Neap

Trial Examination 2021

Suggested solutions

QCE Physics Units 1&2

Paper 2

Copyright © 2021 Neap Education Pty Ltd ABN 43 634 499 791 91a Orrong Cres Caulfield North VIC 3161 Tel: (03) 9639 4318 TEQPhys12_SS_P2_2021

SECTION 1

QUESTION 1 (3 marks)

a) The melting phase of the ice occurs in the period 120–1140 seconds. The total heat added to the ice during this phase is 61.2 kJ, so $Q = 61.2$.

$$Q = mL_{\text{fusion}}$$
$$61.2 = 0.15 \times L_{\text{fusion}} \quad \textit{[1 mark]}$$
$$L_{\text{fusion}} = \frac{61.2}{0.15}$$
$$= 408 \text{ kJ kg}^{-1} \quad \textit{[1 mark]}$$

b) The experiment's latent heat of fusion for water is 408 kJ kg^{-1}. This is greater than the accepted value of latent heat of fusion for water, which is 334 kJ kg^{-1}. There is a difference between the values because heat was lost to the sample's surroundings during the experiment. *[1 mark]*

Note: Responses do not need to reference values to receive marks.

QUESTION 2 (5 marks)

a) $^{227}_{90}\text{Th} \rightarrow {}^{223}_{88}\text{Ra} + {}^{4}_{2}\text{He} + \text{energy}$ *[1 mark]*

$227.0278 = 223.0186 + 4.0026 + \text{energy}$ *[1 mark]*

$227.0278 = 227.0212 + \text{energy}$ *[1 mark]*

$\text{mass defect} = 227.0278 - 227.0212$
$= 0.0066$
$= 0.01 \text{ u}$ *[1 mark]*

b) $1 \text{ u} = 931.6 \text{ MeV}$

$\therefore \text{energy released} = 0.01 \times 931.6$
$= 9.316 \text{ MeV}$ *[1 mark]*

Note: Consequential on answer to Question 2a).

QUESTION 3 (5 marks)

a)

Measured voltage (V)	Measured current (A)	Current (mA)	Resistance (Ω)
0.0	0	0.0	0.00
2.7	0.0010	1.0	2700.00
4.3	0.0016	16.0	**2687.50**
6.0	0.0022	22.0	**2727.27**
7.8	0.0029	29.0	**2689.66**
10.0	0.0037	37.0	**2702.70**

$$V = IR$$
$$4.3 = 0.0016 \times R$$
$$R = \frac{4.3}{0.0016}$$
$$= 2687.50\ \Omega$$

$$V = IR$$
$$6.0 = 0.0022 \times R$$
$$R = \frac{6.0}{0.0022}$$
$$= 2727.27\ \Omega$$

$$V = IR$$
$$7.8 = 0.0029 \times R$$
$$R = \frac{7.8}{0.0029}$$
$$= 2689.66\ \Omega$$

$$V = IR$$
$$10.0 = 0.0037 \times R$$
$$R = \frac{10.0}{0.0037}$$
$$= 2703.70\ \Omega$$

[2 marks]

Note: Award 1 mark only for 2–3 correct values.

b) $$\text{average resistance} = \frac{2700.00 + 2687.50 + 2727.27 + 2689.66 + 2702.70}{5}$$
$$= 2701.43\ \Omega$$

[1 mark]

Note: Consequential on answer to Question 3a).

c) The resistor obeys Ohm's Law. The current flowing through it is directly proportional to the applied voltage. The graph is a straight line passing through the origin. *[1 mark]*

Ohm recognised that the gradient is equal to the inverse of the resistance. For example:

$$R = \frac{I}{V}$$
$$= \frac{0.0037 - 0.0029}{10 - 7.8}$$
$$= \frac{0.0008}{2.2}$$
$$= 0.0003636$$

$$\text{gradient} = \frac{1}{R}$$
$$= \frac{1}{0.0003636}$$
$$= 2750.27\ \Omega$$ *[1 mark]*

QUESTION 4 (8 marks)

a) $F_{\text{net}} = ma$

$0.16 = 0.08 \times a$

$a = \frac{0.16}{0.08}$

$= 2.0\ \text{m s}^{-2}$ north *[1 mark]*

b) $v = u + at$

$= 0 + (2.0 \times 5.0)$ *[1 mark]*

$= 10\ \text{m s}^{-1}$ north *[1 mark]*

Note: Consequential on answer to Question 4a).

c) $s = ut + \frac{1}{2}at^2$

$= 0 + \left(\frac{1}{2} \times 2.0 \times 5.0^2\right)$ *[1 mark]*

$= 25\ \text{m}$ *[1 mark]*

Note: Consequential on answer to Question 4a).

d) $v = u + at$

$0 = 10 + (a \times 3.0)$ *[1 mark]*

$a = \frac{-10}{3}$

$= -3.33\ \text{m s}^{-2}$

$= 3.33\ \text{m s}^{-2}$ south *[1 mark]*

Note: Consequential on answer to Question 4b).

e) $F_{\text{net}} = ma$
$= 0.080 \times -3.33$
$= -0.2664 \text{ N}$
$= 0.27 \text{ N south}$ *[1 mark]*

Note: Consequential on answer to Question 4d).

