Neap

Trial Examination 2021

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 C

C is correct. Heat naturally flows in one direction only: from hot toward cold. **A**, **B** and **D** are incorrect. These diagrams do not show the heat flowing in the correct direction.

Question 2 D

$$U = Q - W$$
$$35 = Q - 15$$
$$Q = 50 \text{ J}$$

Question 3 A

$$Q = mc\Delta T$$
$$1.0 \times 4200 \times (T_f - 15) = -(0.9 \times 880 \times (T_f - 90))$$
$$4992T_f = 127\,800$$
$$T_f = 26.9$$

The final temperature of the mixture is closest to 27.0°C.

Question 4 C

Circuit X:

$$P_T = \frac{V_T{}^2}{R_T}$$
$$= \frac{1.0^2}{0.5}$$
$$= 2.0 \text{ W}$$

Circuit Y:

$$P_T = \frac{V_T{}^2}{R_T}$$
$$= \frac{1.0^2}{2.0}$$
$$= 0.5 \text{ W}$$

Circuit Z:

$$P_T = \frac{V_T{}^2}{R_T}$$
$$= \frac{1.0^2}{1.5}$$
$$= 0.7 \text{ W}$$

In order from lowest total power output to highest total power output, the circuits are Y, Z, X.

Question 5 C

$$\text{energy (kWh)} = 4.8 \times 2.0 \times 14$$
$$= 134.4 \text{ kWh}$$

$25.5 \times 134.4 = 3427.2$

The total cost of the energy consumed is $34.27.

Question 6 D

LHS = RHS

X:

$233 \rightarrow 229 + 4$

$92 \rightarrow 90 + 2$

Hence, $X = {}^{4}_{2}\alpha$.

Y:

$202 \rightarrow 202 + 0$

$81 \rightarrow 81 + 0$

Hence, $Y = {}^{0}_{0}\gamma$.

Z:

$82 \rightarrow 82 + 0$

$35 \rightarrow 36 + (-1)$

Hence, $Z = {}^{0}_{-1}\beta$.

Question 7 D

Slow cooker:

$$P = VI$$
$$200 = 240 \times I$$
$$I = 0.83 \text{ A}$$
$$P = \frac{V^2}{R}$$
$$200 = \frac{240^2}{R}$$
$$R = 288\ \Omega$$

Kettle:

$$P = VI$$
$$1000 = 240 \times I$$
$$I = 4.17 \text{ A}$$
$$P = \frac{V^2}{R}$$
$$1000 = \frac{240^2}{R}$$
$$R = 568\ \Omega$$

Question 8 B

$$\left(+\frac{2}{3}-\frac{1}{3}-\frac{1}{3}\right)=\left(+\frac{2}{3}+\frac{2}{3}-\frac{1}{3}\right)+X$$

$$X=-1$$

Therefore, the other particle produced in this transformation is an electron.

Question 9 B

$$V_{\text{out}}=\frac{R_1}{\left(R_1+R_2\right)}\times V_{\text{in}}$$

$$8=\frac{800}{800+R_2}\times 12$$

$$R_2=400\ \Omega$$

Question 10 C

C is correct. The conversion of an element into another element by bombarding it with a fundamental particle such as a neutron is known as artificial transmutation. **A**, **B** and **D** are incorrect. These terms do not represent the equation shown.

SECTION B

Question 1 (5 marks)

a. $Q = mc\Delta T$

$2000 = m \times 385 \times 100$ 1 mark

$m = 0.05195$ 1 mark

$= 5.19 \times 10^{-2}$ kg (to 3 significant figures) 1 mark

b. The process is endothermic. 1 mark

It is endothermic because the piece of copper absorbs heat from the environment. 1 mark

Question 2 (8 marks)

a. 20°C 1 mark

20 + 273 = 293 K 1 mark

b. At 80°C, the sample is changing state 1 mark

from a gas into a liquid, or from a liquid into a gas. 1 mark

c. $Q = mL_v$

$L_v = \dfrac{6.0 \times 10^3 - 2.0 \times 10^3}{0.05}$ 1 mark

$= 8.0 \times 10^4$ J kg^{-1} 1 mark

d. $Q = mc\Delta T$

$10.0 \times 10^3 - 6.0 \times 10^3 = 0.05 \times c \times (80.0 - 20.0)$ 1 mark

$c = 1.3 \times 10^3$ J kg^{-1} °C 1 mark

Question 3 (4 marks)

