Neap

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

$\Delta v =$ $\uparrow 10 \text{ m s}^{-1}$ $-$ $\rightarrow 20 \text{ m s}^{-1}$

$=$ $\uparrow 10 \text{ m s}^{-1}$ $+$ $\leftarrow 20 \text{ m s}^{-1}$

$=$ 20 m s^{-1} $\leftarrow$, $\uparrow 10 \text{ m s}^{-1}$

$\Delta v = v - u$

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

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

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

$\theta = 63°$

Therefore, the car's change in velocity is 22 m s^{-1} N63°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

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

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

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

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

$t = 10 \text{ s}$

$v = u + at$

$70 = 40 + 10a$

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

Question 4 D

$F_{\text{W}} = mg$

$= 80.0 \times 9.8$

$= 784 \text{ N}$

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

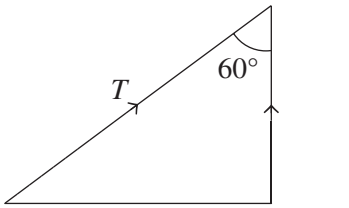
The work done on an object is equal to the area under an *s* versus *F* graph representing its movement.

$$\text{work done} = \left(0.150 \times 80.0\right) + \left(\frac{1}{2} \times 0.05 \times 80.0\right)$$
$$= 140 \text{ J}$$
$$\Delta E_k = \text{work done} = 140 \text{ J}$$
$$\frac{1}{2} \times 5.0 \times v^2 - \frac{1}{2} \times 5.0 \times 10.0^2 = 140$$
$$2.5v^2 = 390$$
$$v = \sqrt{\frac{390}{2.5}}$$
$$= 12.5 \text{ m s}^{-1}$$

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

$$F_{\text{net}} = ma$$
$$12 = 6.0 \times a$$
$$a = 2.0 \text{ m s}^{-2}$$
$$\sum \text{forces}_{\text{horizontally on B}} = m_B \times a$$
$$12 - F_{\text{A on B}} = 1.0 \times 2.0$$
$$F_{\text{A on B}} = 10 \text{ N}$$

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. $\text{displacement} = 4.0 + 4.0 + 4.0 + 4.0$ 1 mark

$= 16.0 \text{ m}$ 1 mark

b. Reading from the graph gives:

2.0 to 3.0 seconds 1 mark

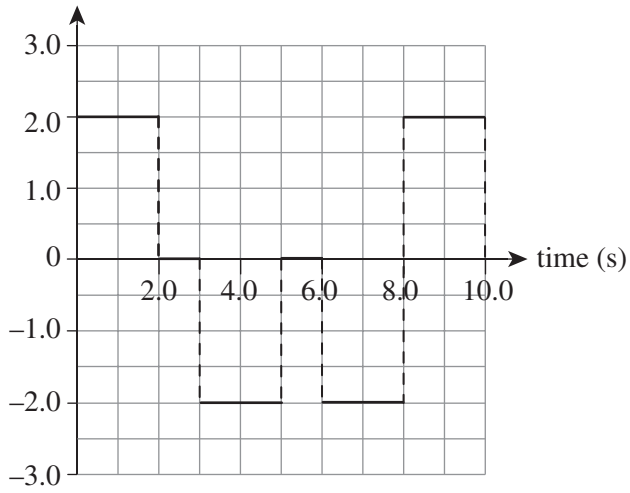
5.0 to 6.0 seconds 1 mark

c. Reading from the graph gives:

3.0 to 5.0 seconds 1 mark

8.0 to 10.0 seconds 1 mark

d. velocity (m s^{-1})



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)

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

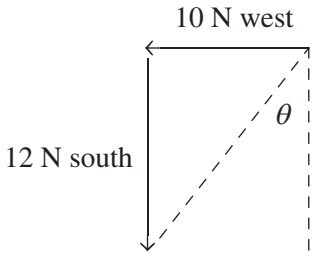
$F_{\text{net (horizontal)}} = 10.0 \text{ N west}$ 1 mark

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

$= 15.6 \text{ N}$ 1 mark

$\tan\theta = \dfrac{10.0}{12.0}$ 1 mark

$\theta = 39.8°$



S39.8°W 1 mark

Question 4 (5 marks)

a. Let to the right be positive for velocity.

