Neap

Trial Examination 2022

VCE Physics Unit 1

Written Examination

Suggested Solutions

SECTION A – MULTIPLE-CHOICE QUESTIONS

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

Question 1 B

B is correct. Convection is the transfer of thermal energy through liquids and gasses via currents that are set up in a fluid and that travel between different temperatures and, hence, different fluid densities.

A is incorrect. Conduction relies on vibrations passing between atoms, not on the atoms moving from a hot region to a cooler one.

C and **D** are incorrect. Radiation is the transfer of heat in the form of electromagnetic radiation, which can travel through a vacuum and does not require a medium.

Question 2 A

A is correct.

$$\begin{aligned} W &= Q - \Delta U \\ &= 840 - 1125 \\ &= -285 \text{ J} \end{aligned}$$

Therefore, 285 J of work is done on the system.

B and **D** are incorrect. Work is not done by the system.

C is incorrect. If 1965 J of work was done on the system, the increase in the system's internal energy would have been 2805 J.

Question 3 B

$$\lambda_{\text{max}} = \frac{0.0029 \text{ mK}}{T}$$

$$\begin{aligned} T &= \frac{0.0029}{0.5 \times 10^{-6}} \\ &= 5.8 \times 10^{3} \text{ K} \\ &= 5.8 \times 10^{3} - 273 \\ &= 5527°\text{C} \\ &= 5.5 \times 10^{3}°\text{C} \end{aligned}$$

Question 4 D

$$Q = n_{\text{electrons}} \times q$$

$$\begin{aligned} n_{\text{electrons}} &= \frac{1}{1.6 \times 10^{-19}} \\ &\approx 6.3 \times 10^{18} \end{aligned}$$

Question 5 C

$$\begin{aligned} V &= \frac{E}{It} \\ &= \frac{2.88 \times 10^{4}}{4.0 \times 120} \\ &= 60 \text{ V} \end{aligned}$$

Question 6 C

When the switch is open, the circuit is a simple series circuit where $R_{total} = 2R$. Therefore, the voltage across each resistor is half the voltage of the battery. When the switch is closed, the circuit is a combination circuit where $R_{total} = 1.5R$. The voltage across the parallel combination is half the voltage across the single resistor. Therefore, the parallel combination takes a third of the voltage of the battery.

Question 7 C

There is 3.0 V across the LED. Therefore, there is 9.0 V across the variable resistor. A current of 150 mA is required for full brightness.

$$\begin{aligned} R &= \frac{V}{I} \\ &= \frac{9.0}{0.15} \\ &= 60\ \Omega \\ &= 6.0 \times 10^{1}\ \Omega \end{aligned}$$

Question 8 C

If $\frac{7}{8}$ of the source has decayed, there is $\frac{1}{8}$ remaining. The number of half-lives is, therefore, $3 \times 25 = 75$ s.

Question 9 B

B is correct. When uranium-238 undergoes α-decay, the atomic number goes down by two and the mass number goes down by four. Hence, it becomes thorium-230.

A is incorrect. The number of neutrons is 140, not the mass number.

C and **D** are incorrect. The final type of decay is not β-decay.

Question 10 B

The inflationary epoch (event 4) was followed by the formation of elementary particles (event 3). Next, nuclear fusion began (event 2) and nucleosynthesis occurred. This was followed by a recombination period where neutral atoms began to form (event 1). The correct order of events is, therefore, 4, 3, 2, 1.

SECTION B

Question 1 (8 marks)

a. 200 K (*read from graph*) 1 mark

$200 - 273 = -73°\text{C}$ 1 mark

b. When it reached 360 K, the sample changed state. 1 mark

It changed from a liquid into a gas via vaporisation. 1 mark

c. $Q = mL_{\text{fusion}}$

$L_{\text{fusion}} = \dfrac{8.0 \times 10^4 - 2.0 \times 10^4}{0.25}$ 1 mark

$= 2.4 \times 10^5 \text{ J kg}^{-1}$ 1 mark

d. $Q = mc\Delta T$

$1.4 \times 10^5 - 8.0 \times 10^4 = 0.25 \times c \times (360 - 200)$ 1 mark

$c = 1.5 \times 10^3 \text{ J kg}^{-1} \text{ K}^{-1}$ 1 mark

Question 2 (6 marks)

