



Trial Examination 2015

VCE Physics Unit 2

Written Examination

Suggested Solutions

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SECTION A – Core studies**Area of study – Motion****Question 1 (15 marks)**

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

$$9 = 100 + 140a$$

1 mark

$$a = -0.65 \text{ m s}^{-2}$$

1 mark

b. $v = u + at$

$$3 = 10 + -0.65 \text{ m s}^{-2} \times t$$

1 mark

$$t = 10.8 \text{ s}$$

1 mark

Note: Consequential on $\frac{3 - 10}{\text{Question 1a.}}$

c. $F = ma$

$$= 55 \times 0.65$$

1 mark

$$= 36 \text{ N}$$

1 mark

Note: Consequential on $55 \times \text{Question 1a.}$

d. $P = \frac{Fs}{T}$

$$= \frac{36 \times 70}{10.8}$$

1 mark

$$= 230 \text{ W}$$

1 mark

Note: Consequential on $\frac{\text{Question 1c.} \times 70}{\text{Question 1b.}}$

e. kinetic energy to gravitational potential (and heat) energy

1 mark

f. The gradient of the velocity versus time graph is used.

1 mark

$$\frac{15}{9} = 1.7 \text{ m s}^{-2}$$

1 mark

g. The area under the graph is displacement.

$$\text{Jack: } \frac{15 \times 9}{2} = 67.5 \text{ m}$$

1 mark

$$\text{Jill: } \frac{12 \times 4}{2} + 12 \times 5 = 84 \text{ m}$$

1 mark

Conclusion: Jack has travelled less, so he has not overtaken Jill.

1 mark

h. $A = 0$

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

1 mark

Question 2 (6 marks)

- a. Reaction: The Moon attracts the Earth. 1 mark
 Direction: from the Earth to the Moon 1 mark
- b. Reaction: The ball pushes the footballer. 1 mark
 Direction: from the ball to the footballer 1 mark
- c. Reaction: The apple pulls on the Earth. 1 mark
 Direction: upward 1 mark

Question 3 (9 marks)

- a. The two impulses are equal in magnitude 1 mark
 and opposite in direction. 1 mark
- b. impulse = Ft
 $= 4000 \text{ N} \times 60$ 1 mark
 $= 2.4 \times 10^5 \text{ N s or kg m s}^{-1}$ 2 marks
1 mark for correct value
1 mark for correct unit
- c. impulse = change in momentum 1 mark
 $Ft = mv$
 $m = \frac{1.2 \times 10^5}{120}$
 $= 1000 \text{ kg}$ 1 mark
- d. $Ft = mv$
 $t = \frac{2 \times 10^4 \text{ kg} \times 80}{4 \times 4000 \text{ N}}$ 1 mark
 $= 100 \text{ s}$ 1 mark

Question 4 (8 marks)

- a. $F_{\text{hor}} = \cos 50^\circ \times 150$
 $= 96 \text{ N}$ 1 mark
 $s = 12 \times 5$
 $= 60 \text{ m}$ 1 mark
 $W = Fs$
 $= 60 \times 96$
 $= 5760 \text{ J}$ 1 mark

- b. After 5 seconds the speed is still 12 m s^{-1} . 1 mark

$$E_{\text{kin}} = 0.5mv^2$$

$$= 0.5 \times 65 \times 144$$

$$= 4680 \text{ J}$$

1 mark

- c. change in E = work

$$= Fs$$

$$4680 = F \times 20$$

1 mark

$$F = 234 \text{ N}$$

1 mark

- d. Friction is the only force contributing to the net force on the surfer. All other forces must cancel.

1 mark

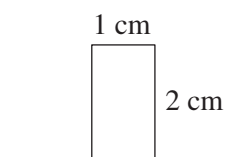
Area of study – Wave-like properties of light

Question 5 (4 marks)

- a. amplitude = 2 cm

1 mark

- b.



2 marks

1 mark for dimensions

1 mark for sketch

- c. constructive interference

1 mark

Note: Use of the term 'constructive' is optional.

