TSSM
Creating VCE Success

2019 Trial Examination

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STUDENT NUMBER | | | | | | | | | Letter | |

PHYSICS

Unit 1 – Written examination

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

QUESTION & ANSWER BOOK

Structure of book

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	20	20	20
B	12	12	70
			Total 90

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- A scientific calculator is permitted in this examination.
- Students are permitted to bring in an A4 page of notes

Materials supplied

- Question and answer book of 25 pages.

Instructions

- Print your name in the space provided on the top of this page.

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

SECTION A – Multiple-choice questions

Instructions for Section A

Section A consists of 20 multiple-choice questions. Choose the response that is **correct** or that **best answers** the question. Write the letter corresponding to your chosen answer in the box at the end of each question.

- A correct answer is worth 1 mark, an incorrect answer scores 0.
- Marks will **not** be deducted for incorrect answers.
- No marks will be given if more than one answer is given for any question

Question 1

When two bodies are in thermal equilibrium with a third body, then they will be in thermal: equilibrium with themselves. This is called

A. The law of thermodynamics.
B. The zeroth law of thermodynamics.
C. The first law of thermodynamics.
D. The law of thermal equilibrium.

Question 2

If a system has undergone no change in internal energy during a process, then it can be assumed that,

A. No work was done on the system.
B. No work was done by the system.
C. The heat gained by the system was equal to the work done by the system.
D. The heat gained by the system was less than the work done by the system.

Question 3

A 0.2 kg piece of metal at 41.76 °C is added to 60 grams of water at 24 °C, the temperature of the water rises to 31.40 °C. The specific heat capacity of the metal is
(Specific heat capacity of water 4200 J kg^{-1} C^{-1}*)*

A. 900 000 J kg^{-1} C^{-1}
B. 52559 J kg^{-1} C^{-1}
C. 900 J kg^{-1} C^{-1}
D. 525.59 J kg^{-1} C^{-1}

SECTION A- continued

Question 4
Particles in a liquid are usually

A. Closer together and lower in energy than in a gas
B. Further apart and lower in energy than in a gas
C. Closer together and lower in energy than in a solid
D. Further apart and lower in energy than in a solid

Question 5
100 grams of water at 75°C is added to 50 grams of ice at 0°C. What is the final temperature of the mixture? (*Specific heat capacity of water* 4200 J kg^{-1} °C^{-1}, *specific heat capacity of ice* 2100 J kg^{-1} °C^{-1}, *latent heat of fusion of water* 3.34×10^5 J kg^{-1})

A. 0 ℃
B. 23.49 ℃
C. 37.5 ℃
D. 70.48

Question 6
During convection, heat is transferred via

A. Collisions of particles.
B. Movement of fluid.
C. Via electromagnetic radiation.
D. No heat is transferred.

Question 7
The gases that contribute to the enhanced greenhouse effect in order of most to least significant are

A. Water vapour, carbon dioxide, methane, nitrous oxide.
B. Carbon dioxide, water vapour , methane, nitrogen.
C. Water vapour, carbon dioxide, nitrogen, oxygen.
D. Carbon dioxide, methane, nitrogen, oxygen .

SECTION A- continued
TURN OVER

Question 8

A circuit has a current of 10 mA following through it. How many electrons will move through the circuit in one minute?

A. 3.75×10^{18}
B. 3.75×10^{21}
C. 6.25×10^{16}
D. 6.25×10^{19}

Question 9

The voltage divider circuit shown in Figure 1 consists of a 9 V battery, a 100 Ω resistor and an unknown resistor.

