

Trial Examination 2022

VCE Physics Unit 2

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 A

$$\Delta v = \begin{array}{c} \uparrow \\ 10 \text{ m s}^{-1} \end{array} - \begin{array}{c} \longrightarrow \\ 20 \text{ m s}^{-1} \end{array}$$

$$= \begin{array}{c} \uparrow \\ 10 \text{ m s}^{-1} \end{array} + \begin{array}{c} \longleftarrow \\ 20 \text{ m s}^{-1} \end{array}$$

$$= \begin{array}{c} \begin{array}{c} \longleftarrow 20 \text{ m s}^{-1} \\ \nwarrow \\ 10 \text{ m s}^{-1} \end{array} \end{array}$$

$$\Delta v = v - u$$

$$= \sqrt{10^2 + 20^2}$$

$$= 22 \text{ m s}^{-1}$$

$$\tan \theta = \frac{20}{10}$$

$$\theta = 63^\circ$$

Therefore, the car's change in velocity is 22 m s^{-1} N 63° W.

Question 2 B

$$v_{\text{average}} = \frac{\text{total displacement}}{\text{total time}}$$

$$= \frac{\left(\left(\frac{1}{2} \times 3.0 \times 6.0 \right) + (4.0 \times 6.0) + \left(\frac{1}{2} \times 3.0 \times 6.0 \right) - \left(\frac{1}{2} \times 2.0 \times 5.0 \right) \right)}{15.0}$$

$$= 2.4666$$

$$\approx 2.5 \text{ m s}^{-1}$$

Question 3 A

$$u = \frac{144}{3.6}$$

$$= 40 \text{ m s}^{-1}$$

$$v = \frac{252}{3.6}$$

$$= 70 \text{ m s}^{-1}$$

$$t = 10 \text{ s}$$

$$v = u + at$$

$$70 = 40 + 10a$$

$$a = 3 \text{ m s}^{-2}$$

Question 4 D

$$F_W = mg$$

$$= 80.0 \times 9.8$$

$$= 784 \text{ N}$$

Question 5 C

Taking up as positive gives:

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

$$N - W = ma$$

$$N = ms + W$$

$$N > W$$

Therefore, the force exerted by the floor of the elevator on Sung-Hoon is more than Sung-Hoon's weight.

Question 6 D

The work done on an object is equal to the area under an s versus F graph representing its movement.

$$\begin{aligned} \text{work done} &= (0.150 \times 80.0) + \left(\frac{1}{2} \times 0.05 \times 80.0 \right) \\ &= 140 \text{ J} \end{aligned}$$

$$\Delta E_k = \text{work done} = 140 \text{ J}$$

$$\frac{1}{2} \times 5.0 \times v^2 - \frac{1}{2} \times 5.0 \times 10.0^2 = 140$$

$$2.5v^2 = 390$$

$$v = \sqrt{\frac{390}{2.5}}$$

$$= 12.5 \text{ m s}^{-1}$$

Question 7 B

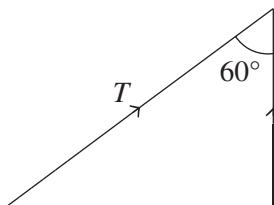
$$P = F \times v$$

$$v = \frac{230}{3.6}$$

$$= 100 \text{ m s}^{-1}$$

$$P = 2500 \times 100$$

$$= 2.5 \times 10^5 \text{ W}$$

Question 8 B

$$F_{\text{up}} \text{ for one wire} = \frac{10.0 \times 9.8}{2}$$

$$\cos 60 = \frac{\left(\frac{10.0 \times 9.8}{2} \right)}{T}$$

$$T = 98.0 \text{ N}$$

Question 9 C

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

$$12 = 6.0 \times a$$

$$a = 2.0 \text{ m s}^{-2}$$

$$\Sigma \text{ forces}_{\text{horizontally on B}} = m_B \times a$$

$$12 - F_{\text{A on B}} = 1.0 \times 2.0$$

$$F_{\text{A on B}} = 10 \text{ N}$$

Question 10 B

B is correct. An independent variable is the variable varied by the experimenter and it is assumed to directly affect the dependent variable.

A is incorrect. This option would not be relevant to the investigation.

C is incorrect. This option refers to a controlled variable.