Question 6 (9 marks)

- a. $\lambda = 0.3 \text{ m}$

1 mark

b. $f = \frac{1}{T}$

$$= \frac{1}{0.4}$$

$$= 2.5 \text{ Hz}$$

1 mark

- c. $v = \lambda f$

$$= 0.3 \times 2.5$$

$$= 0.75 \text{ m s}^{-1}$$

1 mark

Note: Consequential on Question 1a. and Question 1b.

- d. The approaching waves are reflected off the edge, and the reflected waves interfere with the incoming waves.

1 mark

1 mark

- e. The wavefront bends away from the normal 1 mark
because the waves are undergoing refraction as it changes depth. 1 mark
OR
The change in depth changes the speed 1 mark
and the waves undergo refraction. 1 mark
- f. Since frequency is constant, the value depends only on wavelength. 1 mark
value = $\frac{0.35}{0.25}$
= 1.4 1 mark

Question 7 (4 marks)

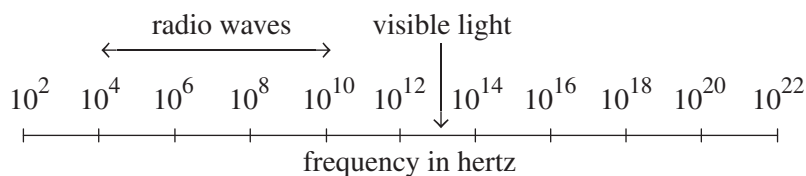
- a. If the incident angle is less than θ_c than it will refract out. Students must calculate the critical angle.
 $\theta_c = \sin^{-1}\left(\frac{1}{1.33}\right)$
= 48.75° 1 mark
Ray 1: The incident angle = $60^\circ > \theta_c$, so it will not refract out.
Ray 2: The incident angle = $45^\circ < \theta_c$, so it will refract out.
Therefore, the person will see ray 2, but not ray 1. 1 mark
1 mark for correctly identifying both ray 1 and ray 2
- b. The white light is dispersed 1 mark
and separated into its component colours. 1 mark

Question 8 (6 marks)

- a. time to aircraft = $\frac{37.33}{2}$
= 18.665 m s^{-1} 1 mark
distance = $3 \times 10^5 \text{ km s}^{-1} \times 18.665 \times 10^{-6} \text{ s}$
= 5.6 km 1 mark
- b. travel/would not 2 marks
1 mark for each correct response

c. $\lambda = 1.12 \text{ cm}$
 $= 0.0112 \text{ m}$
 and $f = \frac{c}{\lambda}$
 $= \frac{3 \times 10^8}{0.0112}$
 $= 2.68 \times 10^{10} \text{ Hz}$

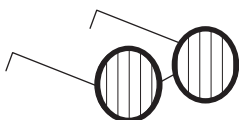
Allow for a range as indicated by the arrow in the diagram below.



2 marks

Question 9 (3 marks)

a.



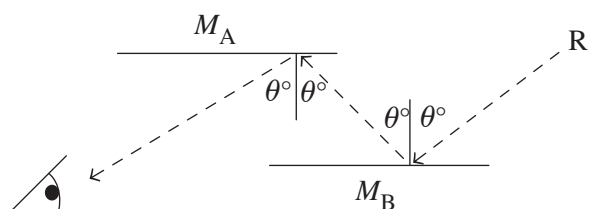
1 mark

- b. Using vertically aligned polarisation filters only allows vertical-plane light through and it blocks the horizontal-plane light, thus reducing the glare.

1 mark
1 mark

Question 10 (4 marks)

a.



2 marks

1 mark for each reflection

Note: Inclusion of the angle is optional.

- b. The image is reflected (or reversed) twice and thus will appear the correct way (or not reversed).

1 mark
1 mark

SECTION B (2 marks for each correct answer)**Detailed study 1 – Astronomy****Question 1 A**

Galileo was one of the first people to notice that planets were actually similar to Earth.

