



Trial Examination 2007

VCE Physics Unit 2

Written Examination

Suggested Solutions

SECTION A – CORE**Area of study 1 – Movement****Question 1**

$$\begin{aligned}
 t &= \frac{s}{v} \\
 &= \frac{60 \text{ m}}{5 \text{ m s}^{-1}} \\
 &= 12 \text{ s}
 \end{aligned}$$

1 mark

Question 2 B

1 mark

As Theo's velocity is constant, the net force acting on him must be zero.

Question 3

$$\begin{aligned}
 s &= \frac{u + v}{2} \times t \\
 &= \frac{0 + 15}{2} \times 10 \\
 &= 75 \text{ m}
 \end{aligned}$$

1 mark

1 mark

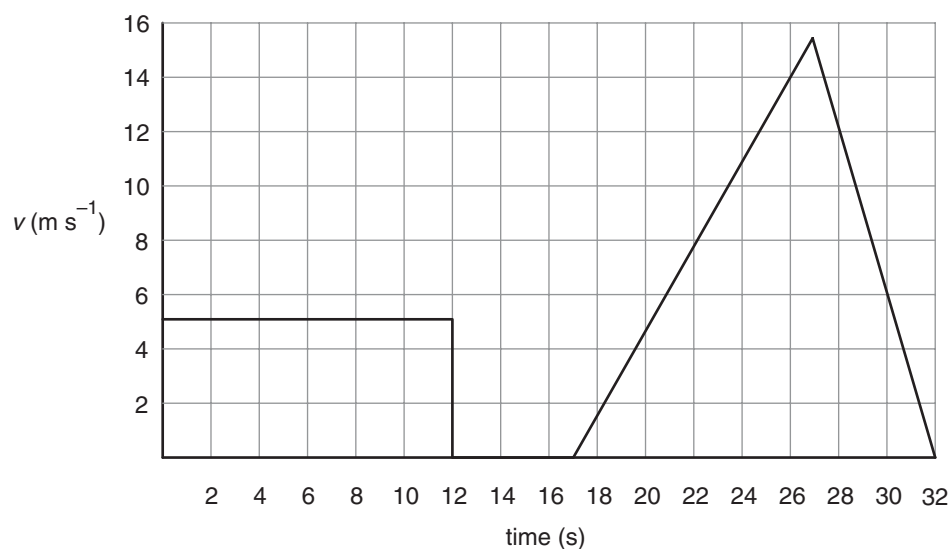
Question 4

First law: Theo comes to a stop because there is a non-zero force acting on him (friction).

1 mark

Second law: Theo comes to a stop because the net force on him causes an acceleration in the direction opposite to that of his velocity. The magnitude of the acceleration depends on the size of the force and on Theo's mass.

1 mark

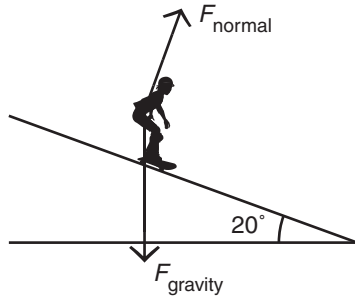
Question 5

3 marks

1 mark for correctly labelled horizontal axis

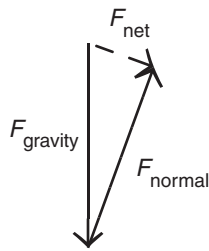
1 mark for correctly labelled vertical axis

1 mark for correct graph

Question 6

2 marks

1 mark for correctly labelled gravitational force
1 mark for correctly labelled normal reaction force

Question 7

1 mark

$$\sin 20^\circ = \frac{F_{\text{net}}}{F_{\text{gravity}}}$$

1 mark

$$F_{\text{net}} = \sin 20^\circ \times F_{\text{gravity}}$$

$$F_{\text{net}} = 205 \text{ N}$$

1 mark

Question 8

$$E_{\text{gravitational}} = E_{\text{kinetic}}$$

$$mgh = \frac{1}{2}mv^2$$

1 mark

$$h = \frac{0.5v^2}{g}$$

$$h = 7.2 \text{ m}$$

1 mark

Question 9**Without friction**

Flora would not go faster if she were heavier,

1 mark

because her acceleration due to gravity would be the same regardless of her mass.

