

Trial Examination 2020

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 B

Displacement is the shortest distance from an initial position to a final position (in this case, the distance from point X to point Z). Therefore, displacement is 9.0 km.

Question 2 C

Taking right as positive:

$$u = 2.0$$

$$v = -4.0$$

$$t = 2.0$$

$$a = ?$$

$$v = u + at$$

$$-4.0 = 2.0 + 2.0a$$

$$a = -3.0 \text{ m s}^{-2}$$

The acceleration is 3.0 m s^{-2} to the left.

Question 3 C

time to top:

$$v = u + at$$

$$0.0 = 9.8 - 9.8t$$

$$t = 1.0 \text{ s}$$

distance to top:

$$v^2 = u^2 + 2as$$

$$0 = 9.8^2 + 19.8s$$

$$s = 4.9 \text{ m}$$

time to bottom:

$$(9.8 + 4.9) = 0 + 4.9t^2$$

$$t = 1.7 \text{ s}$$

total time of flight:

$$t = 1.0 + 1.7$$

$$= 2.7 \text{ s}$$

Question 4 B

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

$$W - f = 0$$

$$f = 60 \times 9.8$$

$$= 588 \text{ N}$$

Question 5 D

In this graph of velocity versus time, the gradient is constant; $F_{\text{net}} = ma$, so F_{net} is constant.

Question 6 B

$$E_k = \frac{1}{2} \times 0.0459 \times (70.0)^2 = 112 \text{ J}$$

Question 7 B

loss in gravitational potential energy = gain in kinetic energy

$$m \times 9.8 \times 15.2 : m \times 9.8 \times (76.0 - 15.2)$$

$$15.0 : 60.8$$

$$1 : 4$$

Question 8 B

$$\tau_{\text{anticlockwise}} = \tau_{\text{clockwise}}$$

$$40.0 \times 9.8 \times 0.5 = 5.0 \times 9.8 \times 0.25 + F_{\text{Hannah}} \times 1.0$$

$$F_{\text{Hannah}} = 184 \text{ N m}$$

Question 9 C

$$F_{\text{one wire}} = \frac{10 \times 9.8}{2 \cos 30}$$

$$= 57 \text{ N}$$

Question 10 A

The scenario in **A** is not accurate as the darts are far from the true value (the bullseye), but it is precise as the darts are close together.

SECTION B**Question 1** (15 marks)

a. 10.0 m s^{-1} 1 mark

The direction is East. 1 mark

b. $a = \frac{40.0}{4.0}$ 1 mark

$= 10.0 \text{ m s}^{-2}$ 1 mark

The direction is West. 1 mark

c. distance = $\frac{1}{2} \times 6.0 \times 20.0 + 4.0 \times 20.0 + \frac{1}{2} \times 2.0 \times 20.0 +$ 1 mark

$\frac{1}{2} \times 2.0 \times 20.0 + 6.0 \times 20.0 + \frac{1}{2} \times 4.0 \times 20$ 1 mark