Question 2 D

Ptolemy's geocentric model was replaced by Copernicus' heliocentric model.

Question 3 B

A lens focuses the rays, which are then reflected off a mirror.

Question 4 B

time difference = $49.7 - 29.7 = 20$ AU

1 AU = 1.5×10^{11} m, so 20 AU = 3×10^{12} m

$$\begin{aligned} \text{time} &= \frac{\text{distance}}{\text{speed}} \\ &= \frac{3 \times 10^{12}}{3 \times 10^8} \\ &= \frac{1 \times 10^4 \text{ s}}{3600} \\ &= 2.8 \text{ h} \approx 3 \text{ h} \end{aligned}$$

Question 5 C

An ellipse best describes the orbit of Pluto.

Question 6 D

The shape of the graph indicates its annual motion.

Question 7 D

The ecliptic would be at zero degrees.

Question 8 C

At the zenith, the star's declination would be -38° .

Question 9 B

One hour of right ascension is equivalent to 15° of an arc.

Question 10 A

For oxygen the loss is around 50 GHz, while for water it is around 3000 GHz.

Question 11 C

Higher altitude reduces the quantity of water in the atmosphere and this reduces attenuation.

Detailed study 2 – Astrophysics**Question 1 D**

Only fusion of hydrogen to helium occurred during this early stage of the universe.

Question 2 A

Fusion of lighter elements into heavier ones leads to the release of energy.

Question 3 D

Main-sequence stars with a high magnitude are massive, hot and short-lived.

Question 4 C

5500 K is roughly the surface temperature of *Sol*. Our Sun appears yellow.

Question 5 B

Stars move away from the main sequence to become red giants. This is the cooler end of the diagram.

Question 6 D

Star C appears four times brighter than star B, so it must be half the distance: 24 ly.

Star A is one-third of the distance compared to star B, so it must be nine times brighter than star B: 36.

Question 7 D

Planetary nebulae are formed when a red giant sheds its outer layers. The remaining star is most likely a white dwarf star.

Question 8 B

Spiral and barred spiral galaxies are the only ones that show a flat, disc-like profile.

Question 9 C

Gravitation is the force that pulls matter together to form galaxies.

Question 10 B

$$E = mc^2$$

$$m = \frac{E}{c^2}$$

$$= \frac{3.8 \times 10^{26}}{9 \times 10^{16}}$$

$$= 4.2 \times 10^9 \text{ kg}$$

Question 11 A

Only the astronomical unit, the light year and the parsec are astronomical units of distance.

Detailed study 3 – Energy from the nucleus**Question 1 C**

The strong nuclear force operates at these short distances.

Question 2 D

The temperature for fusion needs to be very high so that the electrostatic repulsion between atoms is overcome.

Question 3 D

$$\begin{aligned}\text{mass reactant} - \text{mass product} &= 3.34524 \times 10^{-27} + 3.34984 \times 10^{-27} - 6.64466 \times 10^{-27} \\ &= 0.05042\end{aligned}$$

$$\frac{0.05042}{1.67262} \times 100 = 3\%$$

Question 4 A

Fission would involve splitting the atom, so is step sequence $1 \rightarrow 2 \rightarrow 3$, while fusion would be step sequence $3 \rightarrow 2 \rightarrow 1$.

Question 5 D

It is easier for a neutron to approach a nucleus since it is uncharged, compared to a doubly charged alpha particle.

Question 6 B

Plasma could melt the walls and destroy the reactor.

Question 7 C

Three neutrons are released as part of the fission reaction.

Question 8 A

Mainly γ -rays are given off.

Question 9 C

High kinetic energy (speed) makes it difficult to capture a neutron.

Question 10 D

$10 \text{ W} = 10 \text{ J s}^{-1}$ and $1 \text{ J} = 6.25 \times 10^{19} \text{ eV}$, so the number of uranium atoms needed is:

$$\frac{6.25 \times 10^{18} \text{ eV}}{202.5 \times 10^6 \text{ eV per uranium atom}} = 3.09 \times 10^{11} \text{ atoms}$$

Question 11 C

U-238 is unlikely to undergo fission and thus will not generate any energy.

