Neap

Trial Examination 2021

VCE Physics Units 3&4

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 2 hours 30 minutes

Student's Name: _____

Teacher's Name: _____

Structure of booklet

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	20	20	20
B	20	20	110
			Total 130

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, pre-written notes (one folded A3 sheet or two A4 sheets bound together by tape) and one scientific calculator.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied

Question and answer booklet of 36 pages

Formula sheet

Answer sheet for multiple-choice questions

Instructions

Write your **name** and your **teacher's name** in the space provided above on this page, and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

At the end of the examination

Place the answer sheet for multiple-choice questions inside the front cover of this booklet.

You may keep the formula sheet.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2021 VCE Physics Units 3&4 Written Examination.

SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Take the value of g to be 9.8 m s^{-2}.

Question 1

A current carrying wire is placed near the north end of a bar magnet, as shown in the diagram below.

Point P is midway between the north end of the magnet and the centre of the wire. The current in the wire is out of the page. Assume all individual magnetic fields have the same magnitude.

magnet

wire with current out of the page

Which one of the following best represents the direction of the magnetic field at point P?

A. 

B. 

C. 

D. 

Question 2

A charge has a magnitude of 10 μC.

Which one of the following is closest to the magnitude of the electric field at a distance of 1.0 mm from the charge?

A. 9.0×10^{6} N C^{-1}

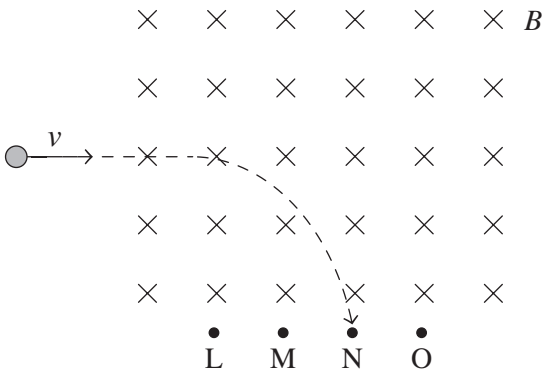
B. 9.0×10^{7} N C^{-1}

C. 9.0×10^{9} N C^{-1}

D. 9.0×10^{10} N C^{-1}

Question 3

The diagram below shows the path of an electron through a magnetic field, B. The electron enters the magnetic field with speed v. The electron exits the field at point N.



The speed of the electron is changed to $\frac{v}{2}$ and the strength of the magnetic field is changed to $\frac{B}{2}$.

At which point does the electron now exit?

A. L

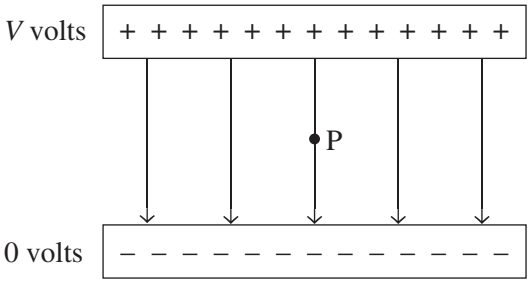
B. M

C. N

D. O

Question 4

Point P is midway between two charged plates, at a distance of 10 cm **from each plate**. The plate potential values are V volts and 0 volts, as shown in the diagram below.

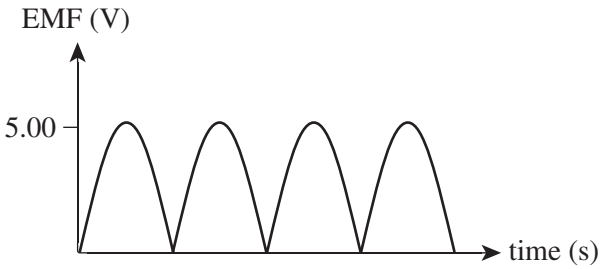


Which one of the following correctly represents the potential and the magnitude of the electric field strength at point P?

	Potential (V)	Electric field strength (V m^{-1})
A.	V	$5V$
B.	$\frac{V}{2}$	$10V$
C.	V	$10V$
D.	$\frac{V}{2}$	$5V$

Use the following information to answer Questions 5 and 6.

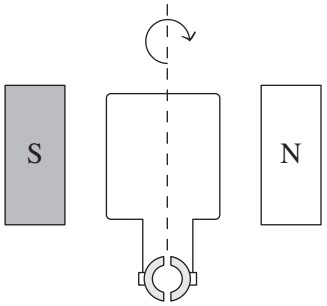
A rectangular coil is rotated at constant speed within a magnetic field produced by two poles from two different magnets. A graph of the EMF output from the coil versus time is shown below.



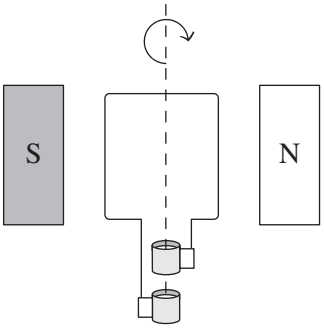
Question 5

Which one of the following circuit configurations results in the output shown in the graph above?