1 mark

With friction

Flora would not go faster if she were heavier,

1 mark

because on a heavier person, the frictional force would be greater as it is proportional to mass (normal force), but the component of weight parallel to the slide is also proportional to mass.

Hence the net force is independent of mass.

1 mark

Question 10

$$\text{work} = \text{change in } E_{\text{kinetic}}$$

1 mark

$$\text{work} = \frac{1}{2}mv^2$$

$$= 2520 \text{ J}$$

1 mark

Question 11change in $E_{\text{kinetic}} = \text{work}$

$$\frac{1}{2}mv^2 = Fs$$

1 mark

$$F = 360 \text{ N}$$

1 mark

Question 12**Explanation 1:** Newton

1 mark

*This explanation uses Newton's second law of motion.***Explanation 2:** Aristotle

1 mark

*This explanation uses the idea of a 'natural motion' associated with a particular object.***Explanation 3:** Galileo

1 mark

*This explanation uses the notion of inertia.***Question 13**spring constant (k) = $\frac{F}{x}$

$$k = \frac{40}{0.20}$$

1 mark

$$k = 200 \text{ N m}^{-1}$$

1 mark

Question 14 $E_{\text{strain}} = E_{\text{gravitational}}$

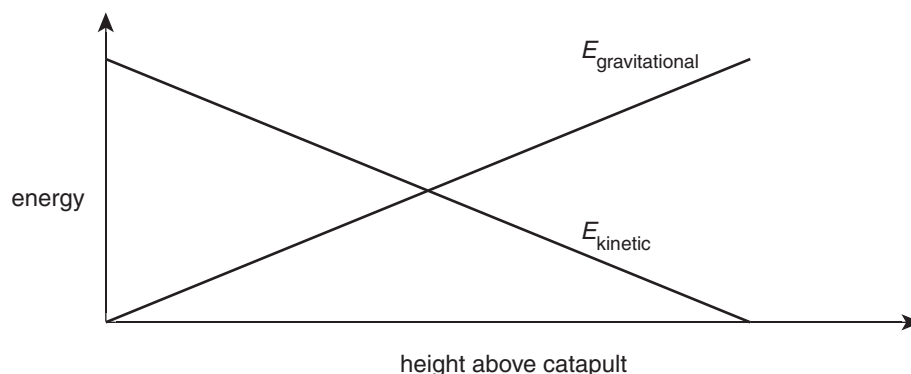
$$\frac{1}{2}kx^2 = mgh$$

$$h = \frac{0.5kx^2}{mg}$$

1 mark

$$h = 20 \text{ m}$$

1 mark

Question 15

2 marks

1 mark for straight lines (as energy must be conserved)
1 mark for correct labelling of kinetic and gravitational energies

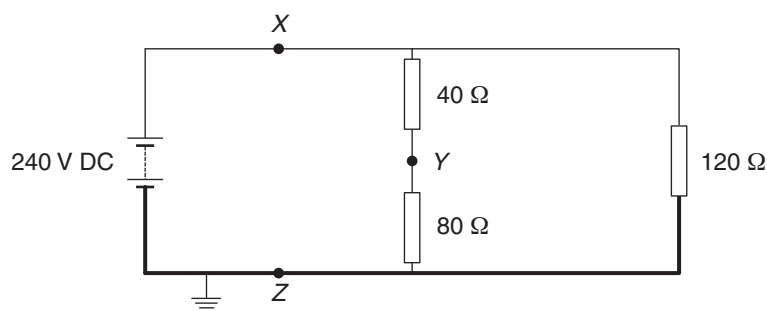
Question 16

In the absence of friction, the final speed of the falling stone is equal to its initial speed.

1 mark

This means that it is safer to move away as the stone comes down (or wear a helmet).

1 mark

Question 8

1 mark

*1 mark for earth placed anywhere along the darker line in the circuit***Question 9**

Earthing ensures that part of the circuit remains at 0 V.

