2025 VCE Physics (NHT) external assessment report

This report provides sample answers, or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

Section A – Multiple-choice questions

Question	Correct answer	Comments
1	B	Perpendicular to the face of the slope.
2	C	$\frac{mv^2}{r} = \frac{800 \times 61^2}{120}$
3	B	The normal force provided by the floor is required to slow the ball to a stop and reverse the momentum.
4	A	$s = \frac{1}{2}at^2,\ t = \sqrt{\frac{2 \times 36}{9.81}} = 2.7\,s.\ d = vt = 10 \times 2.7 = 27\text{ m}$
5	A	$E = \frac{1}{2}xF = 0.5 \times 0.25 \times 80 = 10\text{ J}$
6	B	$\frac{100}{d} = 20,\ \frac{100}{\frac{1}{2}d} = 10\text{ J}$
7	D	$F = BIL$ and $\tau = Fr$ so torque depends on current, *I*, magnetic field, *B*, and the width of the loop, 2*r*.
8	C	$g \propto \frac{m}{r^2},\ \frac{1.5}{0.5^2} = 6$
9	D	Maximum flux occurs when the loop is perpendicular to the field. Maximum induced voltage occurs when $\frac{\Delta\Phi}{\Delta t}$ is maximum, which occurs when the loop is parallel to the field.
10	A	High AC voltages are used to transmit a fixed power at a lower current. Lower current results in less power loss over transmission lines.
11	D	$\frac{N_p}{N_s} = \frac{V_p}{V_s} = \frac{360}{12} = 30$
12	D	Use the right-hand slap rule. The field is to the right, the current flows from L to M; therefore, the force is upwards.

Question	Correct answer	Comments
13	A	Inverters convert DC to sinusoidal AC.
14	C	The sound level gets louder as Sam approaches the speakers.
15	C	$\lambda \propto \frac{1}{v}$ and $v \propto \sqrt{V}$, so $\lambda \propto \frac{1}{\sqrt{V}}$, therefore $\frac{L'}{L} = \frac{\frac{1}{\sqrt{10}}}{\frac{1}{\sqrt{1000}}} = 10$
16	B	$v = f\lambda$, $\lambda = \frac{40}{8} = 5$ m. The string needs to be half a wavelength.
17	A	If the threshold frequency is 6 x 10^{14} Hz, then light of a frequency of 5 x 10^{14} Hz (600 nm) will not result in photoemission.
18	B	The Michelson–Morley experiment failed to find any variation in the measured speed of light. This supports Einstein's postulate that the speed of light is the same for all observers.
19	D	Precision is defined as measurements being close to each other. Accuracy is defined as measurements being close to the true value.
20	A	$r = \frac{mv}{Bq}$, so $r \propto v$. A shows an $r = kv$ relationship.

Section B

Question 1a

$$F_{net} = ma$$

$$64 = (12 + m_B) \times 4$$

$$m_B = 4 \text{ kg}$$

Question 1b

$$F_{on\ B} = m_B \times a_B$$

$$F = 4 \times 4$$

$$F = 16 \text{ N}$$

Other correct workings were accepted.

Question 1c

Same.

In accordance with Newton's third law, the force of A on B has the same magnitude as the force of B on A.

Question 2

The severity of injuries will be directly proportional to the force applied.

Since $\Delta p = F\Delta t$, if the time for the change in momentum is increased, the force can be decreased.

Question 3a

Using conservation of energy:

$$\Delta KE = \Delta GPE$$

$$\Delta GPE = mg\Delta h$$

$$KE = 40.0 \times 9.81 \times 2.50$$

$$KE = 981 \text{ J}$$

Question 3b

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

$$981 = 0.5 \times 40.0 \times v^2$$

$$v = 7.00 \text{ m s}^{-1}$$

Question 3c

Required speed is now 14.0 m s^{-1}.

By conservation of energy:

$$\Delta KE = \Delta GPE$$

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

$$0.5 \times 40.0 \times 14.0^2 = 40.0 \times 9.81 \times h$$

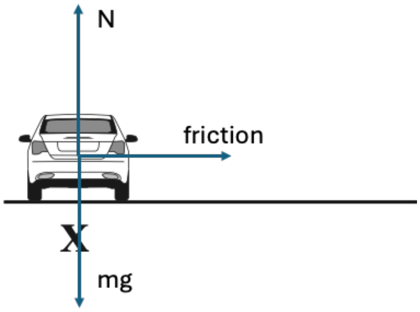
$$h = 10 \text{ m}$$

Question 4a

C.

Towards the centre of the circle.

Question 4b



Question 4c

G.