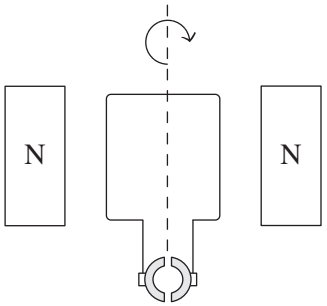
A.



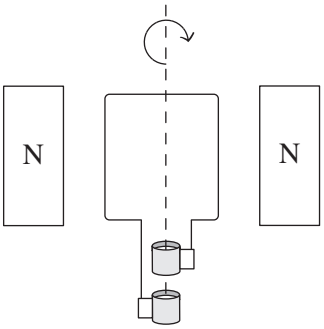
B.



C.



D.



Question 6

The RMS value for the EMF output is

A. 3.54 V

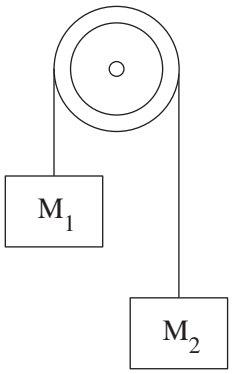
B. 5.00 V

C. 7.07 V

D. 10.00 V

Question 7

Two masses, M_1 and M_2, are connected by a light, inextensible string and hang from a pulley, as shown in the diagram below.



The mass of M_2 is greater than the mass of M_1. M_2 accelerates downwards.

The tension in the string is

A. greater than M_2g.

B. equal to M_2g.

C. less than M_2g.

D. equal to $M_2g - M_1g$.

Question 8

A boy of mass 60.0 kg squats down, then jumps vertically upwards. He takes 0.50 s to jump from rest to 4.00 m s^{-1}.

The magnitude of the impulse imparted to the boy by the Earth is

A. 120 N s

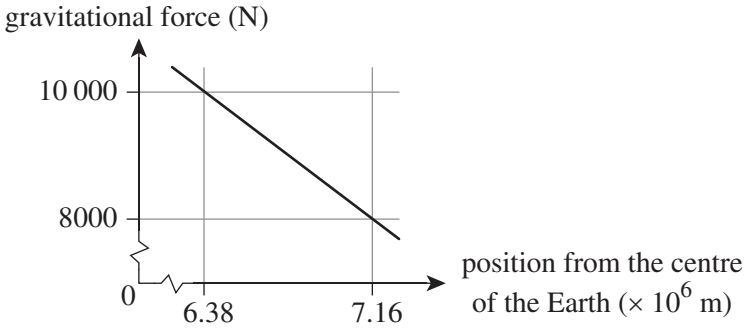
B. 240 N s

C. 588 N s

D. 960 N s

Question 9

The graph below shows the gravitational force acting on a falling object versus its position from the centre of the Earth for a small range of distance.



The work done by gravity to move the object from 7.16×10^6 m to 6.38×10^6 m is

A. 1.56 GJ

B. 6.24 GJ

C. 7.02 GJ

D. 7.80 GJ

Question 10

A travelling subatomic particle has a Lorentz factor of 1.20.

The particle's speed is closest to

A. 0.41*c*

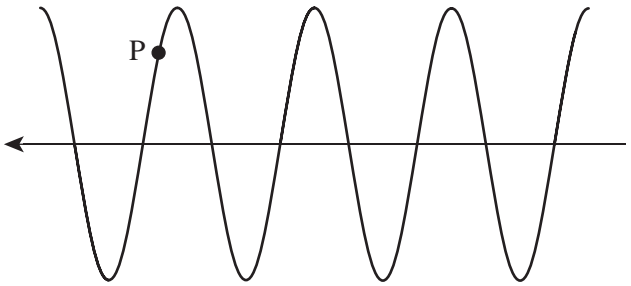
B. 0.55*c*

C. 0.83*c*

D. 0.91*c*

Question 11

A progressive transverse wave passes through point P, as shown in the diagram below. The wave travels to the left.



For the instant shown in the diagram, a particle at point P is moving

A. upwards.

B. downwards.

C. left.

D. right.

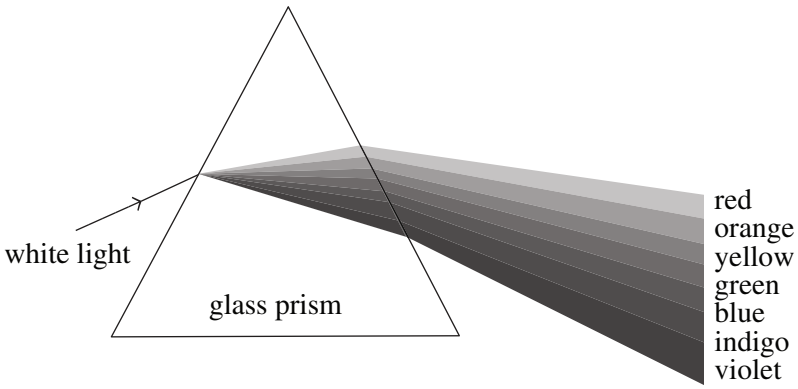
Question 12

Which one of the following correctly identifies two properties of a region of the electromagnetic spectrum?