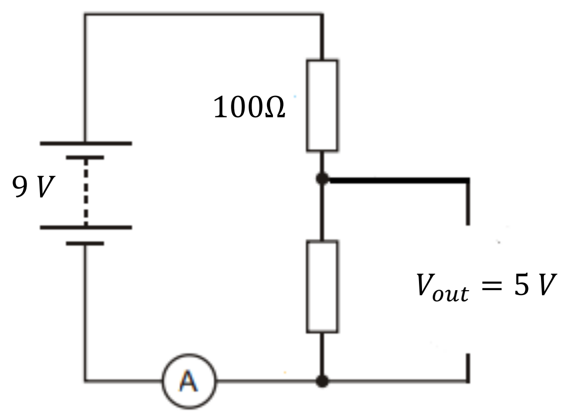


Figure 1

If the voltage dropped across the unknown resistor is 5 V, its value is equal to:

A. 80 Ω
B. 100 Ω
C. 125 Ω
D. 55.5 Ω

SECTION A- continued

Question 10
All of the following units are equivalent to watts except:

A. $\text{Amp}^2 \times \text{Ohm}$
B. $\text{Volt}^2 \div \text{Ohm}$
C. Joule ÷ Second
D. Volt ÷ Amp

Question 11
The resistance of both a thermistor and light dependent resistor (LDR) are variable. Which of the following combinations provides the highest resistance for both the thermistor and the LDR.

	Thermistor	LDR
A.	High temperature	High illumination
B.	High temperature	Low illumination
C.	Low temperature	High illumination
D.	Low temperature	Low illumination

The following information refers to Questions 12 and 13
A 10 Ω, a 15 Ω and a 25 Ω resistor are placed together in series with a 9 volt battery.

Question 12
The total resistance of the circuit is:

A. 4.83 Ω
B. 19.38 Ω
C. 31.25 Ω
D. 50 Ω

Question 13
The voltage dropped across the 15 Ω resistor is equivalent to:

A. 2.7 V
B. 1.8 V
C. 4.84 V
D. 9 V

SECTION A- continued
TURN OVER

Question 14

A circuit requires a total resistance of 475 Ω, however the only resistors available are a $25\ \Omega$, $2 \times 150\ \Omega$ and $2 \times 750\ \Omega$. Using some or all of the resistors how could this be achieved?

A. It is not possible

B. All resistors in series

C. $2\ \times 150$ in parallel, $2\ \times 750$ in parallel and these two combinations in series with 25 Ω

D. $2\ \times 750$ in parallel in series with $150\ \Omega$

Question 15

When ${}^{226}_{88}Ra$ undergoes α decay it will form:

A. ${}^{230}_{92}U$

B. ${}^{226}_{89}Ac$

C. ${}^{222}_{86}Rn$

D. ${}^{222}_{87}Fr$

Question 16

The amount of energy required to disassemble a system of particles into its separate parts is called its:

A. Atomic energy

B. Binding energy

C. Nuclear energy

D. Radioactive energy

Question 17

In an experiment, a physicist measured a sample of material. Initially, it measured 1200 grams, when he reweighed it, it measured 75 grams. If it had a half-life of 12 minutes, the time between the two measurements was equal to:

A. 96 minutes

B. 48 minutes

C. 24 minutes

D. 12 minutes

SECTION A- continued

Question 18
Cosmic background radiation is:

A. Radiation from a galaxy that is redshifted
B. Radiation from the sun
C. Radiation that was formed when electrons and protons combined during the Big Bang
D. Radiation that is continually produced in the atmosphere

Question 19
An uncharged atom of Beryllium has 4 protons and 5 neutrons. The atom has a total of:

A. 9 quarks and 4 leptons
B. 27 quarks and 4 leptons
C. 27 quarks and 9 leptons
D. 9 quarks and 9 leptons

Question 20
Which of the following particles is not a fermion?

A. Neutron
B. Proton
C. Photon
D. Quark

END OF SECTION A
TURN OVER

SECTION B - Short-answer questions

Instructions
Answer **all** questions in all sections in the spaces provided.
Where an answer box has a unit printed in it, give your answer in that unit.
You should take the value of g to be 9.8 m s^{-2}.
Where answer boxes are provided, write your final answer in the box.
In questions worth more than 1 mark, appropriate working should be shown.
Unless otherwise indicated, diagrams are nor to scale.

Question 1 ((5 marks)

Annie and Jo are investigating a thermodynamic system. In the first stage, the system does 25 J of work and has an increase internal energy by 8 J.