The road exerts a force on the tyre both upwards and inwards, and Newton's third law requires that the tyre exerts a force on the road downwards and outwards.

Question 5a

$$\frac{T_e^2}{R_e^3} = \frac{T_v^2}{R_v^3}$$

$$\frac{365^2}{1.5 \times 10^{11}} = \frac{T^2}{3.53 \times 10^{11}}$$

$$\Rightarrow T = 1317.7 \text{ days}$$

There were other valid methods.

Question 5b

$$v = \sqrt{\frac{GM}{r}}$$

$$v = \sqrt{\frac{6.67 \times 10^{-11} \times 2.59 \times 10^{20}}{(262 + 140) \times 10^3}}$$

$$v = 207 \text{ m s}^{-1}$$

Question 5c

$$v \propto \frac{1}{\sqrt{r}}$$

As r decreases, v increases.

Question 6a

$$E = \frac{V}{d}$$

$$E = \frac{5000}{0.02}$$

$$E = 2.5 \times 10^{5}\ \mathrm{V\ m^{-1}}$$

Question 6b.i

By applying the right-hand slap rule (or equivalent), the magnetic force can be shown to be acting downwards.

The electric field must apply an upward force to the electron.

Therefore, the upper plate must be positively charged.

If the upper plate is positive and the lower plate is negative, then the electric field is directed downwards.

Question 6b.ii

$$Bqv = qE$$

$$\therefore v = \frac{E}{B} = \frac{1.5 \times 10^{5}}{3.6 \times 10^{-3}}$$

$$v = 4.2 \times 10^{7}\ \mathrm{m\ s^{-1}}$$

Question 6b.iii

The magnetic force would be decreased ($F = Bqv$).

The electric force would remain unchanged ($F = Eq$).

The electric force would now exceed the magnetic force and the electron would be deflected upwards.

Question 7a

Chen states that ‘there is no gravity where there is no air’. This is incorrect as gravity exists in a vacuum.

Darika states that ‘the force due to gravity is acting on the astronaut’. This is correct.

Darika states that ‘her movement … in a stable circular orbit … creates a force that cancels out the gravitational force’. This is incorrect.

Question 7b

The only force acting on the astronaut is the gravitational force.

Both the astronaut and the ISS are accelerating towards Earth at the same rate, so there is no normal force acting on the astronaut.

Question 8a

$$P = VI$$

$$500 = 220 \times I$$

$$I = 2.27 \text{ A}$$

Question 8b.i

As the number of appliances that are turned on increases, the current drawn by the house increases.

The voltage drop along the supply cables is proportional to the current in the cables.

As the current increases, the voltage drop increases and the voltage measured at the house decreases.

Question 8b.ii

$$V_{loss} = RI$$

$$(220 - 210) = R \times 2.1$$

$$R = 4.8\ \Omega$$

Question 9a

The shape of the waveform is sinusoidal.

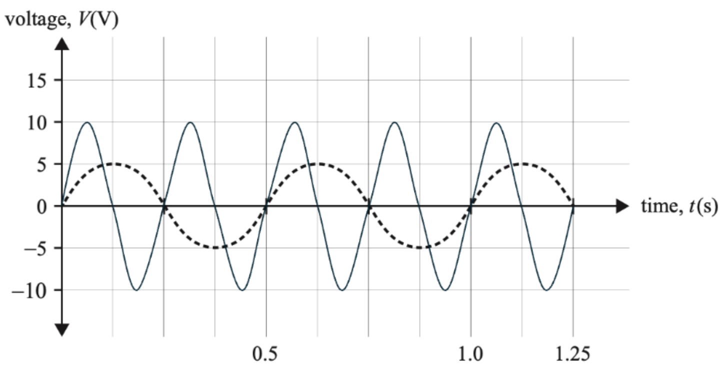
The peak voltage is 5.0 V.

