Neap

Trial Examination 2021

VCE Physics Unit 2

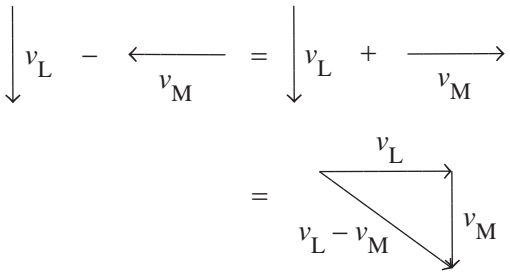
Written Examination

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



Question 2 D

$$\text{total distance travelled} = 3.0 + 3.0 + 2.0 + 2.0 + 6.0 + 6.0$$
$$= 22.0 \text{ m}$$

Question 3 C

C is correct. Inertia is the tendency of an object to resist changes in its state of motion. The more inertia an object has, the more mass it has. This is because the mass of an object is solely dependent on the object's inertia. A feather has less inertia than a hammer because a hammer has greater mass, meaning a hammer has a greater tendency to resist changes in its state of motion. **A** is incorrect. A 10 kg bag of rice has a greater mass than a 2 kg bag and, therefore, has more inertia. **B** is incorrect. A bowling ball has a greater mass and more inertia than a pencil. **D** is incorrect. Bodies of different masses have different inertia, regardless of their proximity to the surface of the Earth.

Question 4 D

$$\Sigma F = ma$$
$$F_{\text{applied}} - 15.0 = 20.0 \times 2.0$$
$$F_{\text{applied}} = 55.0 \text{ N}$$

Question 5 B

B is correct. The centre of mass of the beam is to the right of support Y, so it will have a clockwise torque due to its weight. Therefore, support X is under tension and support Y is under compression.

Question 6 B

$$\Sigma F = ma$$
$$60.0 = 6.0 \times a$$
$$a = 10.0 \text{ m s}^{-2}$$
$$F_{\text{R on S}} = 2.0 \times 10.0$$
$$= 20.0 \text{ N}$$

Question 7 C

C is correct. A dependent variable is the variable a scientist measures after selecting and changing the independent variable that is assumed to affect the dependent variable. **A** is incorrect. This option describes a controlled variable. **B** is incorrect. This option describes an independent variable. **D** is incorrect. This option does not describe any variable in an experiment.

Question 8 A

impulse = area under force versus time graph

$$= \frac{1}{2} \times 0.30 \times 0.30$$

$$= 4.5 \times 10^{-2} \text{ N s}$$

Question 9 A

A is correct. The bag's displacement in the vertical direction is 0.0 m. Hence, the work done against the bag's weight force is 0.0 N. **B** is incorrect. The work done against friction is 200 N. **C** is incorrect. The work done by the net force to move the bag is 300 N. **D** is incorrect. The work done horizontally by the applied force is 500 N.

Question 10 C

C is correct. In this set of results, all the arrows hit the target about an equal distance from and spaced equally around the bullseye; hence, the result is accurate. However, the arrows did not hit the target close to the bullseye; therefore, the result is not precise. **A** is incorrect. This set of results is precise but not accurate. **B** is incorrect. This set of results is not accurate or precise**. D** is incorrect. This set of results is precise and accurate.

SECTION B

Question 1 (3 marks)

No, the forces are not an example of an action–reaction pair in terms of Newton's third law. 1 mark

The weight force is $F_{\text{on Ethan by the Earth}}$, and the normal force is $F_{\text{on Ethan by the surface}}$. 1 mark

This is not an action–reaction pair as both forces act on the same body, Ethan. 1 mark

Question 2 (11 marks)

a. $v = 0.0 \text{ m s}^{-1}$

$u = 20.0 \text{ m s}^{-1}$

$a = g$

$= -9.8 \text{ m s}^{-2}$

$t = ?$

$v = u + at$

$0 = 20.0 - 9.8t$ 1 mark

$t = \dfrac{-20.0}{-9.8}$

$= 2.0 \text{ s}$ 1 mark

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

$0^2 = 20.0^2 + 2 \times (-9.8s)$ 1 mark

$s = \dfrac{-400}{-19.6}$

$= 20.4 \text{ m}$ 1 mark

$\text{maximum height} = 80.0 + 20.4$

$= 100.4$

$\approx 100 \text{ m}$ 1 mark

c. $s = ut + \dfrac{1}{2}at^2$

$100 = 0 + \dfrac{1}{2}9.8t^2$ 1 mark

$t = \sqrt{\dfrac{200}{9.8}}$

$= 4.5 \text{ s}$ 1 mark

$t_{\text{total}} = 2.0 + 4.5$

$= 6.5 \text{ s}$ 1 mark

*Note: Consequential on answers to **Questions 2a** and **2b**.*

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

$v^2 = 0 + 2 \times 9.8 \times 100$ 1 mark

$v = \sqrt{1960}$

$= 44 \text{ m s}^{-1}$ 1 mark

down 1 mark

*Note: Consequential on answer to **Question 2b**.*

Question 3 (13 marks)

a. $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

$1.0 \times 10^3 \times 25.0 + 6.0 \times 10^3 \times 11.0 = 1.0 \times 10^3 v + 6.0 \times 10^3 v$ 1 mark