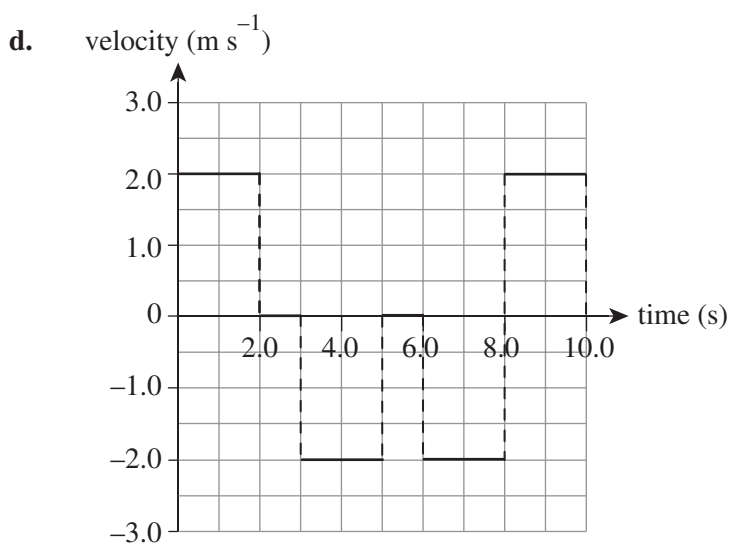
D is incorrect. This option refers to the dependent variable.

SECTION B**Question 1** (9 marks)

a. displacement = $4.0 + 4.0 + 4.0 + 4.0$ 1 mark
 = 16.0 m 1 mark

b. Reading from the graph gives:
 2.0 to 3.0 seconds 1 mark
 5.0 to 6.0 seconds 1 mark

c. Reading from the graph gives:
 3.0 to 5.0 seconds 1 mark
 8.0 to 10.0 seconds 1 mark



3 marks

*1 mark for providing the correct scales.**1 mark for showing the correct plotted points.**1 mark for sketching the correct shape of the graph.***Question 2** (4 marks)

a. $s = ut + \frac{1}{2}at^2$
 $50.0 = 0 + \frac{1}{2}9.8t^2$ 1 mark
 $t = 3.2 \text{ s}$ 1 mark

b. $v^2 = u^2 + 2as$
 $= 0.0^2 + 2 \times 9.8 \times 50.0$ 1 mark
 $v = 31.3 \text{ m s}^{-1}$ 1 mark

Question 3 (6 marks)

$$F_{\text{net (vertical)}} = 12.0 \text{ N north} \quad 1 \text{ mark}$$

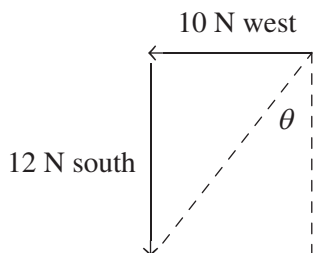
$$F_{\text{net (horizontal)}} = 10.0 \text{ N west} \quad 1 \text{ mark}$$

$$F_{\text{net}} = \sqrt{(12.0)^2 + (10.0)^2} \quad 1 \text{ mark}$$

$$= 15.6 \text{ N} \quad 1 \text{ mark}$$

$$\tan \theta = \frac{10.0}{12.0} \quad 1 \text{ mark}$$

$$\theta = 39.8^\circ$$



$$\text{S}39.8^\circ\text{W} \quad 1 \text{ mark}$$

Question 4 (5 marks)

- a. Let to the right be positive for velocity.

$$m_1 u_1 + m_2 u_2 = m_1 v_1 + m_2 v_2$$

$$3.0 \times 4.0 + 10 \times -2.5 = 3.0 \times 1.0 + 1.0 v \quad 1 \text{ mark}$$

$$v = 6.5 \text{ m s}^{-1} \quad 1 \text{ mark}$$

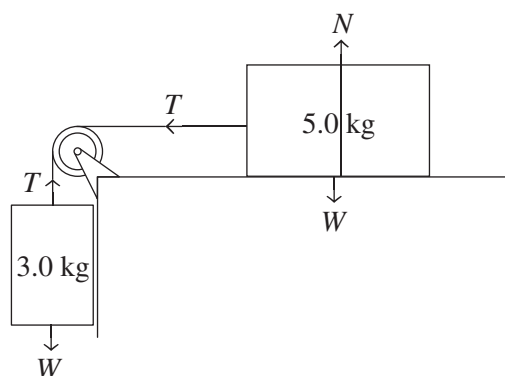
$$\text{b. } F_{\text{by cart B on cart A}} = \frac{mv - mu}{t}$$