Jo says energy has been released from the system while Annie disagrees and says the system is absorbing energy.

a. Find the amount of heat either added to or released from the system in this stage, and hence state who is correct.

3 marks

In the second stage, the system absorbs 15 J of heat and has 21 J of work done on it.

b. Calculate the total change in the internal energy of the system during both stages.

2 marks

J

SECTION B- continued

Question 2 (8 marks)

Energy is being supplied to a 250 gram block of ice, initially at $-12°C$ at a rate of 300 W for 10 minutes.

(*Specific heat capacity of water* 4200 J kg^{-1} °C^{-1}, *specific heat capacity of ice* 2100 J kg^{-1} °C^{-1}, *latent heat of fusion of water* 3.34×10^5 J kg^{-1}).

a. How much energy is required to melt the ice block?

3 marks

J

b. Calculate the time taken for the ice to melt.

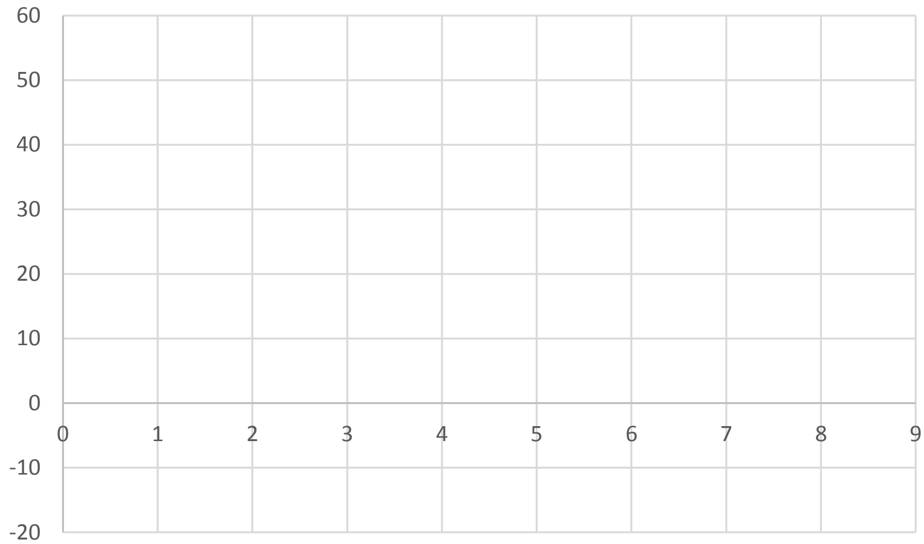
2 marks

min

SECTION B- Question 2 – continued

TURN OVER

c. On the graph below, draw a temperature versus time (minutes) graph showing the time required for the water to reach 50 ℃ and state the total time in the box below.



s

3 marks

SECTION B- continued

Question 3 (3 marks)

A block of ice of unknown mass initially at -15 °C is added to a 500 gram sample of water at 70 °C. If the final temperature of the mixture is 29 °C, how much ice has been added?
(*Specific heat capacity of water* 4200 J kg^{-1} °C^{-1}, *specific heat capacity of ice* 2100 J kg^{-1} °C^{-1}, *latent heat of fusion of water* 3.34×10^5 J kg^{-1})

kg

Question 4 (3 marks)

Figure 2 shows a saucepan sitting on a gas stove which contains an egg.

Figure 2

Outline the energy transfers in order to create a hardboiled egg.

SECTION B- continued
TURN OVER

Question 5 (4 marks)
Without the greenhouse effect, Earth would be significantly different to the way we currently know it.

a. What is the greenhouse effect?

2 marks

b. Why are scientists now worried about the greenhouse effect?

2 marks

SECTION B- continued

Question 6 (7 marks)
A set of 10 Christmas lights shown in Figure 3 are connected in series to a 240 V power supply.

Figure 3

When the lights are switched on and working correctly they draw a current of 0.15 A.

a. What is the power dissipated in each globe?

3 marks

W

b. If the globes are left on for 2 hours, how much charge flows through each globe?

2 marks

C

c. What energy does each globe use if it is left on for this time period?