	Region	Property 1	Property 2
A.	X-ray	highest energy per photon	useful for medical diagnostic imaging
B.	microwave	less energy than infrared per photon	useful for communication
C.	infrared	more energy than ultraviolet per photon	useful for thermal imaging and heat mapping
D.	gamma	highest energy per photon	useful for thermal imaging and heat mapping

Question 13

The dispersion of a beam of white light through a triangular glass prism is shown in the diagram below.



Which one of the following statements about dispersion through the prism is correct?

A. The refractive index of the prism is greater for higher frequency colours.

B. The speeds of the different colours of light in the prism are the same.

C. The refractive index is not affected by the wavelength of the colours.

D. The separation of the colours is not affected by the angle of incidence of the light entering the prism.

Question 14

Polarisation of visible light occurs when a property of light waves oscillating in various planes is affected.

Which one of the following correctly identifies this property?

A. wavelength

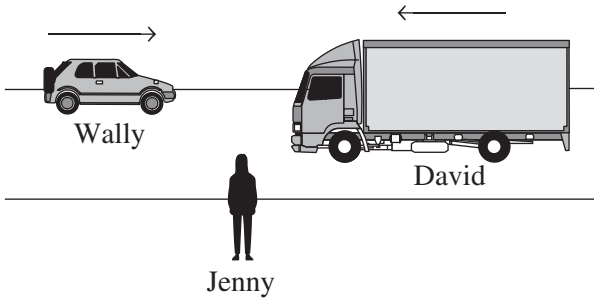
B. period

C. frequency

D. amplitude

Question 15

Wally is driving a car and David is driving a truck. They are travelling in the opposite direction to each other. Jenny is standing on the footpath ready to cross the road, as shown in the diagram below.



David sounds his horn to alert Jenny to stay on the footpath. Wally and Jenny hear the truck's horn at their positions.

Which one of the following statements about the frequency of the truck's horn is correct?

A. Wally and Jenny hear the same frequency as each other, but it is higher than what David hears due to the truck's motion.

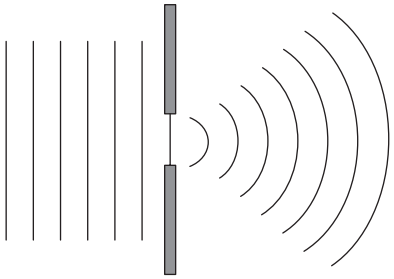
B. Wally and Jenny hear the same frequency as each other, but it is lower than what David hears due to the truck's motion.

C. Jenny hears a higher frequency than Wally.

D. Wally hears a higher frequency than Jenny.

Question 16

Sound waves are passed through a gap, as shown in the diagram below.



The sound waves are of frequency *f* and the gap is of width *d*.

Which one of the following sets of values for *f* and *d* would lead to the greatest diffraction occurring?

	f	*d*
A.	100 Hz	0.15 m
B.	200 Hz	1.0 m
C.	300 Hz	1.5 m
D.	400 Hz	10 m

Question 17

The creation of a helium nucleus in the Sun can be modelled by the fusion of four protons.

Let m_{proton} be the mass of a proton and m_{helium} be the mass of a helium nucleus. The speed of light is c.

Which one of the following represents the energy released in the production of a helium atom in the Sun?

A. $m_{\text{helium}} \times c^2$

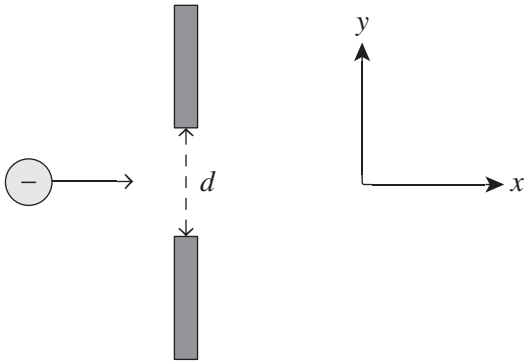
B. $\left(m_{\text{helium}} - m_{\text{proton}}\right) \times c^2$

C. $\left(4m_{\text{proton}} - m_{\text{helium}}\right) \times c^2$

D. $\left(m_{\text{helium}} - 4m_{\text{proton}}\right) \times c^2$

Question 18

An electron is passed through a very narrow gap of width d, as shown in the diagram below. Under certain conditions the electron is able to diffract.



The uncertainty in the y-position of the electron in the gap affects the uncertainty in

A. the y-direction momentum only.

B. the x-direction momentum only.

C. both the x-direction and y-direction of momentum.

D. both the x-direction and y-direction of momentum, but more so for the y-direction.

Question 19

Which one of the following instruments is responsible for the production of light by the forced circular motion of high speed electrons?

A. light-emitting diode (LED)

B. incandescent globe

C. laser

D. synchrotron

Question 20

A correctly calibrated data logger determines that the frequency of a note from a guitar string is 440 Hz.

A group of students use the same guitar string to record the note on a different data logger. Their results are shown below.