1 mark

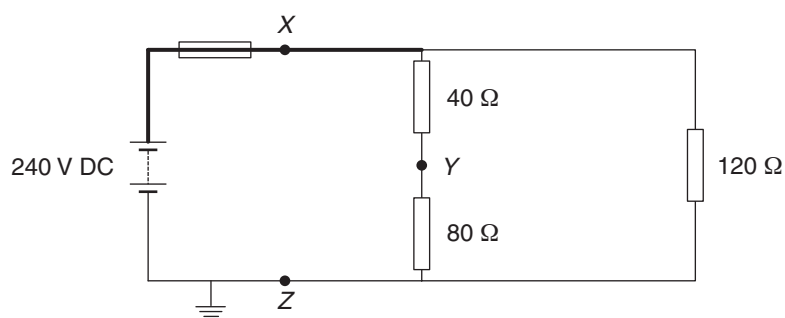
Question 10

A fuse is designed to melt when the current is too large.

1 mark

This opens the circuit, ensuring that the current becomes zero.

1 mark

Question 11

1 mark

*1 mark for fuse placed anywhere along the darker line in the circuit***Question 12**

The fuse should be placed where the current is greatest in the circuit.

1 mark

This means that the fuse will melt if too much current is drawn through any device.

1 mark

It is preferable to place the fuse at X rather than at Z since if the fuse at X melts, there is no chance for current to flow in the circuit. If the fuse is at Z and melts and someone touches Y, the person could conduct current to earth which could be harmful to them.

Question 13

Device A

1 mark

The V–I graph for Device A is linear, which means that Device A's resistance is constant.

Question 14

Reading from Figure 4 in the question booklet, when the potential difference across Device A is 6 V, the current is 0.6 A.

1 mark

Question 15

As Device A and Device B are in series, the current is the same in each device.

The current in Device B is then 0.6 A.

1 mark

Reading from Figure 5 in the question booklet, the potential difference across Device B is then 2 V.

1 mark

The voltage supplied by the battery is $V_A + V_B = 6 + 2 = 8$ V

1 mark

Question 9

The galaxy is rotating about its own centre.

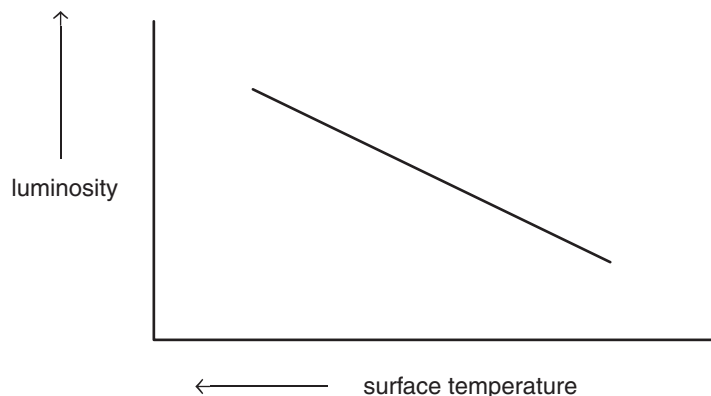
1 mark

Question 10

When a graph is plotted of the luminosity of stars against their temperature (or spectral class), most stars are positioned along a line, as shown in the sketch graph below.

1 mark

1 mark



The stars that lie on this line are called main sequence stars.

1 mark

Question 11

The spectral analysis gives a maximum intensity at a particular wavelength of light.

1 mark

This wavelength can then be used to calculate the surface temperature.

1 mark

Question 12

When looking at the spectrum of sunlight, dark bands can be seen.

1 mark

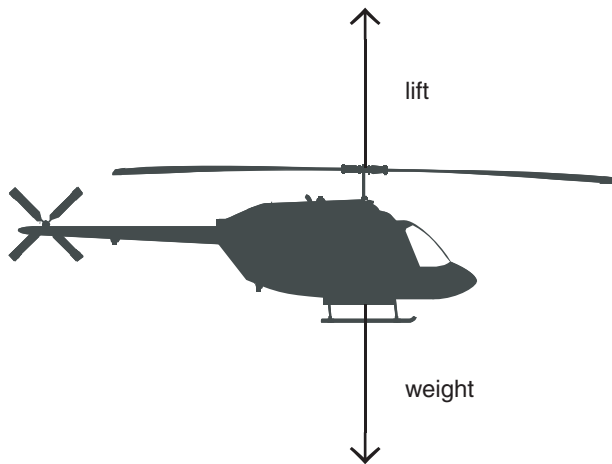
These bands show specific patterns corresponding to the presence of specific elements in the Sun, such as helium.

