Neap

Trial Examination 2022

Suggested Solutions

QCE Physics Units 1&2

Paper 2

Copyright © 2022 Neap Education Pty Ltd ABN 43 634 499 791 91a Orrong Cres Caulfield North VIC 3161 Tel: (03) 9639 4318 TEQPhys12_SS_P2_2022

SECTION 1

QUESTION 1 (4 marks)

a) 2.3 m s^{-1}

[1 mark]
1 mark for providing the correct answer.
Note: Accept answers between 2.2 and 2.4.

b) $f = \dfrac{1}{T}$

$= \dfrac{1}{2.3 \times 10^{-3}}$

$= 435 \text{ Hz}$

[1 mark]
1 mark for providing the correct answer.
Note: Accept follow-through errors from part a).

c) $v = f\lambda$

$\lambda = \dfrac{v}{f}$

$= \dfrac{346}{435}$

$= 0.7958 \text{ m}$

$= 80 \text{ cm}$

[2 marks]
1 mark for using the formula $\lambda = \dfrac{v}{f}$.
Note: This mark may be implied by subsequent working. It is not required to state the formula.

1 mark for providing the correct answer.

Note: Accept follow-through errors from parts a) and b).

QUESTION 2 (6 marks)

a) 4 m s^{-1}

[1 mark]
1 mark for reading the correct answer from the graph.

b) at 4 seconds and 10 seconds (where the graph crosses the *x*-axis)

[1 mark]
1 mark for stating both 4 seconds and 10 seconds.

c) displacement = area under graph

$= \dfrac{b_1 h_1}{2} - \dfrac{b_2 h_2}{2}$

$= \dfrac{2 \times 8}{2} - \dfrac{1 \times 4}{2}$

$= 6 \text{ m}$

[2 marks]
1 mark for using the area under the graph to determine the displacement.
1 mark for providing the correct answer.

d) The maximum acceleration occurs when the positive slope is greatest; that is, between 0 and 2 seconds. Finding the gradient of this part of the slope gives:

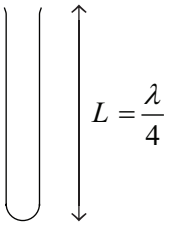
$$\text{gradient} = \frac{8-2}{2}$$
$$= 3 \text{ m s}^{-2}$$

[2 marks]
1 mark for using the most positive gradient to determine the maximum acceleration.
1 mark for providing the correct answer.

QUESTION 3 (4 marks)

a) $v = f\lambda$

$$\lambda = \frac{v}{f}$$
$$= \frac{346}{481}$$
$$= 0.719 \text{ m}$$
$$= 72 \text{ cm}$$



$$L = \frac{\lambda}{4}$$
$$= \frac{0.719}{4}$$
$$= 18 \text{ cm}$$

[4 marks]
1 mark for using $v = f\lambda$.
Note: This mark may be implied by subsequent working.
It is not required to state the formula.
1 mark for finding the wavelength.
1 mark for showing that L is a quarter wavelength using a formula or diagram.
1 mark for providing the correct answer.
Note: Accept follow-through errors.

QUESTION 4 (7 marks)

a) The law of conservation of energy states that energy can be neither created nor destroyed.

Some of the car's gravitational potential energy at point A will be transformed to kinetic energy at point B as the rollercoaster car accelerates down the track.

[2 marks]
1 mark for stating the law of conservation of energy.
1 mark for identifying the transformation between gravitational potential energy and kinetic energy.

b) $$E_A = \frac{1}{2}mv^2 + mgh$$
$$= \frac{1}{2} \times 250 \times 1.2^2 + 250 \times 9.8 \times 12.5$$
$$= 30\,805 \text{ J}$$
$$= 30.8 \text{ kJ}$$

[2 marks]
1 mark for adding the gravitational potential energy and kinetic energy.
1 mark for providing the correct answer.

c) $$E_B = E_A$$
$$\frac{1}{2}mv_B^2 + mgh_B = E_A$$
$$\frac{1}{2} \times 250 \times v_B^2 + 250 \times 9.8 \times 1 = 30\,805$$
$$v_B = 15.1 \text{ m s}^{-1}$$

[3 marks]
1 mark for using the law of conservation of energy.
1 mark for substituting into $E_B = E_A$.
1 mark for providing the correct answer.
Note: Accept follow-through errors from part b).