[451 ± 2] Hz [450 ± 2] Hz [452 ± 2] Hz [451 ± 2] Hz [452 ± 2] Hz

The data is

A. reliable and valid.

B. unreliable and not valid.

C. reliable and not valid.

D. unreliable and valid.

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided.

Where an answer box is provided, write your final answer in the box.

If an answer box has a unit printed in it, give your answer in that unit.

In questions where more than one mark is available, appropriate working **must** be shown.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Take the value of g to be 9.8 m s^{-2}.

Question 1 (8 marks)

An electron is travelling to the right in a region that consists of a uniform electric field, E, and a uniform magnetic field into the page, B, as shown in Figure 1. The electric field is represented by the arrows. At any time, the fields are uniform but their magnitude is able to be varied. Gravitational effects acting on the electron are negligible.

Figure 1 shows a particular instant of the electron's motion. The electron's speed is 1.0×10^6 m s^{-1} for the instant shown.

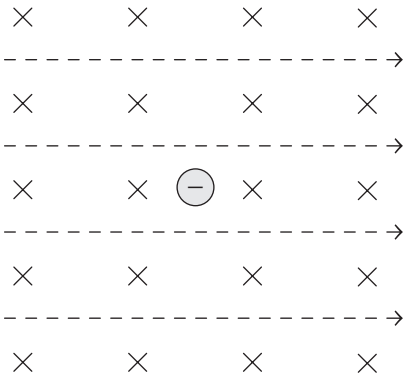


Figure 1

a. Assume that $E = 1.0 \times 10^6$ N C^{-1} and $B = 0.0$ T.

Determine the magnitude of the net force on the electron. Show your working. 2 marks

N

b. Assume that $E = 0$ N C^{-1} and $B = 2.0$ T.

i. Determine the magnitude of the net force on the electron. Show your working. 2 marks

N

ii. Explain, using physics principles, the resulting motion of the electron while it remains in the region of magnetic field B. 2 marks

c. Assume that $E = 1.0 \times 10^6$ N C^{-1} and $B = 2.0$ T.

Using your answers to **part a.** and **part b.i.**, determine the magnitude of the net force on the electron. Show your working. 2 marks

N

Question 2 (6 marks)

The ICESat-2 satellite is part of NASA's Earth Observing System and measures ice sheet elevation and sea ice thickness. It has an orbital period of 94.2 minutes.

a. Calculate the altitude of the ICESat-2 satellite correct to three significant figures.
Show your working. 4 marks

m

b. The satellite is moved to a new, stable orbit of greater altitude.
Explain what effect this has on the speed of the satellite. 2 marks

Question 3 (5 marks)

A rectangular coil is connected to a DC battery to produce a motor arrangement, as shown in Figure 2. The direction of conventional current in the coil and the rotation of the coil are also shown.

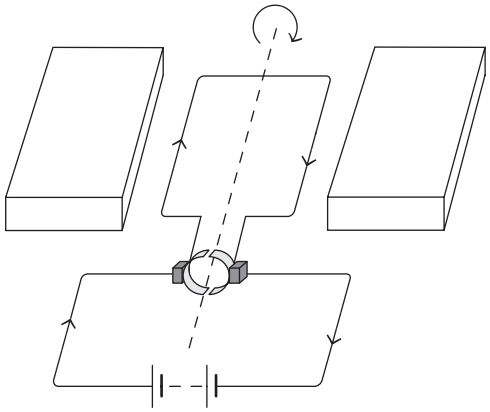


Figure 2

a. On Figure 2, use 'S' for south and 'N' for north to label the poles of the magnets closest to the coil. 1 mark

b. The circuit connected to the battery has a total resistance of 4.5 Ω. The battery voltage is 6.0 V. The coil has sides of length 6.0 cm and 4.0 cm. The longest sides of the coil are shown parallel to the magnetic poles in Figure 2. The magnetic field is uniform and of size 0.10 T.

How many turns does the coil have if a longer side is to experience a force of 0.32 N? Show your working. 2 marks

turns

c. Suggest **two** modifications that could be made to the apparatus shown in Figure 2 that would cause the coil to turn more slowly. 2 marks

Question 4 (7 marks)

As part of a class experiment, students set up a magnet on the end of a spring. Figure 3 shows the magnet stationary on the end of the spring.

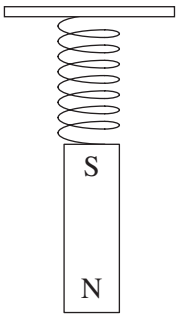


Figure 3

Figure 4 shows the magnet after it has been released from the position shown in Figure 3. It is stationary at its lowest point, with the north pole of the magnet just above a coil. The coil is connected across terminals X and Y of a galvanometer.