2 marks

J

SECTION B- continued
TURN OVER

Question 7 (9 marks)

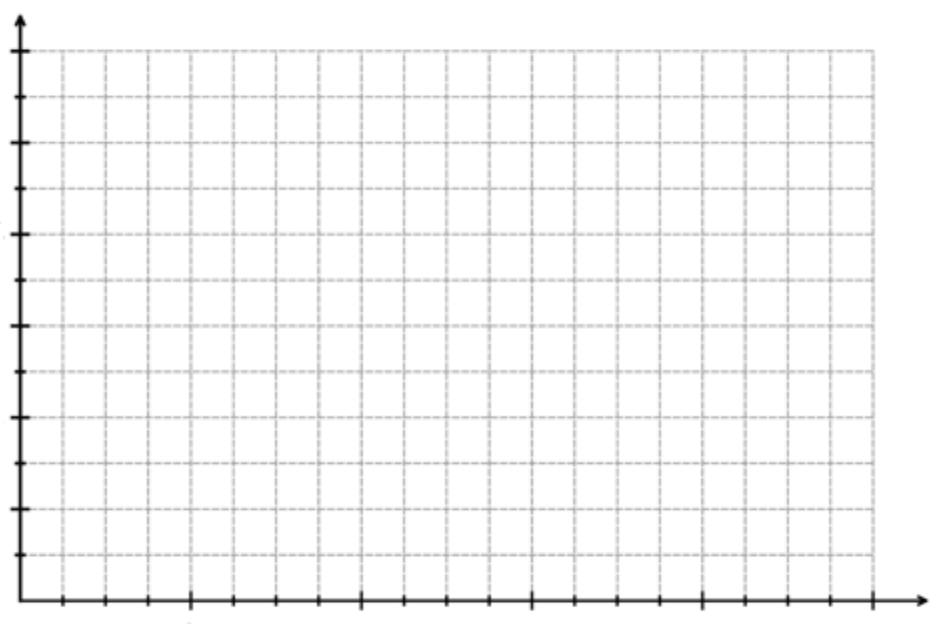
Elliot and Gaby are performing an experiment to verify Ohm's law using two different resistors. They set up a simple series circuit using one resistor at a time with a variable power supply. They then use a multimeter to measure the voltage across and current through each resistor.

The results Elliot and Gaby obtained are shown in Table 1.

Resistor A		**Resistor B**	
Voltage (V)	Current (mA)	Voltage (V)	Current (mA)
0	0	0	0
1	2.5	1	0.5
2	5	2	1.9
2.5	6.3	2.5	2.8
3.8	9.4	3.8	6
4.4	11	4.4	11

Table 1

a. On the axes below sketch graphs for both Resistor A and Resistor B. Label the graph appropriately.



3 marks

SECTION B- Question 7 - continued

b. Which of Elliot and Gaby's resistors is Ohmic? Explain your answer.

2 marks

c. Calculate the resistance of the Ohmic resistor.

Ω

2 marks

d. With the non-ohmic resistor in place in the series circuit, calculate the power dissipated across it when the voltage is measured at 3.5 V.

mW

2 marks

SECTION B- continued
TURN OVER

Question 8 (8 marks)

Students investigating combination circuits set up the circuit shown in Figure 4.

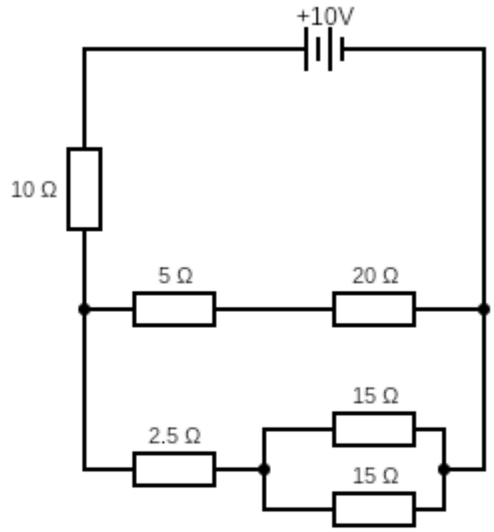


Figure 4

a. What is the effective resistance of this circuit?