Question 9b

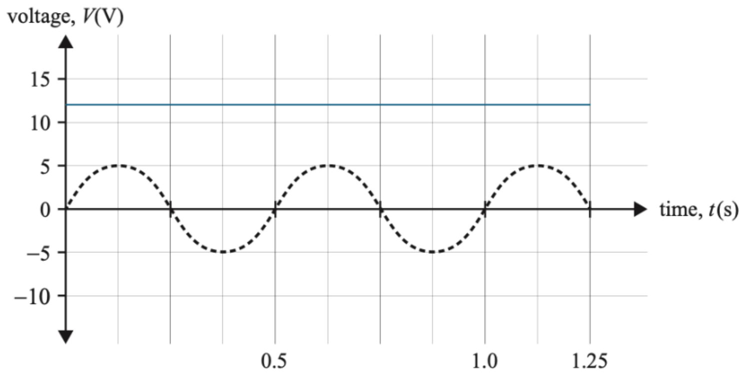
$$f = \frac{1}{T} = \frac{1}{0.5}$$

$$f = 2.0\ \text{Hz}$$

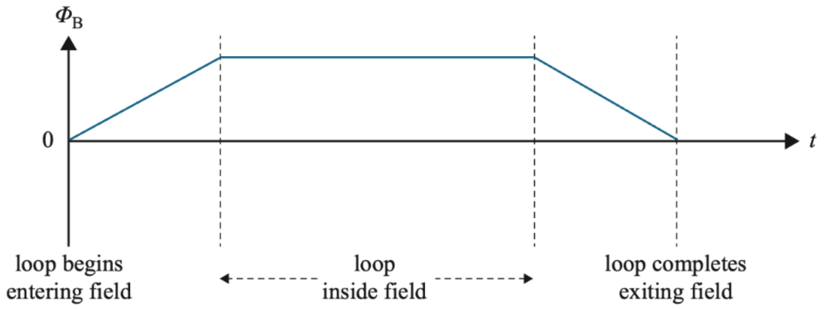
Question 9c



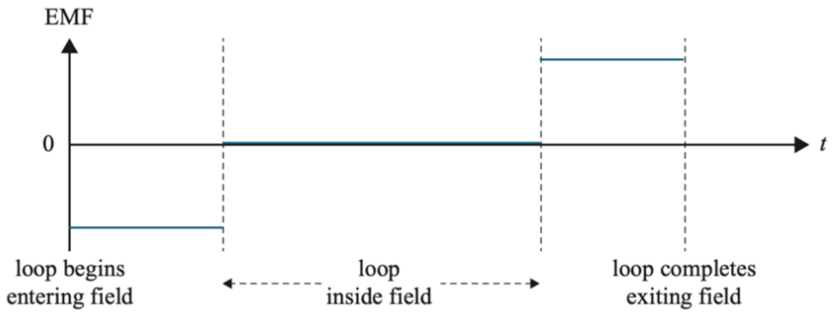
Question 9d



Question 10a



Question 10b



Question 10c

$$|\varepsilon| = \left|\frac{\Delta\Phi}{\Delta t}\right|$$

$$\varepsilon = 1.4 \times \frac{1.0\times10^{-2}}{1.5}$$

$$\varepsilon = 9.33\times10^{-3}\text{ V}$$

Question 10d

The loop is experiencing a decreasing flux downwards.

The induced current may produce an opposing change in flux, that is, an increasing flux downwards.

Applying the right-hand grip rule, a clockwise current results in an increasing downwards flux.

Question 11a

$$\Delta x = \frac{\lambda L}{w}$$

$$0.42 = \frac{\lambda \times 1.5}{0.10}$$

$$\lambda = 0.028 \text{ m } = 2.8 \text{ cm}$$

Question 11b

The path difference to point Z is 1.5 λ.

Since the path difference is of the form $\left(n + \frac{1}{2}\right)\lambda$, destructive interference will occur.

Question 11c

Point Y will be a maximum.

If the frequency is doubled, the wavelength will be halved (1.4 cm). The path difference to Y is now two wavelengths rather than one.

Question 12a

$$E = \frac{hc}{\lambda}$$

$$10.2 = \frac{4.14 \times 10^{-15} \times 3.00 \times 10^{8}}{\lambda}$$

$$\lambda = 122 \text{ nm}$$

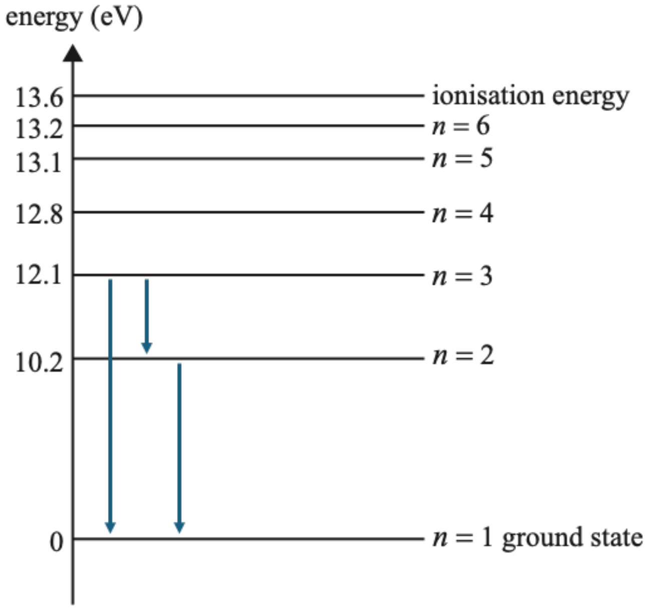
Question 12b

$$p = \frac{h}{\lambda}$$

$$p = \frac{6.63 \times 10^{-34}}{103 \times 10^{-9}}$$

$$p = 6.44 \times 10^{-27} \text{ kg·m/s}$$

Question 12c



Question 13

The timing signals require correction due to the relative motion of the satellites and the Earth-bound receivers. Time dilation will cause the satellite clocks to appear to run slow when measured from the Earth-bound receivers.