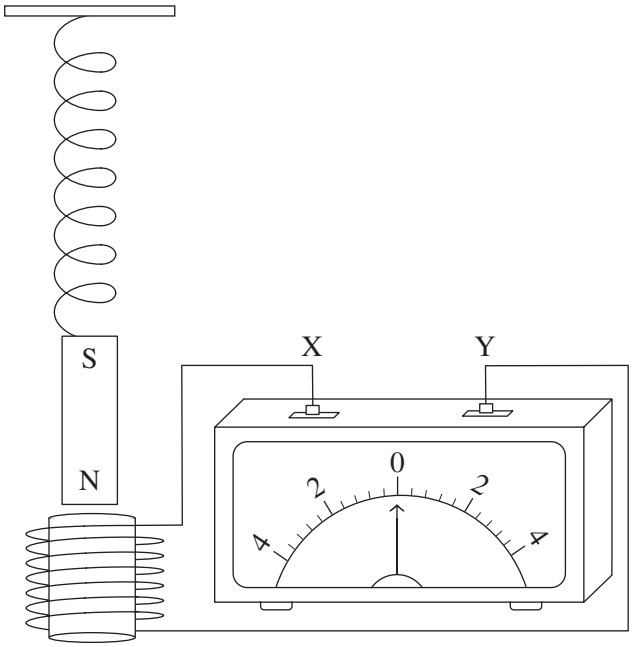


Figure 4

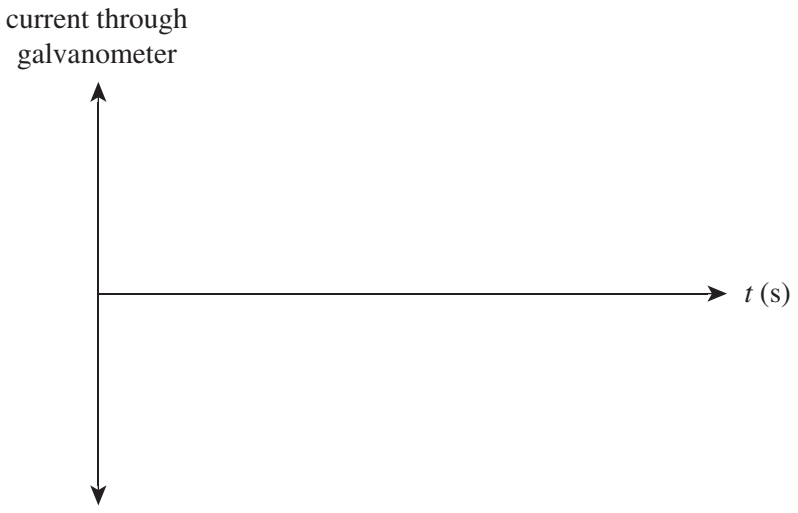
When the magnet is released, it oscillates between the position in Figure 4 and the position in Figure 3. The galvanometer needle remains in the vertical (zero) position when no current passes from the coil. The needle swings left if current passes into Y, through the galvanometer and out from X. The needle swings right if current passes into X, through the galvanometer and out from Y.

a. The magnet moves from the position shown in Figure 4 to the position shown in Figure 3.

Does the galvanometer needle swing left, remain at 0 or swing right? Explain your answer. 4 marks

b. The magnet oscillates between the position shown in Figure 3 and the position shown in Figure 4 over two cycles. The time taken to go between the position shown in Figure 3 and the position shown in Figure 4 is 0.50 seconds.

On the axes provided below, sketch the variation of the current through the galvanometer versus time, *t*, for the two cycles. Include a scale on the horizontal axis. 3 marks



Question 5 (7 marks)

A circular coil of wire of 6 turns and diameter 4.0 cm is connected to a voltmeter, as shown in Figure 5. A magnet is placed close to the right of the coil.

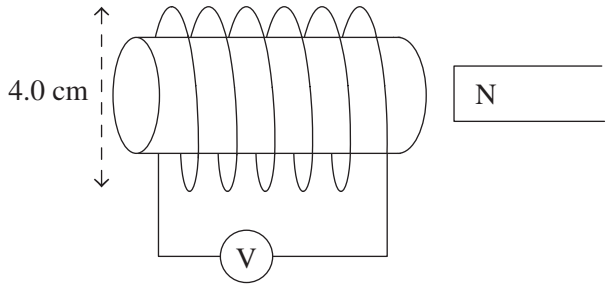


Figure 5

As the magnet is pulled away from the coil over time, the magnetic field experienced by the coil varies according to the graph shown in Figure 6.

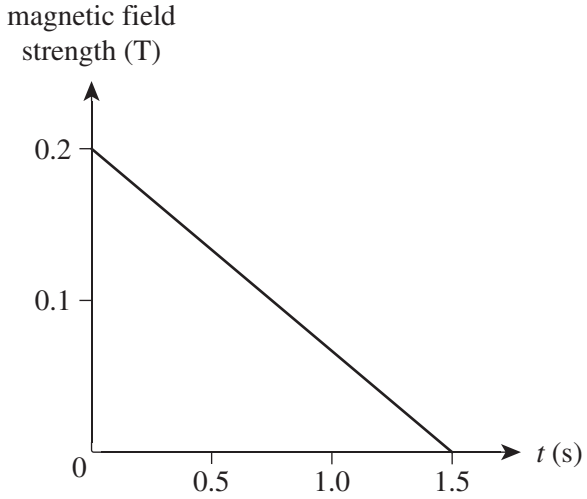


Figure 6

a. Show that the magnetic flux experienced by the coil for the position shown in Figure 5 is 2.5×10^{-4} Wb. 2 marks

b. Determine the magnitude of the average EMF experienced by the coil as the magnet is pulled away from the coil over time. Show your working. 2 marks