$7.0 \times 10^3 v = 9.1 \times 10^4$ 1 mark

$v = 13 \text{ m s}^{-1}$

b. **i.** $\Delta_{\text{Pcar}} = m(v - u)$

$= 1.0 \times 10^3 \times (13 - 25.0)$ 1 mark

$= -12\,000 \text{ kg m s}^{-1}$ 1 mark

*Note: Consequential on answer to **Question 3a**.*

ii. $\Delta_{\text{Pminibus}} = m(v - u)$

$= 6.0 \times 10^3 \times (13 - 11.0)$ 1 mark

$= 12\,000 \text{ kg m s}^{-1}$ 1 mark

*Note: Consequential on answer to **Question 3a**.*

c. $\Delta_{\text{Pcar}} = -\Delta_{\text{Pbus}}$ 1 mark

*Note: Consequential on answers to **Question 3b.i. and 3b.ii**.*

d. The vehicles are in contact with the ground and, through friction with the ground, their momentum is transferred to the Earth. 1 mark 1 mark

e. **i.** If the time of impact were increased by a factor of 4, the force of impact would decrease by a factor of 4. 1 mark

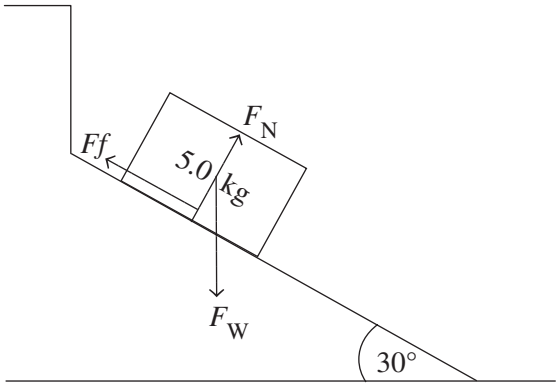
The product of the force and time of impact is the same for the same change in momentum. 1 mark

ii. Crumple zones increase the time of impact, meaning the time it takes for the momentum of a car's occupants to change increases. 1 mark

Therefore, the force of impact would decrease, reducing the severity of injuries. 1 mark

Question 4 (10 marks)

a.



3 marks
1 mark for the normal force.
1 mark for the weight force.
1 mark for the frictional force.
Note: Do not award a mark for a component of the weight force.

b. $F_N = mg\cos\theta$

$= 5.0 \times 9.8\cos 30$ 1 mark

$= 42$ N 1 mark

c. $F_{net} = mg\sin\theta - f$ 1 mark

$5.0 \times a = 5.0 \times 9.8\sin 30 - 10$ 1 mark

$a = 2.9$ m s^{-2} 1 mark

d. work done $= F \times s$

$= 10.0 \times 5.0$ 1 mark

$= 50$ J 1 mark

Question 5 (7 marks)

a. $\Delta U_g = \Delta E_k$ 1 mark

$m \times 9.8 \times 2.0 = \frac{1}{2}mv^2$ 1 mark

$9.8 \times 2.0 = \frac{1}{2}v^2$

$v = \sqrt{39.2}$ 1 mark

$= 6.3$ m s^{-1} 1 mark

b. If friction were significant, it would do work against the motion and some useful mechanical energy would be converted to heat. 1 mark

This would mean that less energy would be available as kinetic energy, 1 mark
so Ziqi would reach the bottom of the curved ramp at a lower speed. 1 mark

Question 6 (16 marks)

a. Reading from the graph:

2.00 m s^{-1} 1 mark

East 1 mark

b. $a = \text{gradient of a velocity versus time graph}$

$= \dfrac{2.00}{2.00}$ 1 mark

$= 1.00 \text{ m s}^{-2}$ 1 mark

West 1 mark

Note: The car is travelling East and decelerating, so the acceleration is in the opposite direction.