$$= \frac{3.0 \times 1.0 - 3.0 \times 4.0}{0.05}$$

$$= -180 \text{ N} \quad 1 \text{ mark}$$

$$\text{magnitude of } F_{\text{by cart B on cart A}} = 180 \text{ N} \quad 1 \text{ mark}$$

$$\text{direction} = \text{left} \quad 1 \text{ mark}$$

Question 5 (10 marks)**a.**

4 marks

*1 mark for showing F_W for both masses.**1 mark for showing F_N on the 5.0 kg mass.**1 mark for showing F_T on the 5.0 kg mass with the correct direction.**1 mark for showing F_T on the 3.0 kg mass with the correct direction.***b.** Finding the acceleration of the 5.0 kg box gives:

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

$$T = 5a$$

1 mark

Finding the acceleration of the 3.0 kg box gives:

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

$$W - T = 3a$$

1 mark

$$3 \times 9.8 - T = 3a$$

$$29.4 - 5a = 3a$$

1 mark

$$a = 3.7 \text{ m s}^{-2}$$

1 mark

c. $u = 0.0$, $s = 1.0 \text{ m}$, $a = 3.7$, $t = ?$

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

$$1.0 = 0 + \frac{1}{2} \times 3.7t^2$$

1 mark

$$t = 0.74 \text{ s}$$

1 mark

*Note: Consequential on answer to **Question 5b**.*

Question 6 (9 marks)

- a. $\Delta p = m(v - u)$
 $= 0.06(-35 - 25)$ 1 mark
 $= -3.6$ 1 mark

kg m s⁻¹ **OR** N s

1 mark

Note: The negative sign is not required for full marks.

- b. $I = \Delta p$
 3.6 N s 1 mark
 direction = left 1 mark

Note: Consequential on answer to Question 6a.

- c. 3.6 N s 1 mark
 direction = right 1 mark

Note: Consequential on answer to Question 6a.

- d. The tennis player could increase the speed of the racquet to the left so that the relative speed between the racquet head and the ball is greater than 25 m s⁻¹. 1 mark
 This is equivalent to increasing the force of impact. 1 mark

Question 7 (2 marks)

- a. The normal force and the force due to gravity act on the same body (the textbook). 1 mark
 b. force of the textbook on the bench 1 mark

Question 8 (8 marks)

- a. $E_K = \frac{1}{2}mv^2$
 $= \frac{1}{2} \times 1000.0 \times 5.00^2$ 1 mark
 $= 1.25 \times 10^4 \text{ J}$ 1 mark

- b. $E_X = E_Y$
 $1.25 \times 10^4 + 1000.0 \times 9.8 \times 10.0 = \frac{1}{2} \times 1000 \times v^2$
 $v = 14.9 \text{ m s}^{-1}$ 1 mark

1 mark for LHS substitution.

1 mark for RHS substitution.

Note: Consequential on answer to Question 8a.

- c. $E_X = E_Z$
 $1.11 \times 10^5 = 1000 \times 9.8 \times h$
 $h = 11.3 \text{ m}$ 1 mark

1 mark for LHS substitution.

1 mark for RHS substitution.

Question 9 (6 marks)

- a. $E_K = \frac{1}{2}mv^2$
 $2.0 = \frac{1}{2} \times 1.0 \times v^2$ 1 mark
 $v = 2.0 \text{ m s}^{-1}$ 1 mark
- b. work done $= \Delta E_K$
 $= 2.0 \text{ J}$ 1 mark
- c. $U_s = 2.0 \text{ J}$ 1 mark
 $= \frac{1}{2}kx^2$
 $2.0 = \frac{1}{2} \times k \times (0.1)^2$ 1 mark
 $k = 400.0 \text{ or } 4.0 \times 10^2 \text{ N m}^{-1}$ 1 mark