a. $\Delta Q = mc\Delta T$

$= 0.50 \times 2500 (78 - 25)$ 1 mark

$= 6.63 \times 10^4 \text{ J}$ 1 mark

b. $\Delta Q = mL_{\text{v}}$

$= 0.50 \times 8.5 \times 10^5$ 1 mark

$= 4.25 \times 10^5 \text{ J}$ 1 mark

c. $\Delta Q = 6.63 \times 10^4 + 4.25 \times 10^5$

$= 4.91 \times 10^5 \text{ J}$ 1 mark

$= 4.9 \times 10^5 \text{ J}$ 1 mark

Question 3 (4 marks)

$Q = mc\Delta T$

$0.2 \times 4200 \times (26.6 - 25.0) = m \times 450 \times (85.0 - 26.6)$ 1 mark

$1344 = 26\,280m$ 1 mark

$m = 0.05114 \text{ kg}$ 1 mark

$\approx 51 \text{ g}$ 1 mark

Question 4 (3 marks)

a. shorter 1 mark

lower 1 mark

b. The majority of the radiation emitted by Earth is absorbed by greenhouse gases and re-emitted. 1 mark

Question 5 (10 marks)

a. resistor A 1 mark

The graph for resistor A shows a proportional relationship between voltage and current, which, therefore, shows a constant resistance. 1 mark

b. 200 mA 1 mark

When the voltage across resistor A is 2.0 V, the current flowing through resistor A is 200 mA. Because the two resistors are in series, the current is the same when it flows through resistor B. 1 mark

c. The current flowing through resistor A is 400 mA. 1 mark

The current flowing through resistor B is 200 mA. 1 mark

Total current flowing through the variable supply:

$$I_T = I_1 + I_2$$
$$= 400 + 200$$
$$= 600 \text{ mA}$$ 1 mark

d. $R_{total} = \frac{V_{total}}{I_{total}}$ 1 mark

$$= \frac{2.0}{0.6}$$ 1 mark

$$= 3.3\ \Omega$$ 1 mark

Question 6 (4 marks)

$V_{\text{total}} = I_{\text{total}} R_{\text{total}}$

$12.0 = 1.0 \times R_{\text{total}}$

$R_{\text{total}} = 12.0\ \Omega$ 1 mark

Total resistance of the parallel branch:

$R_{\text{parallel}} = 12.0 - 4.0 - 4.0$

$= 4.0\ \Omega$ 1 mark

$$\frac{1}{R_{\text{parallel}}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{4.0} = \frac{1}{8.0} + \frac{1}{R_x}$$ 1 mark

$$\frac{1}{R_x} = \frac{1}{4.0} - \frac{1}{8.0}$$

$$= \frac{2.0 - 1.0}{8.0}$$

$= 8.0\ \Omega$ 1 mark

Question 7 (6 marks)

a. The resistance of the light-dependent resistor (LDR) is 3.0 kΩ. 1 mark

$$V_{\text{out}} = \frac{R_2}{R_1 + R_2} \times V_{\text{in}}$$

$$3.0 = \frac{3.0}{3.0 + R_2} \times 12.0$$ 1 mark

$R_2 = 9.0\ \text{k}\Omega$ 1 mark

b. $1.2 = \dfrac{R}{9.0 + R_1} \times 12.0$ 1 mark

$R_1 = 1.0\ \text{k}\Omega$ 1 mark

$\text{light intensity} = 25.0\ \text{lux}$ 1 mark

*Note: Consequential on answer to **Question 7a.** Accept responses in the range of 23.0–27.0 lux.*

