Neap

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 $3.0 \text{ m s}^{-2}$ 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 $F_{\text{net}}$ is constant.

**Question 6** **B**

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

**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.** $10.0 \text{ m s}^{-1}$ 1 mark

The direction is East. 1 mark

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

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

The direction is West. 1 mark

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

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

$= 340 \text{ m}$ 1 mark

NA 1 mark

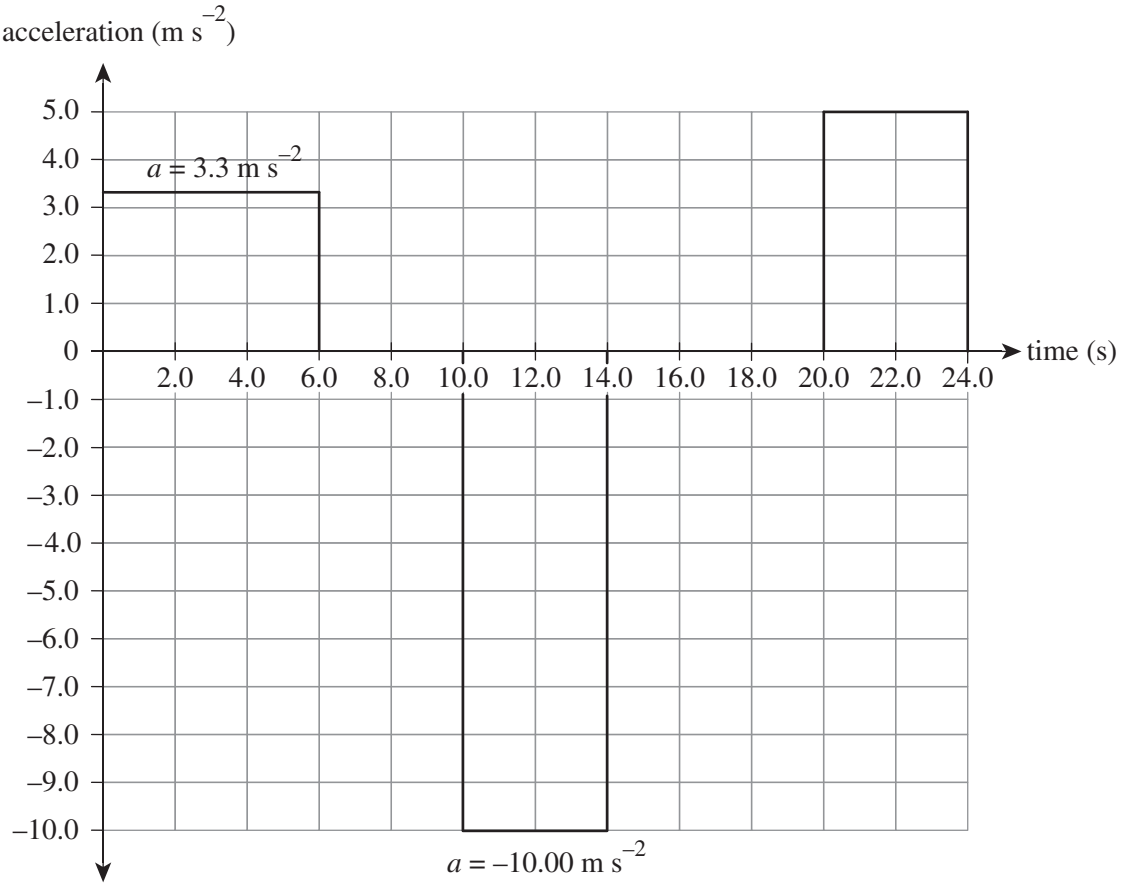
**d.** $\text{displacement} = \left(\dfrac{1}{2} \times 6.0 \times 20.0 + 4.0 \times 20.0 + \dfrac{1}{2} \times 2.0 + 20.0\right) -$

$\left(\dfrac{1}{2} \times 2.0 \times 20.0 + 6.0 \times 20.0 + \dfrac{1}{2} \times 4.0 \times 20.0\right)$ 1 mark

$= 20 \text{ m}$ 1 mark

**e.**




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

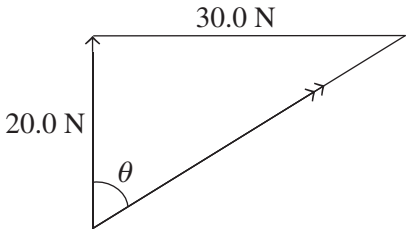
$$v = 56 \text{ m s}^{-1}$$ 1 mark

*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

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

$= 56°$

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

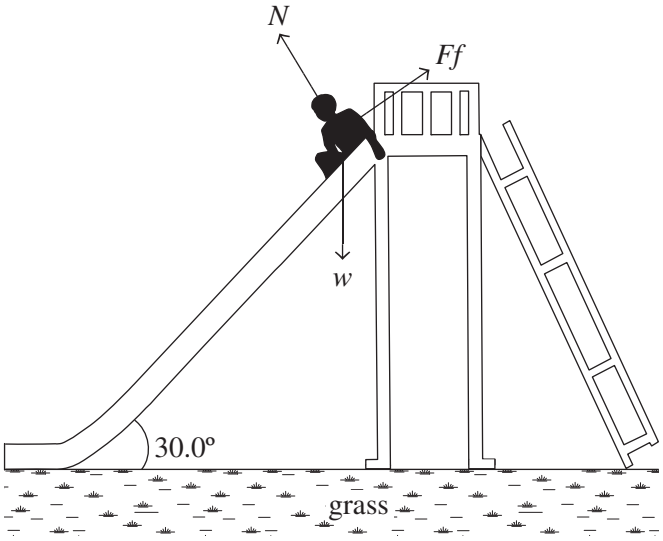
**b.** $T - 4.0 \times 9.8 = 4.0 \times 1.1$ 1 mark