V

c. Suggest **two** modifications that could be made to the **apparatus** shown in Figure 5, using the same magnet, that would enable the coil to experience a greater EMF as the magnet is removed. Use physics principles to justify your suggestions. 3 marks

Question 6 (5 marks)

A group of students construct a model of a long-distance power transmission system using the circuit shown in Figure 7. The long distance wiring has a total resistance of 5.0 Ω. The circuit consists of an ideal transformer at the beginning of the long distance wiring and an identical ideal transformer at the end of the long distance wiring. The transformer terminals are labelled P, Q, R and S.

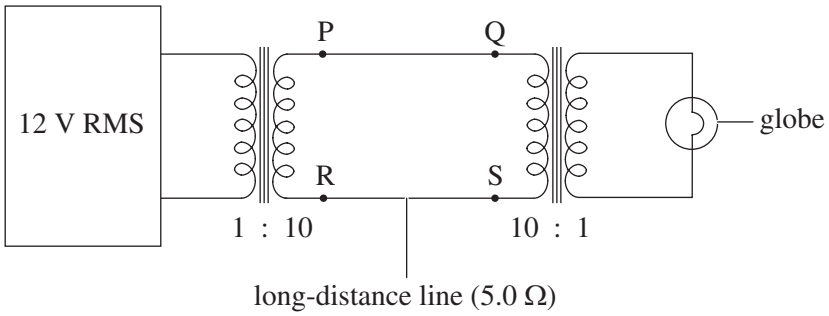


Figure 7

The voltage across the globe is 11.5 V RMS.

a. Determine the potential difference across PR (V_{PR}) and across QS (V_{QS}) in the circuit. Show your working. 2 marks

V_{PR} = V

V_{QS} = V

b. Determine the power supplied to the globe. Show your working. 3 marks

W

Question 7 (5 marks)

A toy car of mass 20 g starts from rest at a height of 2.20 m above ground and travels down a track that has the profile shown in Figure 8. The crest has a circular profile of radius 0.50 m. Point A on the track is 0.50 m above the ground. The track-and-car system is frictionless and air resistance is negligible.

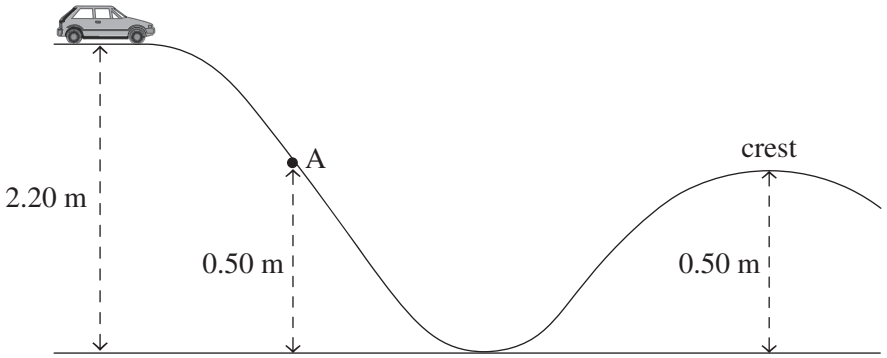


Figure 8

a. Determine the speed of the toy car when it reaches point A. Show your working. 2 marks

m s^{-1}

b. Does the toy car leave the track at the top of the crest? Support your answer with calculations. 3 marks

Question 8 (3 marks)

Figure 9 shows a ball of mass 0.080 kg travelling in a horizontal circular path at a constant speed while suspended from the ceiling by a 1.0 m long string. The radius of the circle is *r*. The string is at an angle of 20° to the centre of the circular path. The period of rotation of the ball is 1.95 seconds.

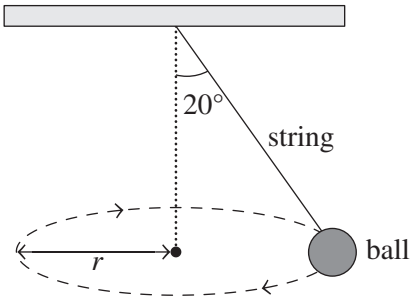


Figure 9

Determine the speed of the ball. Show your working.

m s^{-1}

Question 9 (5 marks)

A golf ball is launched from an unknown height above the ground. It lands at a horizontal distance of 2.35 m away from its starting position, as shown in Figure 10. The vertical and horizontal components of the velocity of the golf ball, v_X and v_Y, are shown at the landing position.