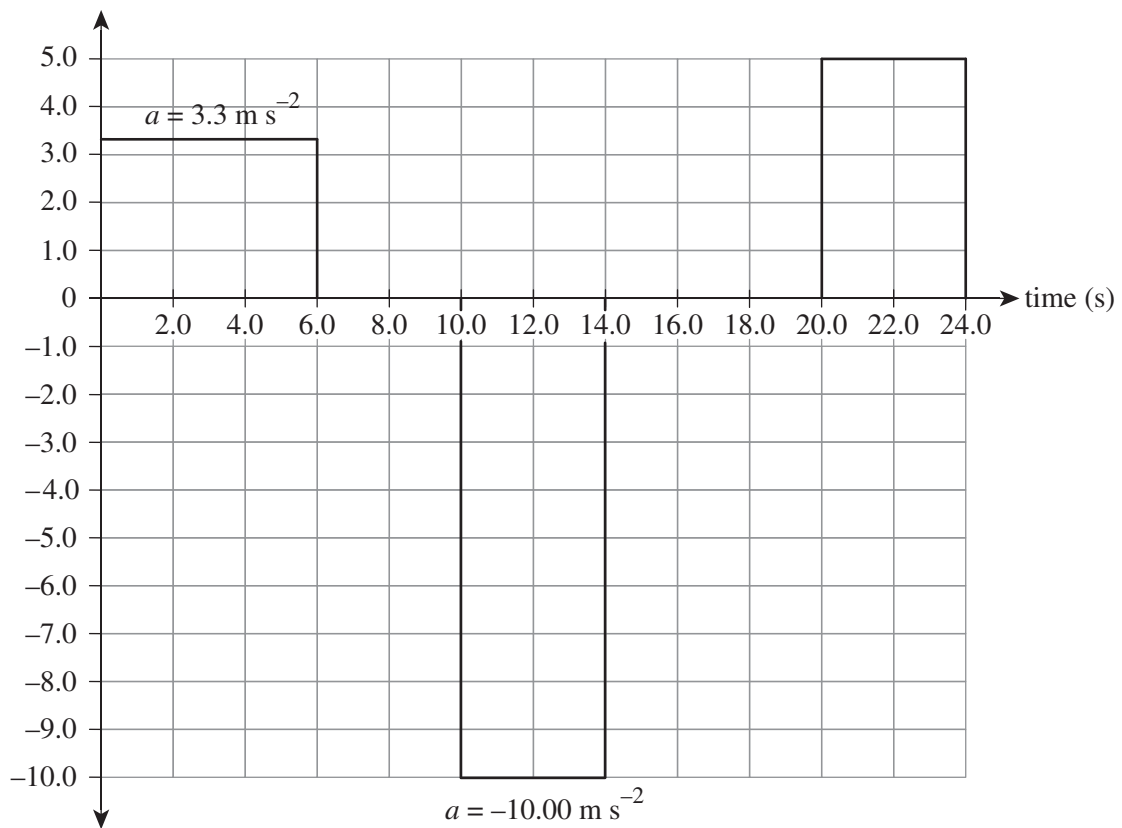
$= 340 \text{ m}$ 1 mark

NA 1 mark

d. displacement = $\left(\frac{1}{2} \times 6.0 \times 20.0 + 4.0 \times 20.0 + \frac{1}{2} \times 2.0 \times 20.0\right) -$
 $\left(\frac{1}{2} \times 2.0 \times 20.0 + 6.0 \times 20.0 + \frac{1}{2} \times 4.0 \times 20.0\right)$ 1 mark

$= 20 \text{ m}$ 1 mark

e. acceleration (m s^{-2})



4 marks

1 mark for correct scale.

1 mark for correct shape.

1 mark for acceleration = 3.3 m s^{-2} East.

1 mark for acceleration = 10.0 m s^{-2} West.

Question 2 (5 marks)

a. $v = u + at$

$$= 0 + 3.0 \times 6.0$$

1 mark

$$= 18.0 \text{ m s}^{-1}$$

1 mark

- b. distance in 4.0 s:

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

$$= 0 + \frac{1}{2} \times 3.0 \times (4.0)^2$$

$$= 24.0 \text{ m}$$

1 mark

- distance in 5.0 s:

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

$$= 0 + \frac{1}{2} \times 3.0 \times (5.0)^2$$

$$= 37.5 \text{ m}$$

1 mark

- distance in fifth second:

$$s = 37.5 - 24.0$$

$$= 13.5 \text{ m}$$

1 mark

Question 3 (3 marks)

a. $\text{speed} = \frac{180}{3.6}$

$$= 50 \text{ m s}^{-1}$$

1 mark

b. $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$$0.18 \times 50 + 0 = (0.18 + 0.10)v$$

1 mark

$$v = 32 \text{ m s}^{-1}$$

1 mark

Note: Consequential on answer to Question 3a.

Question 4 (5 marks)

- a. impulse = area under the curve

There are approximately 53 to 55 squares.

1 mark

impulse = 54 × value of one square

$$= 54 \times 2.5 \times 10^{-3} \times 25.0$$

1 mark

$$= 3.4 \text{ N s}$$

1 mark

- b. impulse = change in momentum

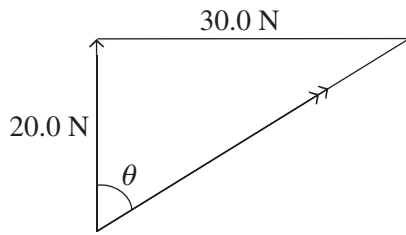
$$0.06v = 3.4$$

1 mark

$$v = 56 \text{ m s}^{-1}$$

1 mark

Note: Consequential on answer to Question 4a.

Question 5 (4 marks)**a.**

1 mark

b.

$$F_{\text{net}} = \sqrt{20.0^2 + 30.0^2}$$

1 mark

$$F_{\text{net}} = 36.1 \text{ N}$$

1 mark

$$\tan \theta = \frac{30.0}{20.0}$$

$$= 56^\circ$$

The direction is N56°E.