c. $\text{distance} = (3.0 \times 2.0) + \left(\frac{1}{2} \times 3.0 \times 2.0\right) + \left(\frac{1}{2} \times 2.0 \times 2.0\right) + (2.0 \times 8.0) + \left(\frac{1}{2} \times 2.0 \times 2.0\right)$ 1 mark

$= 29.0 \text{ m}$ 1 mark

N/A 1 mark

d. $\text{displacement} = \left((3.0 \times 2.0) + \left(\frac{1}{2} \times 3.0 \times 2.0\right)\right)$

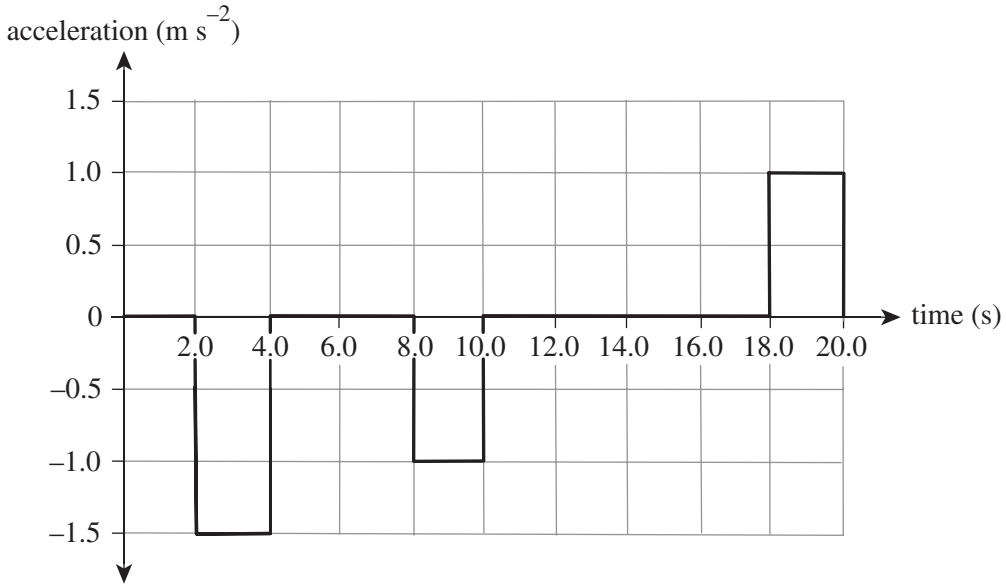
$- \left(\left(\frac{1}{2} \times 2.0 \times 2.0\right) + (2.0 \times 8.0) + \left(\frac{1}{2} \times 2.0 \times 2.0\right)\right)$ 1 mark

$= -11.0 \text{ m}$

$= 11.0 \text{ m}$ 1 mark

East 1 mark

e.



5 marks
1 mark for correct axis labels.
1 mark for appropriate axis scales.
Note: More than half the graph area must be employed to obtain a mark.
1 mark for correct axis units.
1 mark for correct magnitudes of acceleration.
1 mark for correct directions of acceleration.

Question 7 (3 marks)

clockwise torques = anticlockwise torques

clockwise torques = $(10\,000 \times 9.8 \times 10.0) + (800 \times 9.8 \times 10.0)$ 1 mark

anticlockwise torques = $2T\sin 45 \times 15.0$ 1 mark

$$(10\,000 \times 9.8 \times 10.0) + (800 \times 9.8 \times 10.0) = 2T\sin 45 \times 15.0$$

$$2T\sin 45 = 70\,560$$

$$2T = \frac{70\,560}{\sin 45}$$

$$T = 5.0 \times 10^4 \text{ N}$$ 1 mark

Question 8 (14 marks)

a.

Classification	Variable
independent	**hanging mass**
dependent	**total length of the spring**
controlled	**the spring**

3 marks
1 mark for each correct variable.