1 mark

Question 13

The fusion of light elements (e.g. hydrogen) into heavier ones (e.g. helium).

1 mark

Detailed study 2 – Aerospace**Question 1**

2 marks

*1 mark for two forces correctly labelled**1 mark for two forces equal in magnitude and opposite in direction***Question 2 C**

2 marks

As the helicopter is not rotating, there must be zero net torque. This can only happen if both forces act through the helicopter's centre of mass.

Question 3

If the tail rotor failed, the main rotor would exert a non-zero torque on the helicopter.

1 mark

This would cause the whole helicopter to start spinning in the opposite direction to that of the main rotor.

1 mark

Question 4

torque from main rotor = torque from tail rotor

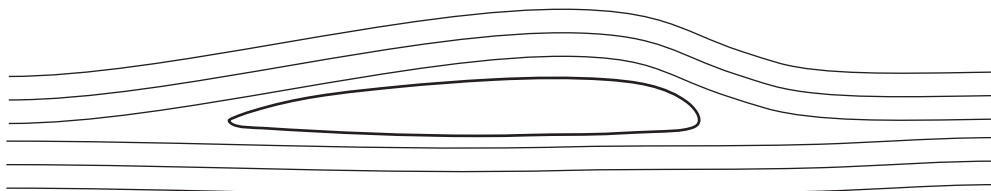
1 mark

$$6.0 \times 10^5 \text{ N m} = F_{\text{tail}} \times r$$

$$F_{\text{tail}} = \frac{6.0 \times 10^5 \text{ N m}}{5 \text{ m}}$$

$$F_{\text{tail}} = 1.2 \times 10^5 \text{ N}$$

1 mark

Question 5

1 mark

1 mark for cross-section of rotor blade showing longer pathway above it than underneath

The air above the moving blade has a longer distance to travel than the air underneath the blade, and as a result the air above the blade is moving faster relative to the blade.

1 mark

The higher air speed means lower air pressure, and the pressure difference provides the lift force.

1 mark

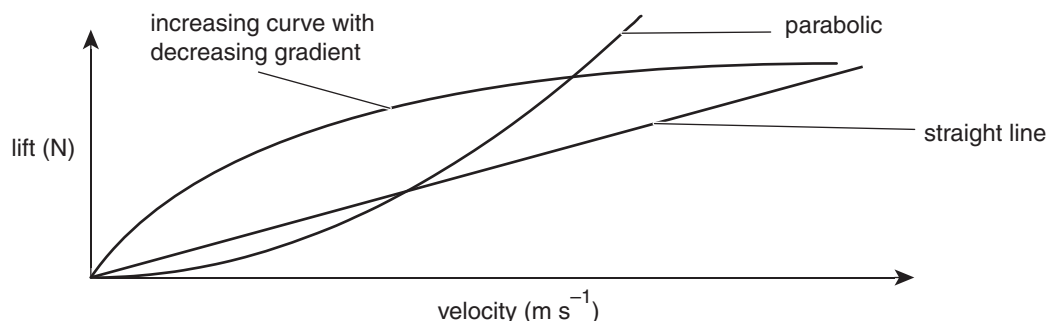
Question 6

The board forces the air below it (and above it) to move downward.

1 mark

This change of momentum results in an equal but opposite impulse on the board, providing lift.

1 mark

Question 7

2 marks

1 mark for correct labels on axes

1 mark for ONE of the three curves shown on the graph above

Question 8

If the answer to Question 7 is a linear graph:

A faster bicycle would mean more displaced air,
and therefore an increased impulse on the board.

1 mark

1 mark

OR

If the answer to Question 7 is a curved graph with decreasing gradient:

Initially the lift increases with velocity, as a faster bicycle would mean more displaced air and an increased impulse on the board.

1 mark

At higher speeds, however, the lift no longer increases because turbulence increases.