1 mark

*Note: Consequential on answer to Question 5a.***Question 6 (6 marks)**

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

$$300 = 60a$$

1 mark

$$a = 5 \text{ m s}^{-2}$$

1 mark

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

$$F_{\text{A on B}} = 40 \times 5$$

1 mark

$$= 200 \text{ N}$$

1 mark

Note: Consequential on answer to Question 6a.

c. $F_{\text{B on A}} = 200 \text{ N}$

1 mark

The direction is to the left.

1 mark

*Note: Consequential on answer to Question 6b.***Question 7 (5 marks)**

a. $F_N = ma$

$$T - 4.0 \times 9.8 = 4.0a$$

$$5.0 \times 9.8 - T = 5.0a$$

$$5.0 \times 9.8 - (4a + 4.0 \times 9.8) = 5.0a$$

$$9.8 = 9.0a$$

1 mark

$$a = 1.1 \text{ m s}^{-2}$$

1 mark

The direction is up.

1 mark

b. $T - 4.0 \times 9.8 = 4.0 \times 1.1$
 $T = 43.6 \text{ N}$

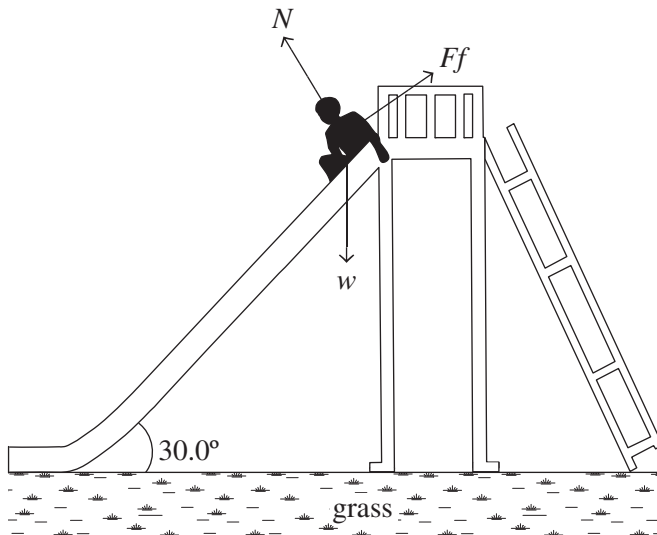
1 mark

1 mark

Note: Consequential on answer to Question 7a.

Question 8 (9 marks)

a.



3 marks

1 mark for showing force due to weight (w).

1 mark for showing force due to normal reaction (N).

1 mark for showing frictional forces (Ff).

b. $F_{\text{normal force}} = 80 \times 9.8 \cos 30$
 $= 679.0 \text{ N}$

1 mark

1 mark

c. $F_{\text{net}} = 80 \times 9.8 \sin 30 - 100$
 $= 292.0 \text{ N}$

1 mark

1 mark

d. $F_{\text{net}} = ma$
 $292.0 = 80a$
 $a = 3.7 \text{ m s}^{-2}$

1 mark

1 mark

Note: Consequential on answer to Question 8b.

Question 9 (4 marks)

a. $k = \text{gradient} = \frac{5.0 \times 10^3}{0.1}$
 $= 5.0 \times 10^4 \text{ N m}^{-1}$
 $= 50\,000 \text{ N m}^{-1}$

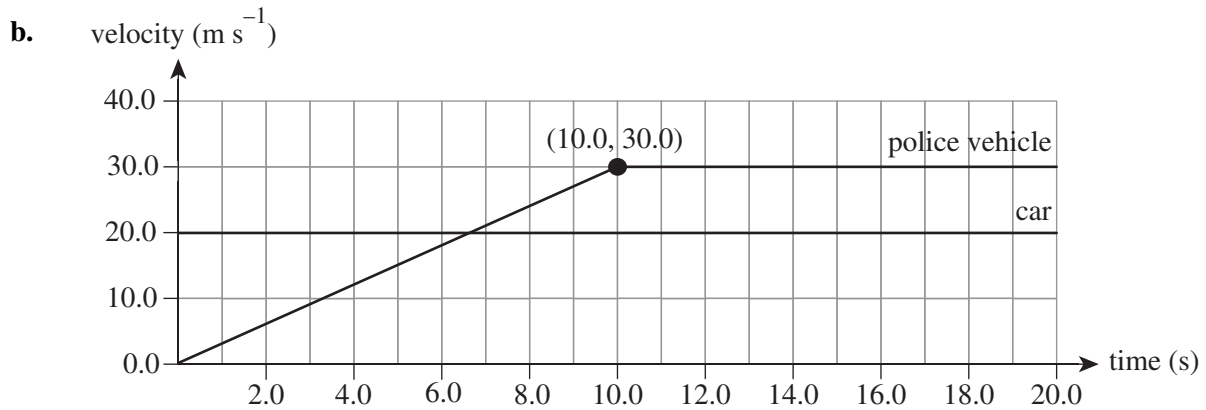
1 mark

1 mark

- b. elastic potential energy = $\frac{1}{2} \times 2.5 \times 10^3 \times 0.05$ 1 mark
 $= 62.5 \text{ J}$ 1 mark