Question 14

Only Observation 3 cannot be explained by the wave model.

The wave model predicts that the kinetic energy of the electrons emitted from a given metal will be independent of frequency and dependent on the intensity of the light striking the metal.

The particle model predicts that the light will arrive in discrete quanta (photons).

The energy of these photons is dependent on their frequency ($E = hf$).

Question 15

The electron double-slit experiment demonstrates interference (of electrons).

Interference is a property of waves and provides evidence for the wave nature of electrons.

Question 16

$E = \Delta mc^2$

$1.52 \times 10^{27} = \Delta m \times \left(3.00 \times 10^8\right)^2$

$\Delta m = 1.69 \times 10^{10}\ \text{kg s}^{-1}$

Question 17a

$E = qV$

$E = 1.6 \times 10^{-19} \times 1.9 \times 10^{12}$

$E = 3.04 \times 10^{-7}\ \text{J}$

Question 17b

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

$3.04 \times 10^{-7} = 0.5 \times \left(3.27 \times 10^{-25}\right) \times v^2$

$v = 1.36 \times 10^9\ \text{m s}^{-1}$

Question 17c

No, it does not agree with our understanding of physics.

The velocity exceeds the speed of light in a vacuum.

Question 17d

$E_{total} = \gamma mc^2$

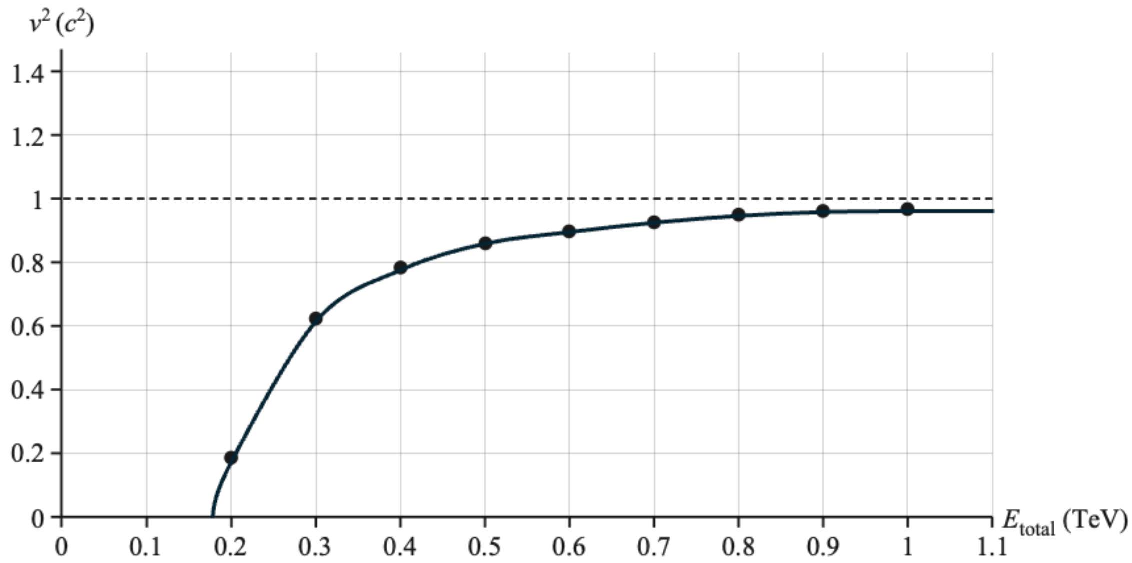
$3.04 \times 10^{-7} = \gamma \times 3.27 \times 10^{-25} \times \left(3.00 \times 10^8\right)^2$

$\gamma = 10.3$

Question 17e

Classification	Variable
independent	accelerating voltage
dependent	speed
controlled	type of particle (gold ion) / mass of gold ion

Question 17f.i



Question 17f.ii

The dashed line represents a value of v^2 that equals c^2, where c is the speed of light. v^2 cannot exceed c^2.

Question 17f.iii

The value of the horizontal intercept is ~0.18 TeV.

This value represents the rest energy of the gold ion.