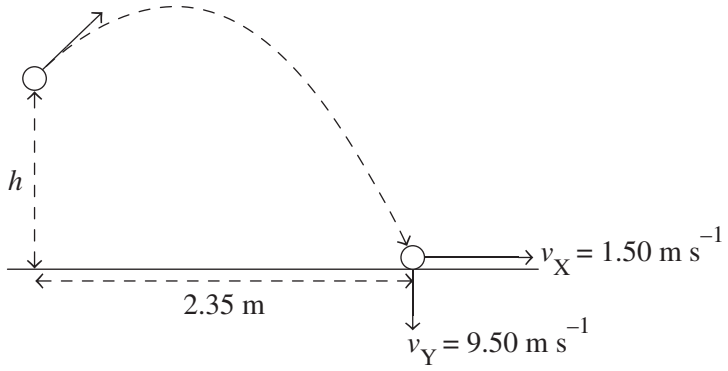


Figure 10

a. Show that the time the ball spends in the air is approximately 1.57 s. 2 marks

b. Determine the launch speed of the ball. Show your working. 3 marks

m s^{-1}

Question 10 (4 marks)

A toy cart of mass 100 g has a spring-loaded launch mechanism. A steel ball of mass 20 g is loaded into it. The cart–ball system is shown in Figure 11.

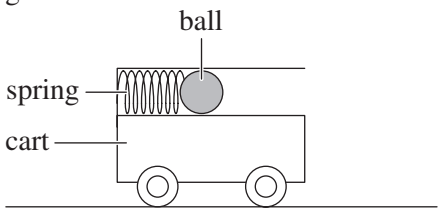


Figure 11

The spring has a spring constant of 800 N m^{-1}. The spring is compressed by 1.0 cm with the ball against it.

The cart–ball system is stationary.

A graph of energy versus spring displacement is shown in Figure 12.

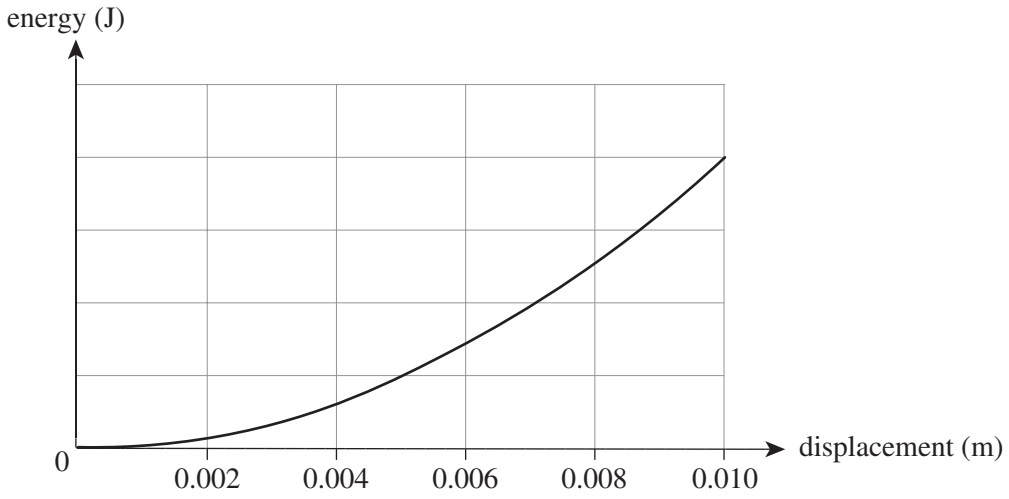


Figure 12

The spring is released so that the ball is projected. Both the cart and the spring move. As the spring expands, no energy is released as heat or sound.

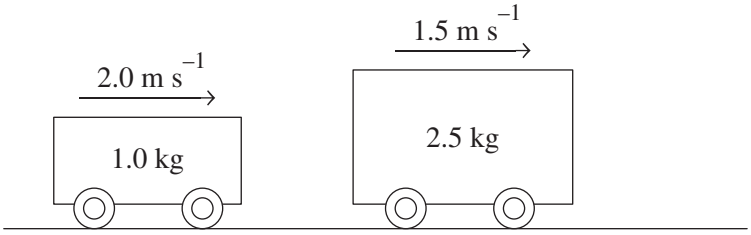
a. On the graph above:

- draw the graph of the kinetic energy of the cart–ball system as the spring expands from 1 cm compression to its unloaded length
- include a scale for the *y*-axis, in joules. 2 marks

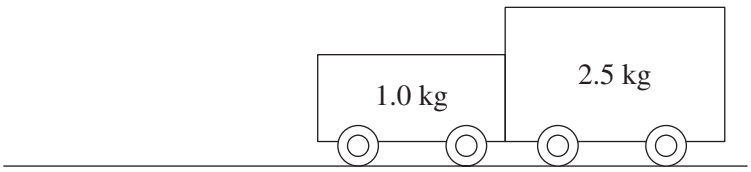
b. Explain, using physics principles, your reasoning for the scale for the *y*-axis chosen in **part a.** 2 marks

Question 11 (3 marks)

As part of a class experiment, two carts are involved in a collision. A cart of mass 1.0 kg travelling at 2.0 m s^{-1} approaches a cart of mass 2.5 kg travelling at 1.5 m s^{-1} in the same direction. They couple as a single unit upon contact. This is shown in Figure 13 below.



before coupling



after coupling

Figure 13

Determine the speed of the coupled carts immediately after they couple. Show your working.