$\lambda_{max} = \dfrac{0.0028 \text{ m K}}{T}$ 1 mark

$635 \times 10^{-9} = \dfrac{0.0028 \text{ m K}}{T}$

$T = \dfrac{0.0028}{635 \times 10^{-9}}$ 1 mark

$= 4409$ K 1 mark

$= 4409 - 273$

$= 4140$°C 1 mark

Question 4 (2 marks)

a. increases 1 mark

b. shorter wavelengths 1 mark

Question 5 (3 marks)

a. *For example, any two of:*

- melting ice caps and rising sea-levels
- more severe weather events (such as more intense cyclones)
- increased stress and death rates in animals

2 marks

Note: A range of responses are acceptable.

b. *For example, any one of:*

- reduce the levels of gases that absorb heat and hence re-radiate heat
- reduce use of fossil fuels
- increase the amount of materials recycled

1 mark

Note: A range of responses are acceptable.

Question 6 (2 marks)

This is an example of conduction. 1 mark

The electrons in the metal spoon leave their atoms and move about in the metal as free electrons transferring kinetic energy from the head of the spoon to the cooler handle. Hotter, more rapidly vibrating atoms collide with cooler, less rapidly vibrating atoms and transfer kinetic energy. 1 mark

Question 7 (4 marks)

a. **i.** equal to 1 mark

ii. less than 1 mark

b. Temperature is average kinetic energy. As both the cup and swimming pool are at the same temperature, the water molecules have the same average kinetic energy. Temperature is proportional to the average kinetic energy. 1 mark

Internal energy is the sum of total kinetic energy and potential energy within a substance. Hence, the swimming pool of water has more internal energy than the cup of water. 1 mark

Question 8 (6 marks)

$$R_T = 10.0 + 10.0 + 20.0$$
$$= 40.0\ \Omega$$
$$V_T = I_T \times R_T$$
$$24.0 = I_T \times 40.0$$
$$I_T = 0.6\ \text{A}$$

$$I_T = I_1 = I_2 = I_3 = 0.6\ \text{A}$$

$$V_1 = 0.6 \times 10.0$$
$$= 6.0\ \text{V}$$
$$V_1 = V_2 = 6.0\ \text{V}$$

$V_3 = 0.6 \times 20.0$

$= 12.0 \text{ V}$

$P_1 = 12.0 \times 0.6$

$= 3.6 \text{ W}$

$P_1 = P_2 = 3.6 \text{ W}$

$P_3 = 0.6 \times 12$

$= 7.2 \text{ W}$

$P_T = 3.6 + 3.6 + 7.2$

$= 14.4 \text{ W}$

	$\mathbf{R_1}$	$\mathbf{R_2}$	$\mathbf{R_3}$	**Total**
V **(V)**	**6.0**	**6.0**	**12.0**	24.0
I **(A)**	**0.6**	**0.6**	**0.6**	**0.6**
R **(Ω)**	10.0	10.0	20.0	**40.0**
P **(W)**	**3.6**	**3.6**	**7.2**	**14.4**

6 marks

Note: Award 6 marks for all 12 correct values. Award 5 marks for 9–11 correct values. Award 4 marks for 7–8 correct values. Award 3 marks for 5–6 correct values. Award 2 marks for 3–4 correct values. Award 1 mark for 2 correct values.

Question 9 (6 marks)

$$\frac{1}{R_T} = \frac{1}{(10.0 + 10.0)} + \frac{1}{20.0}$$

$$R_T = \frac{20.0}{2}$$

$= 10.0 \text{ Ω}$

$V_T = I_T \times R_T$

$24.0 = I_T \times 10.0$

$I_T = 2.4 \text{ A}$

Each branch has total resistance of 20.0 Ω, so each branch has 1.2 A.

$I_1 = I_2 = I_3 = 1.2 \text{ A}$

There is a voltage drop of 24.0 V across each branch, and this voltage is equally shared across both resistors in the first branch.

$V_1 = V_2 = 12.0 \text{ V}$

$V_3 = 24.0 \text{ V}$

$P_1 = P_2 = 12.0 \times 1.2 = 14.4 \text{ W}$

$P_3 = 24.0 \times 1.2$

$= 28.8 \text{ W}$

$P_T = 14.4 + 14.4 + 28.8$

$= 57.6 \text{ W}$

	$\mathbf{R_1}$	$\mathbf{R_2}$	$\mathbf{R_3}$	**Total**
V **(V)**	**12.0**	**12.0**	**24.0**	24.0
I **(A)**	**1.2**	**1.2**	**1.2**	**2.4**
R **(Ω)**	10.0	10.0	20.0	**10.0**
P **(W)**	**14.4**	**14.4**	**28.8**	**57.6**

6 marks

Note: Award 6 marks for all 12 correct values. Award 5 marks for 9–11 correct values. Award 4 marks for 7–8 correct values. Award 3 marks for 5–6 correct values. Award 2 marks for 3–4 correct values. Award 1 mark for 2 correct values.