b. **i.** $F_R = 0.0500 \times 9.8$
$= 0.49\ \text{N}$ 1 mark

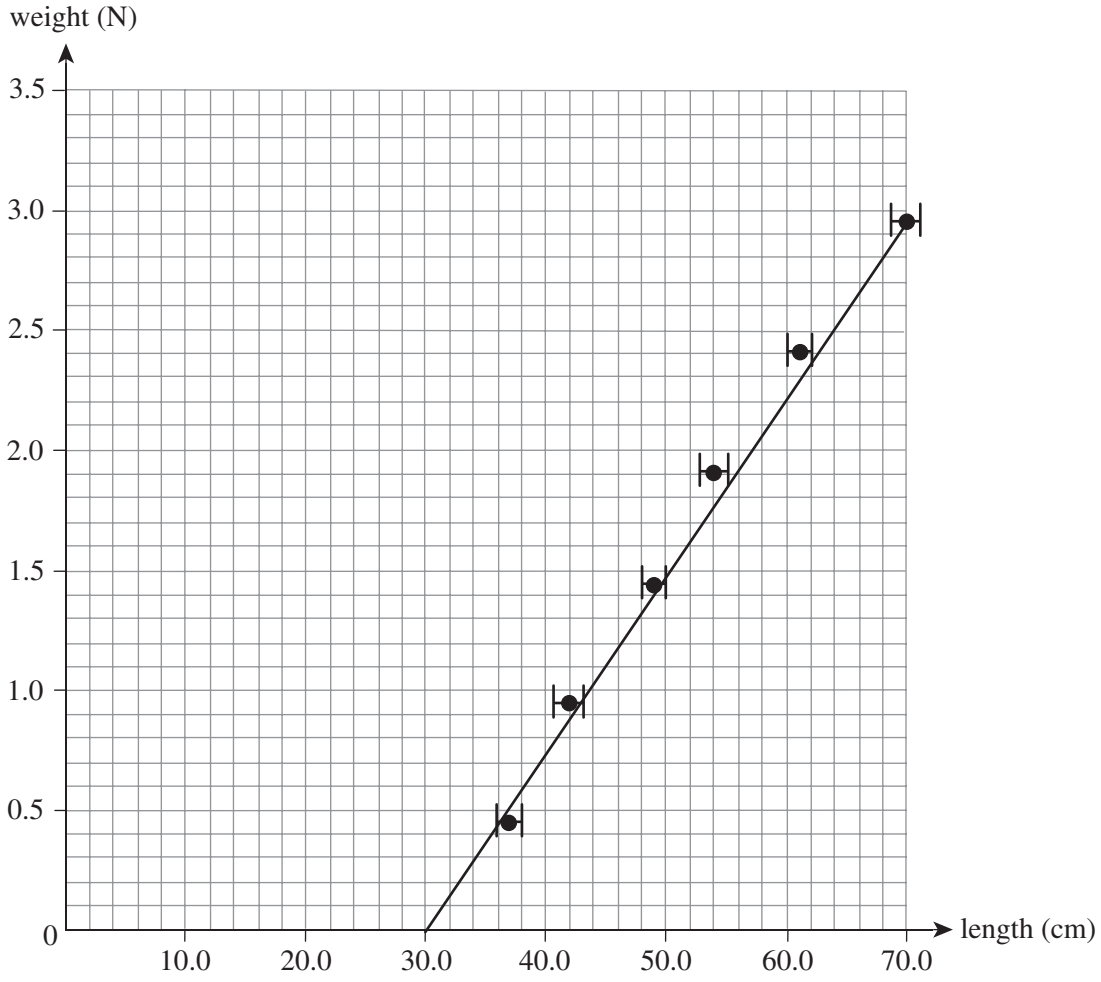
ii.

Hanging mass (g)	Weight of hanging mass (N)	Total length of spring (cm) ± 1.0 cm
50.0	0.49	37.0
100.0	**0.98**	42.0
150.0	**1.47**	49.0
200.0	**1.96**	54.0
250.0	**2.45**	61.0
300.0	**2.94**	70.0

3 marks

Note: Award 1 mark for 1–2 correct weights. Award 2 marks for 3–4 correct weights. Award 3 marks for 5 correct weights.

c.



3 marks

1 mark for correct plotted points.
1 mark for correct line of best fit.
1 mark for correct uncertainty bars.

d. Reading from the graph:

30.0 cm 1 mark

*Note: The original length of the spring is found from the x-axis intercept. Accept responses 30.0 ± 1.0 cm. Consequential on answer to **Question 8c**.*

e. $k = \text{gradient}$

$$= \frac{\text{rise}}{\text{run}}$$

$$\approx \frac{2.9}{0.40} \quad \text{1 mark}$$

$$\approx 7.3 \text{ N m}^{-1} \quad \text{1 mark}$$

f. Reading from the graph:

1.5 N 1 mark

*Note: Accept responses in the range 1.4–1.7 N. Consequential on answer to **Question 8c**.*

Question 9 (3 marks)

Using total mechanical energy conservation gives:

$$\frac{1}{2}k(\Delta x)^2 = \frac{1}{2}mv^2$$

$$\frac{1}{2} \times 100.0 \times 0.100^2 = \frac{1}{2} \times 0.1000v^2 \quad \text{1 mark}$$

Note: Award mark for conversions (centimetres to metres and grams to kilograms).

$$v = \sqrt{10} \quad \text{1 mark}$$

$$= 3.16 \text{ m s}^{-1} \quad \text{1 mark}$$