3 marks

Ω

b. Calculate the current supplied by the battery.

2 marks

A

SECTION B- Question 8 - continued

c. What is the voltage drop across the 2.5 Ω resistor?

3 marks

V

Question 9 (6 marks)

Oliver and Charlotte are investigating the workings of a thermistor. They complete an experiment to determine the resistance across the thermistor at a variety of different temperatures and their results are shown in a temperature vs resistance graph in Figure 5.

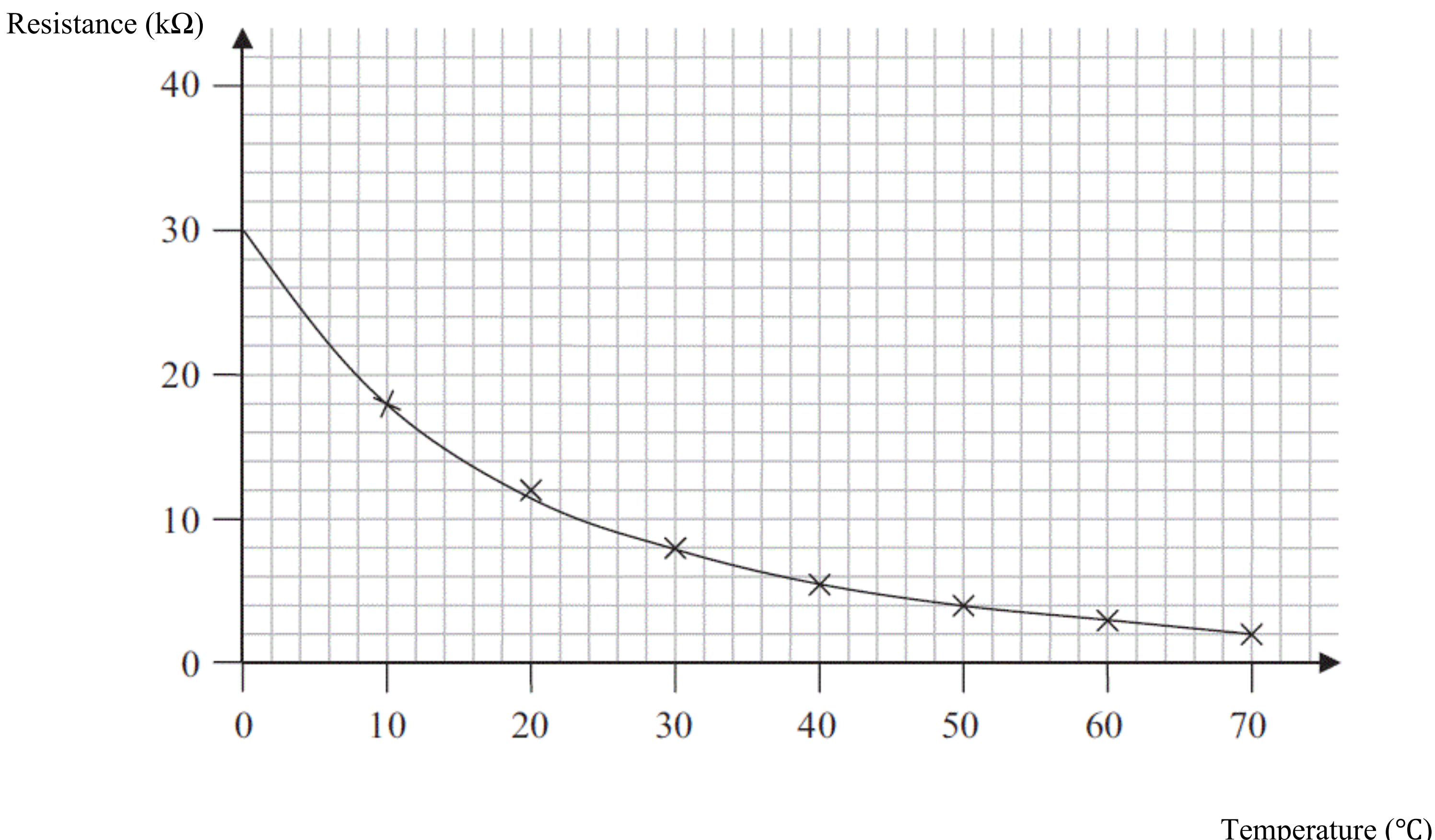


Figure 5

SECTION B- Question 9 – continued
TURN OVER

a. What was the resistance of the thermistor when Charlotte and Oliver recorded the temperature as 30 °C?

1 mark

kΩ

Charlotte and Oliver then place their thermistor into a circuit used to control an air conditioner as shown in Figure 6.

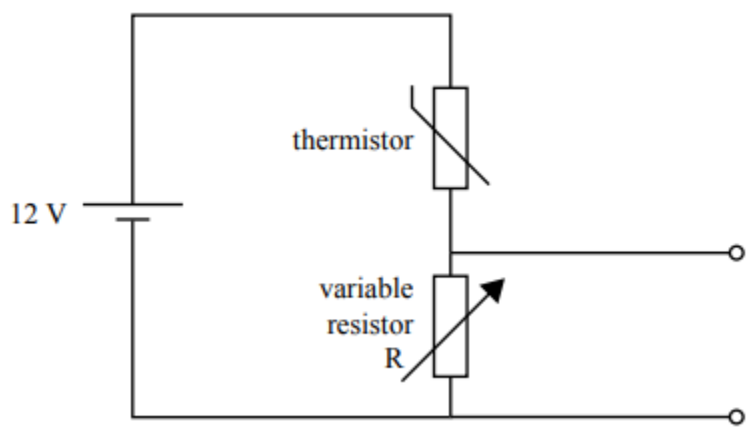


Figure 6

They design the circuit so the air conditioner switch, which is across the variable resistor, switches ON when the input across it reaches 8 V and OFF when it is below this.

b. If the air conditioner is designed to switch on at 30 °C, what value should the variable resistor be set to?

2 marks

kΩ

SECTION B- Question 9 - continued

c. Charlotte and Oliver decide they actually want the air conditioner to switch on at a lower temperature. Should they increase or decrease the value of the variable resistor to achieve this? Explain your answer.

3 marks

Question 10 (7 marks)

Iodine-131 (I-131) is a radioactive isotope used for medical purposes, particularly in treating a condition of the thyroid called hyperthyroidism.

I-131 is known to decay via beta emission. (β^{-}).

a. Explain how a beta particle is ejected from the nucleus of an atom.

2 marks

b. Write a balanced equation to show the decay of I-131.

2 marks

SECTION B- Question 10 – continued
TURN OVER

Figure 6 shows the disintegrations per minute of I-131 versus time in hours.