QUESTION 5 (7 marks)

a) Nuclear fission is a nuclear reaction in which a large nucleus splits into smaller nuclei.

[1 mark]
1 mark for providing the correct definition.

b) The fission of each uranium-233 atom is triggered by a neutron.

Because three neutrons are produced in the reaction, each of the three neutrons trigger three more fission reactions, which each release three more neutrons, and so on. This causes a chain reaction that sustains the release of energy for the reactor.

[2 marks]
1 mark for stating that nuclear fission is triggered by a neutron.
1 mark for explaining the chain reaction that occurs due to the release of neutrons.

c) $\Delta m = 233.039634 + 1.008664 - 136.911557 - 93.915355 - 3(1.008664)$

$= 0.195394 \text{ amu}$

$= 0.195394 \times 1.66 \times 10^{-27}$

$= 3.24 \times 10^{-28} \text{ kg}$

$\Delta E = \Delta m c^2$

$= 3.24 \times 10^{-28} \times \left(3 \times 10^8\right)^2$

$= 2.92 \times 10^{-11} \text{ J}$

[4 marks]
1 mark for finding Δm in amu.
1 mark for converting the mass to kg.
1 mark for converting Δm to energy.
1 mark for providing the correct answer.

QUESTION 6 (3 marks)

When light passes from a less dense to a more dense medium, it slows slightly and, therefore, refracts slightly towards the normal.

White light consists of light from all visible wavelengths.

Each colour has a different wavelength that slows by a slightly different amount, so each colour refracts at a slightly different angle. This splits the white light into its different colours.

[3 marks]
1 mark for describing the refraction of light due to changing medium.
1 mark for stating that white light contains all colours.
1 mark for stating that colours of different wavelengths refract at different angles.

QUESTION 7 (5 marks)

a) Momentum is conserved when there is no net external force acting on the 'system'.

[1 mark]
1 mark for stating the condition for the law of conservation of momentum.

b) $p_{\text{before}} = p_{\text{after}}$

$m_1 v_1 + m_2 v_2 = \left(m_1 + m_2\right) v_{\text{final}}$

$20\,500 \times 1.46 + 33\,600 v_2 = (20\,500 + 33\,600) \times 0.28$

$v_2 = 0.4399 \text{ m s}^{-1}$

Carriage 2 had a velocity of 0.44 m s^{-1} to the left before the collision.

[4 marks]
1 mark for using conservation of momentum before and after the collision.
1 mark for substituting into the formula.
1 mark for providing the correct magnitude.
1 mark for providing the correct direction.

QUESTION 8 (4 marks)

a) impulse = area under graph

$$= \frac{b_1 h_1}{2} + b_2 h_2$$
$$= \frac{2 \times 11}{2} + 8 \times 5$$
$$= 51 \text{ N s}$$

[2 marks]
1 mark for using the area under the graph to determine the total impulse.
1 mark for providing the correct answer.

b) impulse = change in momentum

$$51 = m(v_f - v_i)$$
$$51 = 1.23 \times v_f$$
$$v_f = 42 \text{ m s}^{-1}$$

[2 marks]
1 mark for equating the impulse to the change in momentum.
1 mark for providing the correct answer.
Note: Accept follow-through errors from part a).

QUESTION 9 (5 marks)

a) Kirchhoff's current law states that the sum of currents entering a node is equal to the sum of the currents leaving the node.

[1 mark]
1 mark for stating Kirchoff's current law.

b) $I_{\text{lamp}} = A_1 - A_2$
$= 2.2 - 1.0$
$= 1.2 \text{ A}$

[2 marks]
1 mark for using Kirchoff's current law.
1 mark for providing the correct answer.

c) $R = \frac{V}{I}$
$= \frac{3}{1.2}$
$= 2.5 \ \Omega$

[2 marks]
1 mark for using Ohm's Law on the lamp.
1 mark for providing the correct answer.
Note: Accept follow-through errors from part b).