1 mark

OR

If the answer to Question 7 is a parabolic curve:

Lift is proportional to the square of the velocity.

2 marks

Question 9

The angle of attack (or the size of the board or any other reasonable independent variable).

1 mark

Question 10

The lift would increase with small increases of angle.

1 mark

However, once a critical angle is reached the lift would start to decrease.

1 mark

If another independent variable is chosen, accept a reasonable prediction of the outcome of the experiment.

Question 11

$$\text{power} = F \times v$$

$$15 \text{ kW} = F \times \frac{30}{12}$$

1 mark

$$F = 6000 \text{ N}$$

1 mark

Question 12

three

1 mark

roll

1 mark

yaw

1 mark

Detailed study 3 – Alternative energy sources**Question 1**

carbon dioxide	1 mark
non-renewable	1 mark
coal	1 mark

Question 2

$$\begin{aligned}
 E &= Pt \\
 &= 80 \times 1 \\
 &= 80 \text{ J}
 \end{aligned}$$

1 mark

Question 3

$$3\% \text{ of } 80 \text{ J} = 2.4 \text{ J} \quad 1 \text{ mark}$$

Question 4

If 15% of the electrical energy is converted to light, then to produce 2.4 J of light energy,

$$\frac{15}{100} \times \text{electrical energy} = 2.4 \text{ J.} \quad 1 \text{ mark}$$

$$\text{electrical energy} = \frac{100}{15} \times 2.4 \text{ J}$$

So the answer is 16 J. 1 mark

Question 5

$$\text{One light saves } 80 - 16 \text{ J} = 64 \text{ J in 1 s.} \quad 1 \text{ mark}$$

$$1 \text{ year} = 365 \text{ days} = 365 \times 24 = 7300 \text{ min} = 7300 \times 60 = 438000 \text{ s} \quad 1 \text{ mark}$$

$$438000 \text{ s} \times 64 \text{ J s}^{-1} = 2.8 \times 10^7 \text{ J} \quad 1 \text{ mark}$$

$$15 \text{ lights} \Rightarrow 15 \times 2.8 \times 10^7 = 4.2 \times 10^8 \text{ J}$$

$$\frac{4.2 \times 10^8}{1000 \times 3600} = 117 \text{ kW h} \quad 1 \text{ mark}$$

Question 6

$$E_{\text{gravitational}} (\text{water}) \rightarrow E_{\text{kinetic}} (\text{turbine}) + \text{heat} \rightarrow E_{\text{electrical}} (\text{generator}) + \text{heat} \quad 3 \text{ marks}$$

1 mark for three types of energy (gravitational, kinetic, electrical)

1 mark for correct location of each type of energy

1 mark for inclusion of heat

Question 7

$$\text{gravitational potential energy} = mgh$$

$$= 8 \times 10 \times 0.1 \quad 1 \text{ mark}$$

$$= 8 \text{ J} \quad 1 \text{ mark}$$

Question 8

$$E = VIt$$

$$= 1.5 \times 0.014 \times 95$$

1 mark

$$= 2.0 \text{ J}$$

1 mark

Question 9

The gravitational potential energy was 8 J, and 2 J was converted to electrical energy.

6 J of energy is 'missing' from the system.

1 mark

Possible causes include:

water not passing through water wheel;

friction in water wheel;

heat generated by water wheel;

heat generated by generator;

some kinetic energy of water (since the water still has velocity after it hits the wheel).

1 mark

1 mark for any option from the list above (or any other reasonable answer)

Question 10

Possible answers include:

the efficiency of the model is much less than one would expect from a real power generation system;

the size of the hole determines the water flow and is difficult to model precisely;

the volume of water determines the pressure with which it exits the dam which is difficult to model precisely;

the water in the model needs to be replenished (i.e. there is no source of tidal energy);

the model does not include water at different pressures on either side of the turbine;

the model does not allow for the reversal of water flow through the turbine.

2 marks

1 mark for each option from the above list (or any other reasonable answer) to a maximum of 2 marks

Question 11

Energy source	Advantage	Disadvantage
Coal	A3	D2
Hydroelectricity	A1	D3
Wind	A2	D1

3 marks

1 mark for each pair of correct answers