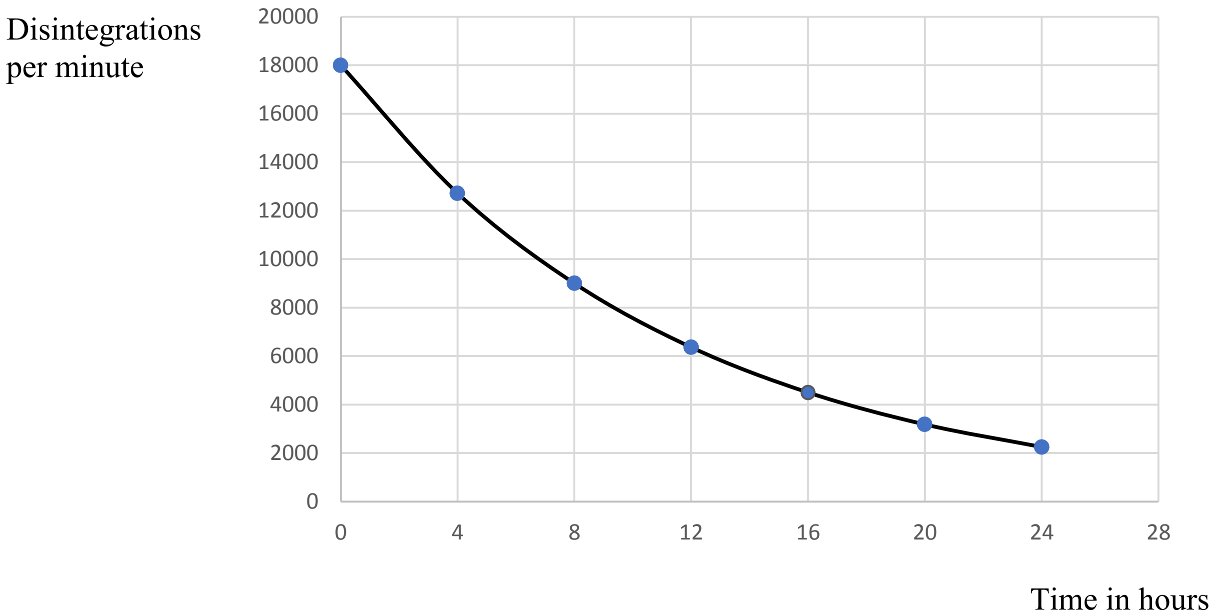


Figure 6

c. Using Figure 5 what is the half-life of I-131?

1 mark

hours

A patient in a remote location needs to be given a dose of I-131 with an activity of 0.75 MBq to treat their condition. The hospital where it is produced is located a significant distance away and there is a turnaround time of 32 hours in between producing the drug and the patient receiving it.

d. What should be the minimum activity of the I-131 at the time it is produced to ensure that the patient receives the dose at the correct activity?

2 marks

MBq

SECTION B- continued

Question 11 (4 marks)

Scientists believe that the Big Bang theory is the correct theory in relation to the beginning of the universe. They were able to reach this conclusion using the Doppler Effect.

a. What is the Doppler Effect?

2 marks

b. What is the Big Bang theory and how does the Doppler Effect provide the evidence to support it?

2 marks

Question 12 (6 marks)

The standard model is a model scientists use to describe the role of fundamental particles and the interactions between them.

a. What are fundamental particles?

2 marks

b. What is the difference between a fermion and a boson?

2 marks

SECTION B- Question 12 – continued
TURN OVER

c. Show the combination and charge of the quarks required to produce a

i. Neutron?

1 mark

ii. Proton?

1 mark

END OF QUESTION AND ANSWER BOOK

Formula and Data Sheet

First Law of Thermodynamics	$Q = U + W$
Wien's Law:	$\lambda_{\text{max}} T = 2.898 \times 10^{-3}$ m K
Power radiated per unit surface area: (Stefan-Boltzmann Law)	$R = \sigma T^4$ $\sigma = 5.670 \times 10^{-8}$ W m^{-2} K^{-4}
Heat capacity:	$Q = mc\Delta T$
Latent heat:	$Q = mL$
Charge on an electron	$1.6 \times 10^{-19}\ C$
Electrical charge	$Q = It$
Electrical work	$W = QV$
Voltage	$V = IR$
Power	$P = VI$
Resistors in series	$R_{TOTAL} = R_1 + R_2 + \cdots + R_n$
Resistors in parallel	$\frac{1}{R_{TOTAL}} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots + \frac{1}{R_n}$