QUESTION 5 (6 marks)

a) $F_{\text{net}} = F_g$
$= mg$
$= 0.5 \times 9.8$
$= 4.9 \text{ N}$ *[1 mark]*

$F = ma$
$4.9 = (2.5 + 0.5)a$
$a = \frac{4.9}{3}$
$= 1.6333$
$= 1.63 \text{ m s}^{-2}$ *[1 mark]*

b) $v = u + at$
$= 0 + (1.63 \times 0.5)$ *[1 mark]*
$= 0.815$
$= 0.82 \text{ m s}^{-1}$ *[1 mark]*

Note: Consequential on answer to Question 5a).

c) $F_{\text{net}} = ma$
$= F_g - F_f$
$= 4.9 - 4.3$
$= 0.6 \text{ N}$ *[1 mark]*

$a = \frac{F_{\text{net}}}{m}$
$= \frac{0.6}{3.0}$
$= 0.2 \text{ m s}^{-2}$ *[1 mark]*

QUESTION 6 (6 marks)

a) The wavelength, λ, is the distance between two similar points in successive waves of the graph.

Using points (4, 1.5) and (20, 0.5) from the second graph:

$\lambda = 20 - 4$
$= 16 \text{ cm}$ *[1 mark]*

Note: Accept working based on other relevant points from the graph.

b) The period, T, is the time it takes for one cycle of the wave (or one wavelength) to pass through a particular point.

Using the point (10, 1.5) from the first graph, which appears at (20, 1.5) in the second graph:

$$\text{distance} = 20 - 10$$
$$= 10 \text{ cm}$$ *[1 mark]*

Note Accept working based on other relevant points from the graph.

In 0.05 seconds, the point has travelled 10 cm.

The wavelength is 16 cm long, so the point needs to travel an additional 6 cm to complete the wavelength. 10 cm takes 0.05 s to traverse.

$$T = 16 \times \frac{0.05}{10}$$
$$= 0.08 \text{ seconds}$$ *[1 mark]*

Note: Consequential on answer to Question 6a).

c) $$f = \frac{1}{T}$$
$$= \frac{1}{0.08}$$
$$= 12.5 \text{ Hz}$$ [1 mark]

Note: Consequential on answer to Question 6b).

d) The amplitude of a wave is the maximum displacement of a particle from the average position (0).

Reading from the graphs, the amplitude of the wave is 1.5 cm. *[1 mark]*

e) $$v = f\lambda$$
$$= 12.5 \times 16$$
$$= 200 \text{ cm s}^{-1}$$ *[1 mark]*

Note: Consequential on answers to Questions 6a) and 6c).

QUESTION 7 (8 marks)

a) The ray of light travels from the fibre toward the cladding. The critical angle is the angle of incidence where the angle of refraction will be 90° and total reflection occurs.

$n_1 = 1.50$

$n_2 = 1.40$

angle of reflection, $r = 90^\circ$

$$\frac{\sin c}{\sin r} = \frac{n_2}{n_1}$$

$$\frac{\sin c}{\sin 90^\circ} = \frac{1.40}{1.50}$$

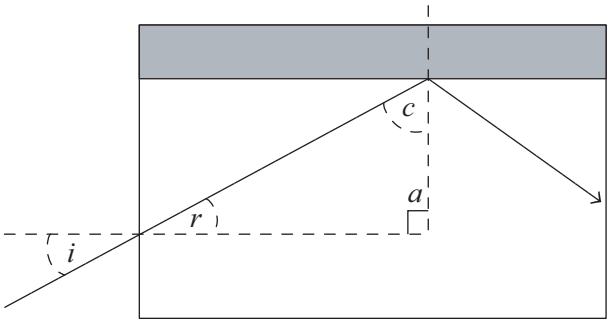
$\sin 90^\circ = 1$ *[1 mark]*

$\therefore \sin c = \frac{1.40}{1.50}$ *[1 mark]*

$\sin c = 0.9333$

$c = 68.96^\circ$ *[1 mark]*

b) The value of r can be deduced by creating a right-angled triangle, per the following diagram.



As the sum of a triangle's interior angles is 180°, r can be deduced through subtraction.

$$a + c + r = 180$$
$$90 + 68.96 + r = 180$$
$$r = 180 - 90 - 68.96$$
$$= 21.04°$$

The angle i is the angle at which the ray of light travelled from air ($n = 1.00$) to the fibre ($n = 1.50$).

$n_1 = 1.00$

$n_2 = 1.50$

$r = 21.04°$ *[1 mark]*

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1}$$ *[1 mark]*

$$\frac{\sin i}{\sin 21.04°} = \frac{1.5}{1.0}$$

$$\sin i = 1.5 \times \sin 21.04°$$ *[1 mark]*

$$\sin i = 0.5385$$ *[1 mark]*

$$i = 32.584°$$
$$= 32.6°$$ *[1 mark]*

Note: Consequential on answer to Question 7a).

QUESTION 8 (4 marks)

a) $$a = \frac{2d}{t^2}$$
$$= \frac{2 \times 0.98}{0.86^2}$$ *[1 mark]*
$$= 2.65 \text{ m s}^{-2}$$ *[1 mark]*

b) $$\text{percentage error (\%)} = \left| \frac{\text{measured value} - \text{true value}}{\text{true value}} \right| \times 100$$
$$= \frac{0.3796 - 0.36179}{0.36179} \times 100$$ *[1 mark]*
$$= 4.9227\%$$
$$= 4.92\%$$ *[1 mark]*

