completed for any question.

All answers must be completed like this example: A B C D

Use pencil only

1	A	B	C	D
2	A	B	C	D
3	A	B	C	D
4	A	B	C	D
5	A	B	C	D
6	A	B	C	D
7	A	B	C	D
8	A	B	C	D
9	A	B	C	D
10	A	B	C	D