Question 8 (7 marks)

a. $\text{energy} = 1.6 \times 1.5 \times 5$ 1 mark

$= 12.0\ \text{kWh}$ 1 mark

b. $\text{cost} = \text{energy} \times \text{tariff}$

$32.51 = 12.0 \times n \times 0.25$ 1 mark

$n = 10.8$ 1 mark

≈ 11 weeks

c. $I = \dfrac{P}{V}$

$= \dfrac{1700}{240}$ 1 mark

$= 7.1$ A 1 mark

The fuse will not blow because 7.1 A is below 10.0 A. 1 mark

Question 9 (3 marks)

a. $A = 239 + 0$

$= 239$ 1 mark

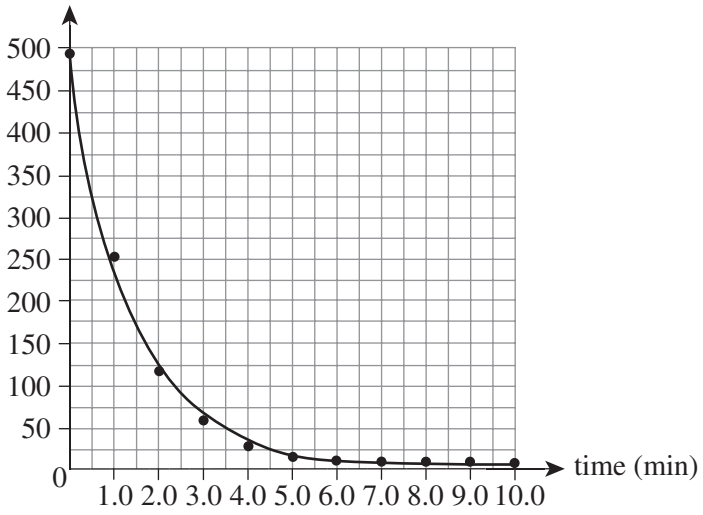
$Z = 94 - 1$

$= 93$ 1 mark

b. neptunium (*as found on the periodic table*) 1 mark

Question 10 (8 marks)

a. activity (counts per minute)



4 marks
1 mark for including appropriate scales.
1 mark for including appropriate axis labels.
1 mark for correctly plotting the data.
1 mark for including a correct line of best fit.

b. The term half-life refers to the time it takes for half of a radioactive sample to decay. 1 mark

OR

The term half-life refers to the time after which there is a 50% chance that an unstable nucleus will have decayed. 1 mark

c. $t_{\frac{1}{2}} = 1.0$ min 1 mark

*Note: Consequential on answer to **Question 10a**. Accept responses in the range of 0.9–1.1 min.*

d. 150 s = 2.5 min 1 mark

85 counts per minute 1 mark

Note: Accept responses in the range of 80–90 counts per minute.

Question 11 (4 marks)

Radiation	Mass (amu)	Charge (C)	Speed	Ionising ability
α	**1**	+2	10% of c	**high**
β^-	$\frac{1}{1800}$	**–1**	**90% of *c***	**medium**
γ	**0**	**none**	***c***	low

4 marks

1 mark for every two correct cells of the table completed.

Question 12 (9 marks)

a. LHS = RHS

$235 + 1 = 144 + 89 + Y$ 1 mark

$Y = 3$ 1 mark

$92 = 56 + Z$ 1 mark

$Z = 36$ 1 mark

b. krypton (*as found on the periodic table*) 1 mark

*Note: Consequential on answer to **Question 12a**.*

c. $168 \text{ MeV} = 1.68 \times 10^8 \text{ eV}$ 1 mark

$1.60 \times 10^7 \times 1.6 \times 10^{-19} = 2.56 \times 10^{-11} \text{ J}$ 1 mark

$E = mc^2$

$m = \frac{2.56 \times 10^{-11}}{(3.0 \times 10^8)^2}$ 1 mark

$= 2.84 \times 10^{-28} \text{ kg}$ 1 mark

Question 13 (8 marks)

a. **i.** arrow A 1 mark

12.8 – 10.2 = 2.6 eV upwards 1 mark

ii. arrow D 1 mark

13.1 – 10.2 = 2.9 eV 1 mark

$2.9 \times 1.6 \times 10^{-19} = 4.64 \times 10^{-19}$ J 1 mark

b. No. 1 mark

Photon emissions and absorptions can only happen 1 mark

as electrons move from one level to another. 1 mark