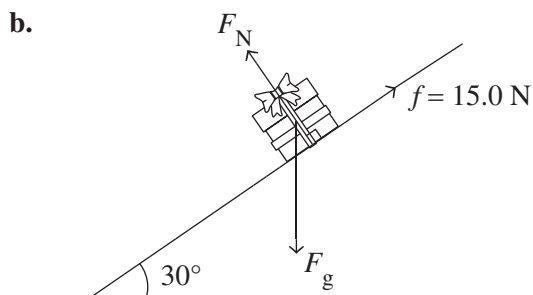
Question 10 (5 marks)

- a. $\tau_{\text{clockwise}} = \tau_{\text{anticlockwise}}$
 $F \times 0.800 = 10.0 \times 9.8 \times 0.200$ 1 mark
 $F = 24.5 \text{ N}$ 1 mark
- b. Taking up as positive gives:
 $\Sigma F_{\text{vertical}} = 0$
 $F + 10.0 \times 9.8 - F_R = 0$ 1 mark
 $F_R = 123 \text{ N}$ 1 mark
direction = up 1 mark

Note: Consequential on answer to Question 10a.

Question 11 (6 marks)

- a. $F_{\text{net}} = 0 \text{ N}$
 $F_{\text{down the plane}} - f = 0$ 1 mark
 $F_{\text{down the plane}} = mg \sin \theta$
 $15.0 = m \times 9.8 \sin 30$ 1 mark
 $m = 3.1 \text{ kg}$ 1 mark



1 mark

Note: The normal force must be drawn perpendicular to the plane and upwards.

c. $N = mg \cos \theta$

$$= 3.1 \times 9.8 \cos 30$$

$$= 26 \text{ N}$$

1 mark

1 mark

Note: Consequential on answer to Question 11a.

Question 12 (10 marks)

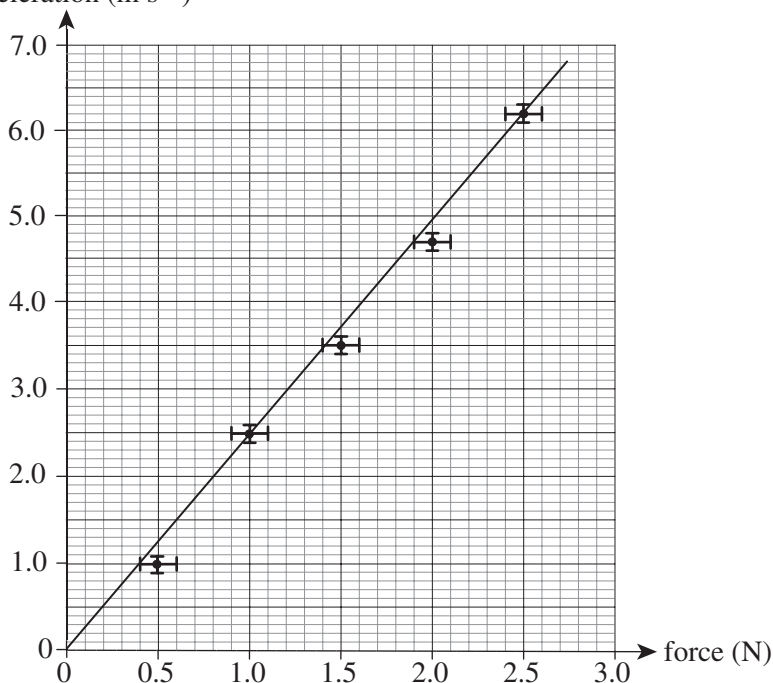
a.

Classification	Variable
independent	force applied
dependent	acceleration
controlled	mass of the glider

3 marks

1 mark for providing each correct variable.

b. acceleration (m s^{-1})



5 marks

1 mark for using the correct axes labels.

1 mark for using correct scales. (At least half of the provided grid must be used.)

1 mark for showing the correct plotted points.

1 mark for showing the correct line of best fit.

1 mark for showing the correct uncertainty bars.

c. $\text{gradient} = \frac{6.2}{2.5}$

$$= 2.48$$

1 mark

$$\text{mass} = \frac{1}{\text{gradient}}$$

$$= \frac{1}{2.48}$$

$$= 0.40 \text{ kg}$$

1 mark

Note: Consequential on answer to Question 12b.