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

hydrogen 1 **H** 1.0079																		helium 2 **He** 4.0026
lithium 3 **Li** 6.941	beryllium 4 **Be** 9.0122												boron 5 **B** 10.811	carbon 6 **C** 12.011	nitrogen 7 **N** 14.007	oxygen 8 **O** 15.999	fluorine 9 **F** 18.998	neon 10 **Ne** 20.180
sodium 11 **Na** 22.990	magnesium 12 **Mg** 24.305												aluminium 13 **Al** 26.982	silicon 14 **Si** 28.086	phosphorus 15 **P** 30.974	sulfur 16 **S** 32.065	chlorine 17 **Cl** 35.453	argon 18 **Ar** 39.948
potassium 19 **K** 39.098	calcium 20 **Ca** 40.078		scandium 21 **Sc** 44.956	titanium 22 **Ti** 47.867	vanadium 23 **V** 50.942	chromium 24 **Cr** 51.996	manganese 25 **Mn** 54.938	iron 26 **Fe** 55.845	cobalt 27 **Co** 58.933	nickel 28 **Ni** 58.693	copper 29 **Cu** 63.546	zinc 30 **Zn** 65.39	gallium 31 **Ga** 69.723	germanium 32 **Ge** 72.61	arsenic 33 **As** 74.922	selenium 34 **Se** 78.96	bromine 35 **Br** 79.904	krypton 36 **Kr** 83.80
rubidium 37 **Rb** 85.468	strontium 38 **Sr** 87.62		yttrium 39 **Y** 88.906	zirconium 40 **Zr** 91.224	niobium 41 **Nb** 92.906	molybdenum 42 **Mo** 95.94	technetium 43 **Tc** [98]	ruthenium 44 **Ru** 101.07	rhodium 45 **Rh** 102.91	palladium 46 **Pd** 106.42	silver 47 **Ag** 107.87	cadmium 48 **Cd** 112.41	indium 49 **In** 114.82	tin 50 **Sn** 118.71	antimony 51 **Sb** 121.76	tellurium 52 **Te** 127.60	iodine 53 **I** 126.90	xenon 54 **Xe** 131.29
caesium 55 **Cs** 132.91	barium 56 **Ba** 137.33	57-70 *	lutetium 71 **Lu** 174.97	hafnium 72 **Hf** 178.49	tantalum 73 **Ta** 180.95	tungsten 74 **W** 183.84	rhenium 75 **Re** 186.21	osmium 76 **Os** 190.23	iridium 77 **Ir** 192.22	platinum 78 **Pt** 195.08	gold 79 **Au** 196.97	mercury 80 **Hg** 200.59	thallium 81 **Tl** 204.38	lead 82 **Pb** 207.2	bismuth 83 **Bi** 208.98	polonium 84 **Po** [209]	astatine 85 **At** [210]	radon 86 **Rn** [222]
francium 87 **Fr** [223]	radium 88 **Ra** [226]	89-102 **	lawrencium 103 **Lr** [262]	rutherfordium 104 **Rf** [261]	dubnium 105 **Db** [262]	seaborgium 106 **Sg** [266]	bohrium 107 **Bh** [264]	hassium 108 **Hs** [269]	meitnerium 109 **Mt** [268]	ununnilium 110 **Uun** [271]	unununium 111 **Uuu** [272]	ununbium 112 **Uub** [277]		ununquadium 114 **Uuq** [289]				

*Lanthanide series	lanthanum 57 **La** 138.91	cerium 58 **Ce** 140.12	praseodymium 59 **Pr** 140.91	neodymium 60 **Nd** 144.24	promethium 61 **Pm** [145]	samarium 62 **Sm** 150.36	europium 63 **Eu** 151.96	gadolinium 64 **Gd** 157.25	terbium 65 **Tb** 158.93	dysprosium 66 **Dy** 162.50	holmium 67 **Ho** 164.93	erbium 68 **Er** 167.26	thulium 69 **Tm** 168.93	ytterbium 70 **Yb** 173.04
**Actinide series	actinium 89 **Ac** [227]	thorium 90 **Th** 232.04	protactinium 91 **Pa** 231.04	uranium 92 **U** 238.03	neptunium 93 **Np** [237]	plutonium 94 **Pu** [244]	americium 95 **Am** [243]	curium 96 **Cm** [247]	berkelium 97 **Bk** [247]	californium 98 **Cf** [251]	einsteinium 99 **Es** [252]	fermium 100 **Fm** [257]	mendelevium 101 **Md** [258]	nobelium 102 **No** [259]

SECTION A MULTIPLE CHOICE ANSWER SHEET

Answers – Circle ONE of A-D for each of the 20 multiple choice questions.

Question	Answer			
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
11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D