Detailed study 4 – Investigations: Flight**Question 1 C**

Such an object would experience a lot of drag because of eddies forming behind the object.

Question 2 A

Pressure drag would be the dominant force in this situation.

Question 3 B

Pressure builds up in front of the object and there is a partial vacuum behind. It is this that creates the drag friction.

Question 4 B

Laminar flow, as depicted in the diagram, would only show around an aerodynamic, tear-shaped object.

Question 5 D

All three principles are important in explaining lift force.

Question 6 C

$$\begin{aligned}P &= F \times v \\&= 2000 \text{ N} \times \frac{600}{3.6} \text{ m s}^{-1} \\&= 3.3 \times 10^5 \text{ W}\end{aligned}$$

Question 7 A

Pitch is not produced through this action. Roll (turning around the long axis) and yaw (around the vertical axis) will occur.

Question 8 C

torque = force $\times$ distance
Therefore the unit is Nm.

Question 9 B

Rotation around axis (1) would occur.

Question 10 B

Weight and lift are opposing forces, and drag and thrust are opposing forces.

Question 11 C

The higher wind speed at X leads to a lower pressure at X. This in turn leads to lift.

Detailed study 5 – Investigations: Sustainable energy sources**Question 1 C**

Energy is in joules.

60% of 650 W = 390 J in one second for every 1 m².

Question 2 B

After the initial installation, solar energy is free. All other alternatives are untrue.

Question 3 A

Solar energy is renewable because of its ‘never-ending’ supply.

Question 4 D

Available energy from wind is proportional to velocity squared, so doubling the wind speed would mean there is four times as much energy contained in the wind.

Question 5 C

energy available (gravitational energy) = mgh

$$= 1500 \text{ kg} \times 10 \text{ m s}^{-2} \times 3 \text{ m}$$

$$= 45\,000 \text{ J s}^{-1}$$

$$= 45 \text{ kJ s}^{-1}$$

Question 6 C

The thermal energy of the water is irrelevant to a hydropower system such as this, but not insignificant.

Question 7 C

To turn the movement of the water into rotational movement in order to turn the generator, a water turbine is required. Options **A** and **B** might be useful, but not before the electricity itself is generated. **D** is simply another generator.

Question 8 D

Both statements are incorrect.

Question 9 B

For a lesser flow, the efficiency of the system will be reduced, so the total output will be less than one-third of the original output.

Question 10 A

It can be concluded that the power station is less than 50% efficient, as the waste energy arrow is thicker than the electricity arrow.

Question 11 B

energy in kWh = power in kW × time in hours

$$1 \text{ GW} = 10^6 \text{ kW}$$

$$5 \times 10^6 \times 24 \text{ hours} = 120 \times 10^6 \text{ kWh}$$

Detailed study 6 – Medical physics**Question 1 B**

B gives the correct sequence.

Question 2 D

An unstable nucleus produces an emission that can be detected.

Question 3 A

Ray 1 would reach a detector. Ray 2 is absorbed and ray 3 is deflected from its original path.

Question 4 B

Ray 2, since it is absorbed by the body.

Question 5 C

Light is required to see inside the body.

Question 6 D

An operation site often needs to be ‘inflated’ so that more space is available for the surgeon.

Question 7 A

Total internal reflection of light allows the fibre optic to be flexible.

Question 8 B

Ultrasound can be used to measure bone density.

Question 9 B

Laser light is used.

Question 10 D

D is the best option.

Question 11 C

$$\begin{aligned}f_{\text{light}} &= \frac{c}{\lambda} \\&= \frac{3 \times 10^8}{667 \times 10^{-9}} \\&= 4.5 \times 10^{14} \text{ Hz}\end{aligned}$$

So $1.5 \times 10^6 : 4.5 \times 10^{14} \Rightarrow 1 : 3 \times 10^8$