Question 10 (10 marks)

- a. Yes, the car is speeding. 1 mark
 speed = $20.0 \times 3.6 = 72 \text{ km h}^{-1}$ 1 mark



3 marks

1 mark for scales.

1 mark for car's graph.

1 mark for police vehicle's graph.

- c. $s_{\text{car}} = s_{\text{police vehicle}}$ 1 mark
 $20.0t = \left(\frac{1}{2} \times 10 \times 30.0\right) + 30.0(t - 10)$ 1 mark
 $t = 15.0 \text{ s}$ 1 mark
- d. $s = 20.0 \times 15.0$ 1 mark
 $= 300.0 \text{ m}$ 1 mark

*Note: Consequential on answer to Question 10c.***Question 11** (2 marks)

clockwise torque = anticlockwise torque

$$120.0 \times 9.8 \times 2 + 70 \times 9.8 \times 3.0 = F_Q \times 4.0 \quad 1 \text{ mark}$$

$$F_Q = 1102.5 \text{ N} \quad 1 \text{ mark}$$

Question 12 (12 marks)**a.**

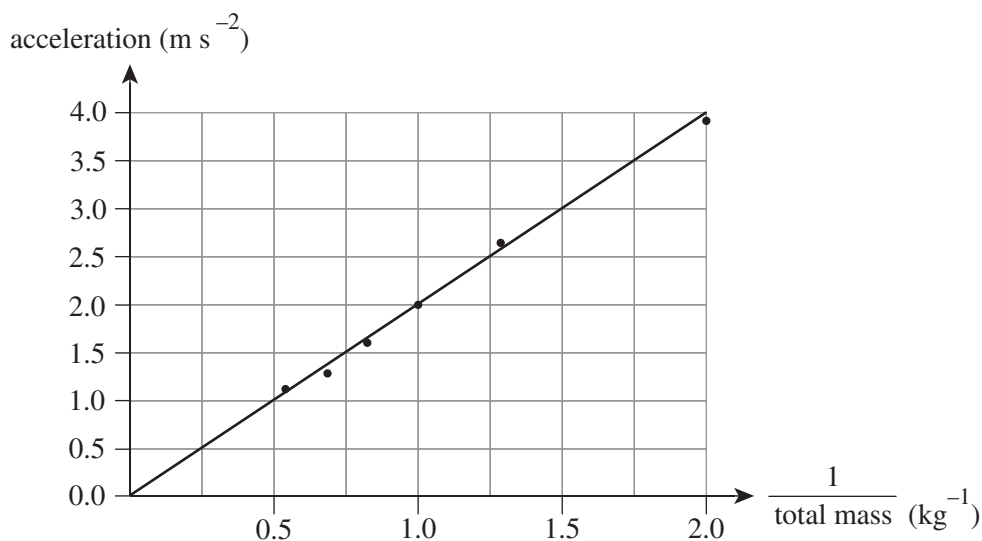
Total mass (kg)	Acceleration (m s^{-2})	$\frac{1}{\text{total mass}}$ (kg^{-1})
0.500	3.9	2.0
0.750	2.7	1.3
1.000	2.0	1.0
1.250	1.6	0.8
1.500	1.3	0.7
1.750	1.1	0.6

2 marks

*1 mark for correct entry of (kg^{-1}).**1 mark for correct entry of 1.3.***b.**

Classification	Variable
controlled	total mass of system (trolley + masses)
dependent	acceleration
independent	force applied/falling mass

3 marks

*Award 1 mark for each correct entry.***c.**

3 marks

*1 mark for data points.**1 mark for line of best fit.**1 mark for horizontal axis unit kg^{-1} .***d.**

$$\begin{aligned} \text{gradient} &= \frac{\text{rise}}{\text{run}} = \frac{4.0}{2.0} \\ &= 2.0 \end{aligned}$$

1 mark

1 mark

e. $\text{gradient} = \frac{a}{\left(\frac{1}{m}\right)} = ma$

$$F_{\text{applied}} = \text{gradient}$$

1 mark

$$= 2.0 \text{ N}$$

1 mark