$m_1\boldsymbol{u}_1 + m_2\boldsymbol{u}_2 = m_1\boldsymbol{v}_1 + m_2\boldsymbol{v}_2$

$3.0 \times 4.0 + 10 \times -2.5 = 3.0 \times 1.0 + 1.0v$ 1 mark

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

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

$= \dfrac{3.0 \times 1.0 - 3.0 \times 4.0}{0.05}$ 1 mark

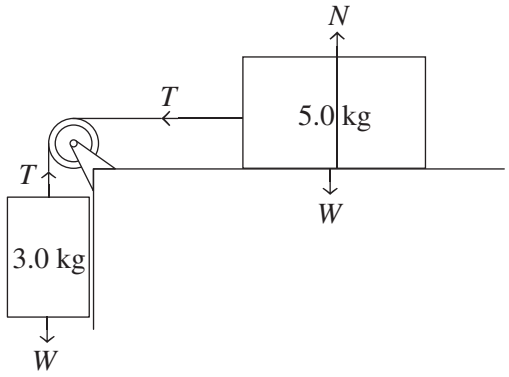
$= -180 \text{ N}$

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

direction = left 1 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. $u = 0.0$, $s = 1.0$ m, $a = 3.7$, $t = ?$

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

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

$t = 0.74$ 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

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

kg m s^{-1} **OR** N s 1 mark

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

$= 1.25 \times 10^4$ J 1 mark

b. $E_X = E_Y$

$1.25 \times 10^4 + 1000.0 \times 9.8 \times 10.0 = \frac{1}{2} \times 1000 \times v^2$

1 mark for LHS substitution.
1 mark for RHS substitution.

$v = 14.9$ m s^{-1} 1 mark

*Note: Consequential on answer to **Question 8a.***

c. $E_X = E_Z$

$1.11 \times 10^5 = 1000 \times 9.8 \times h$

1 mark for LHS substitution.
1 mark for RHS substitution.

$h = 11.3$ m 1 mark

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:

$\Sigma F_{\text{vertical}} = 0$

$F + 10.0 \times 9.8 - F_{\text{R}} = 0$ 1 mark

$F_{\text{R}} = 123 \text{ N}$ 1 mark

direction = up 1 mark

*Note: Consequential on answer to **Question 10a.***

Question 11 (6 marks)

a. $F_{\text{net}} = 0 \text{ N}$

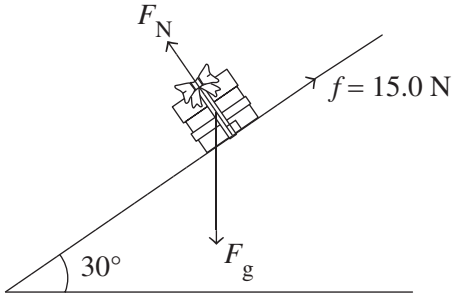
$F_{\text{down the plane}} - f = 0$ 1 mark

$F_{\text{down the plane}} = mg \sin\theta$

$15.0 = m \times 9.8 \sin 30$ 1 mark

$m = 3.1 \text{ kg}$ 1 mark

b.



1 mark

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

c. $N = mg\cos\theta$

$= 3.1 \times 9.8 \cos 30$ 1 mark

$= 26$ N 1 mark

*Note: Consequential on answer to **Question 11a.***

Question 12 (10 marks)

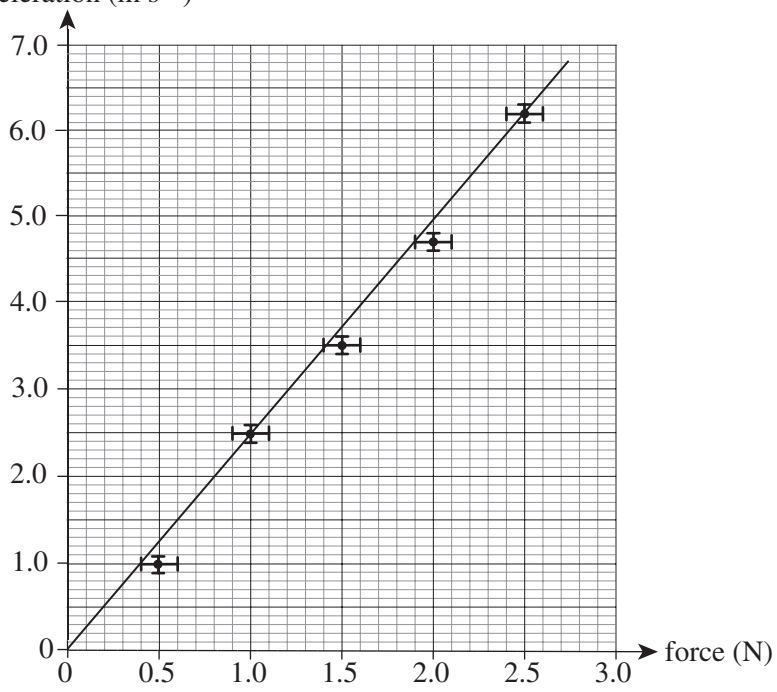
a.

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

3 marks

1 mark for providing each correct variable.

b.



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. $\text{gradient} = \dfrac{6.2}{2.5}$

$= 2.48$ 1 mark

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

$= \dfrac{1}{2.48}$

$= 0.40$ kg 1 mark

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