$T = 43.6$ N 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.** $F_{\text{normal force}} = 80 \times 9.8 \cos 30$ 1 mark

$= 679.0$ N 1 mark

**c.** $F_{\text{net}} = 80 \times 9.8 \sin 30 - 100$ 1 mark

$= 292.0$ N 1 mark

**d.** $F_{\text{net}} = ma$

$292.0 = 80a$ 1 mark

$a = 3.7$ m s$^{-2}$ 1 mark

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

**Question 9** (4 marks)

**a.** $k = \text{gradient} = \dfrac{5.0 \times 10^3}{0.1}$ 1 mark

$= 5.0 \times 10^4$ N m$^{-1}$ 1 mark

$= 50\ 000$ N m$^{-1}$

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

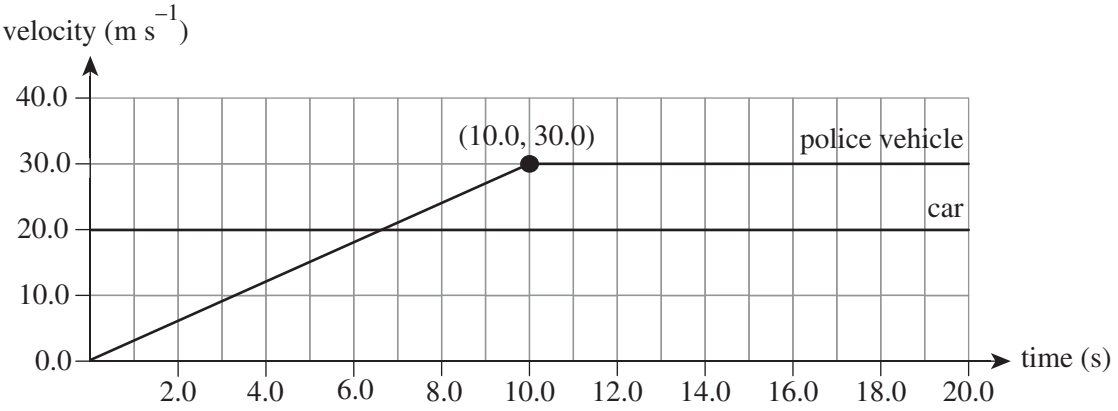
$= 62.5$ J 1 mark

**Question 10** (10 marks)

**a.** Yes, the car is speeding. 1 mark

speed $= 20.0 \times 3.6 = 72$ km h$^{-1}$ 1 mark

**b.**




3 marks

*1 mark for scales.*
*1 mark for car's graph.*
*1 mark for police vehicle's graph.*

**c.** $s_{car} = s_{police\ vehicle}$ 1 mark

$20.0t = \left(\frac{1}{2} \times 10 \times 30.0\right) + 30.0(t - 10)$ 1 mark

$t = 15.0$ s 1 mark

**d.** s $= 20.0 \times 15.0$ 1 mark

$= 300.0$ m 1 mark

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

**Question 11** (2 marks)

clockwise torque = anticlockwise torque

$120.0 \times 9.8 \times 2 + 70 \times 9.8 \times 3.0 = F_Q \times 4.0$ 1 mark

$F_Q = 1102.5$ N 1 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.*

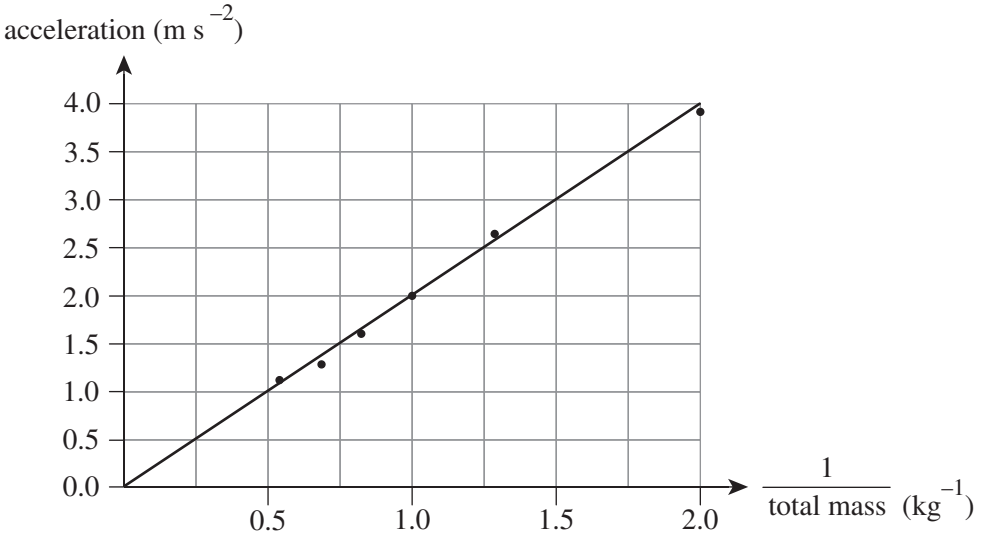
**b.**

| 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.** $\text{gradient} = \frac{\text{rise}}{\text{run}} = \frac{4.0}{2.0}$ 1 mark

$= 2.0$ 1 mark

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

$F_{\text{applied}} = \text{gradient}$ 1 mark

$= 2.0 \text{ N}$ 1 mark