Question 10 (7 marks)

a. 0.7 V (read from graph) 1 mark

b. $V_{\text{resistor}} = V_{\text{supply}} - V_{\text{diode}}$

$= 6.0 - 0.7$

$= 5.3 \text{ V}$ 1 mark

c. $V = I \times R$

$5.3 = I \times 100$ 1 mark

$I = 0.053 \text{ A}$ 1 mark

$= 53 \text{ mA}$ 1 mark

d. 6.0 V 1 mark

As there is no current in the circuit, there are 0 V across the resistor. Hence, the new potential difference across the diode is 6.0 V. 1 mark

Question 11 (5 marks)

a. Double insulation means there are two layers of protection to prevent electric shock. 1 mark

The first layer of insulation insulates electrical cable from the internal component of the appliance. 1 mark

The second layer of insulation involves insulating any internal metal parts that could become live from the external casing. 1 mark

b. Double insulation prevents any possibility of the external casing of the appliance becoming live. 1 mark

The live wire cannot touch the casing even if wires inside become loose, so there is no need for an earth pin. 1 mark

Question 12 (7 marks)

a. $^{238}_{92}\text{U} \rightarrow {}^{234}_{90}\text{Th} + {}^{4}_{2}\text{He}$

2 marks

1 mark for correct reactants and products.
1 mark for nucleons correctly balanced.

b. $\text{mass}_{\text{defect}} = \left(238.0508 \text{ u} - (234.0426 \text{ u} + 4.0026 \text{ u})\right) \times 1.6605 \times 10^{-27}$ 1 mark

$= 9.2988 \times 10^{-30} \text{ kg}$ 1 mark

$E = mc^2$

$= 9.2988 \times 10^{-30} \times (3.0 \times 10^8)^2$ 1 mark

$= 8.3689 \times 10^{-13} \text{ J}$ 1 mark

$= 5.2306 \times 10^6 \text{ eV}$ 1 mark

Question 13 (5 marks)

a. *Any one of:*

- mass
- spin
- lifetime

1 mark

b. The main difference between a matter particle and its corresponding antimatter particle is the electric charge. 1 mark

The electric charge of a matter particle and its corresponding antimatter particle is the same in magnitude, but opposite in sign. 1 mark

c. When a matter particle and its corresponding antimatter particle collide, a photon is produced. 1 mark

The photon is equivalent to the energy of the two particles, calculated by Einstein's mass–energy equation, $E = mc^2$. 1 mark

Question 14 (4 marks)

a. ${}^{214}_{82}\text{Pb} \rightarrow {}^{214}_{83}\text{Bi} + {}^{0}_{-1}\beta$

2 marks

1 mark for correct reactants and products.
1 mark for nucleons correctly balanced.

b. ${}^{210}_{84}\text{Po} \rightarrow {}^{206}_{82}\text{Pb} + {}^{4}_{2}\alpha$

2 marks

1 mark for correct reactants and products.
1 mark for nucleons correctly balanced.

Question 15 (3 marks)

a. Light from moving galaxies will appear to have different wavelengths and, hence, spectrum, depending on the relative motion of the source and the observer. 1 mark

Observers looking at an approaching galaxy, such as Andromeda, see light that is shifted to a shorter wavelength (a blueshift). 1 mark

b. Blueshift provides evidence that a source of light is moving closer towards the observer. 1 mark

Question 16 (9 marks)

a. 8 days 1 mark

b. $n = 4$ 1 mark

$$\frac{100}{2^4} = 6.25\%$$

$$= 6.3\%$$ 1 mark

c. As radioactive isotopes with relatively short half-lives decay quickly, they allow for a quick diagnosis 1 mark
and decrease the time in which harmful effects could occur. 1 mark

d. **Mass:** Beta-minus radiation is lighter. 1 mark

Charge: Beta-minus radiation has a negative charge, not a positive charge. 1 mark

Penetrating ability: Beta-minus radiation is more penetrating. 1 mark

Ionising ability: Beta-minus radiation is less ionising. 1 mark