m s^{-1}

Question 12 (5 marks)

A spacecraft of mass 5 000 000 kg is travelling from Earth to a star-system that is 10.2 light years from Earth, as measured by scientists on Earth. The spacecraft travels at $0.750c$ ($\gamma = 1.51$) directly towards the star-system. According to scientists on Earth, the trip will take 13.6 years.

a. Will the measuring instruments on the spacecraft record a greater, equal, or lesser time than 13.6 years? Provide an explanation for your answer. Do **not** provide calculations. 3 marks

b. Determine the kinetic energy of the spacecraft as it travels to the star-system. Show your working. 2 marks

J

Question 13 (4 marks)

Figure 14 shows the position of a progressive transverse wave for a particular instant in time, as measured by its position. The wave moves to the right at 6.0 m s^{-1}.

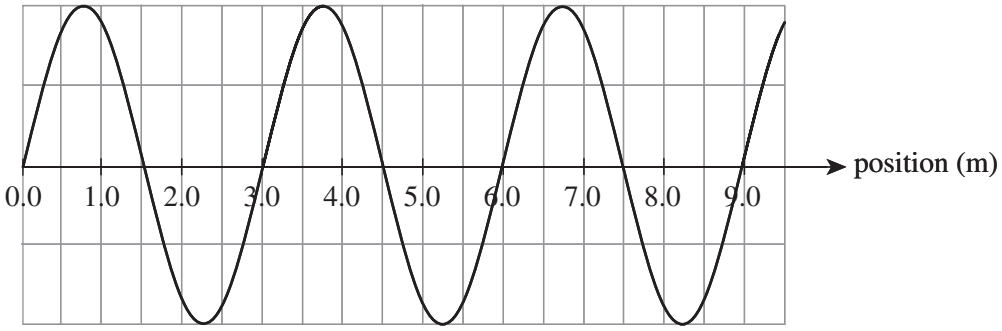


Figure 14

a. What is the period of the wave? Show your working 2 marks

s

b. On Figure 14, sketch the position of **one** cycle of the wave 0.25 s later than the instant shown. 2 marks

Question 14 (6 marks)

Two loudspeakers, L_1 and L_2, are able to play the same single note simultaneously using the same power output. Zara stands in front of the speakers. *A* and *B* are the distances from the speakers to Zara, as shown in Figure 15.

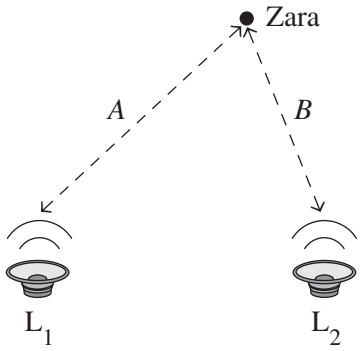


Figure 15

Data

distance *A*	5.4 m
distance *B*	3.8 m
speed of sound in air	340 m s^{-1}

At a particular time, L_1 and L_2 play a note of frequency 850 Hz simultaneously.

a. Compare how Zara would perceive the intensity of the sound from both speakers with the intensity of the sound from speaker L_1 only. Support your answer with calculations. 4 marks

b. Zara moves to a new position so that distance *A* is 6.0 m. She is still closer to speaker L_2 than she is to speaker L_1. The note played by the speakers changes to a note of wavelength 0.75 m. Zara is now barely able to hear any sound.
Determine a possible value for distance *B* from her new position. Show your working. 2 marks

m

Question 15 (3 marks)
Explain why the term 'resonant frequenices' is used to refer to musical notes produced by plucking a guitar string.

Question 16 (3 marks)

Figure 16 shows the passage of a ray of green light through various media. It passes from water into sapphire. At a specific angle, θ, the transmitted ray of green light only just reflects at the sapphire–air interface.

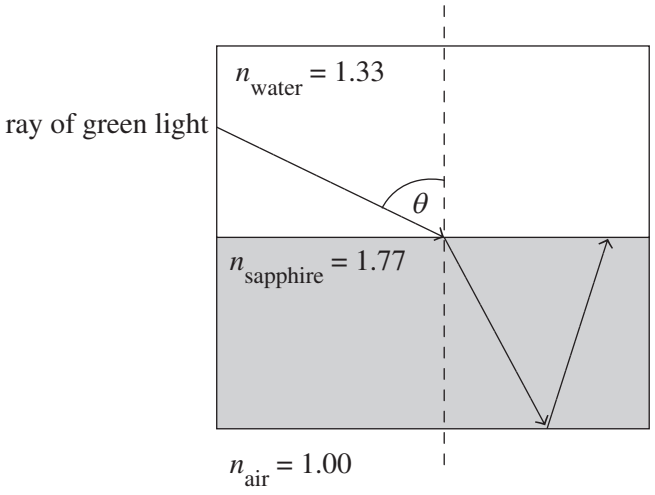


Figure 16

Determine the size of angle θ. Show your working.

°

Question 17 (7 marks)

In a photoelectric effect experiment, light is shone onto the metal cathode of a photocell, as shown in Figure 17.

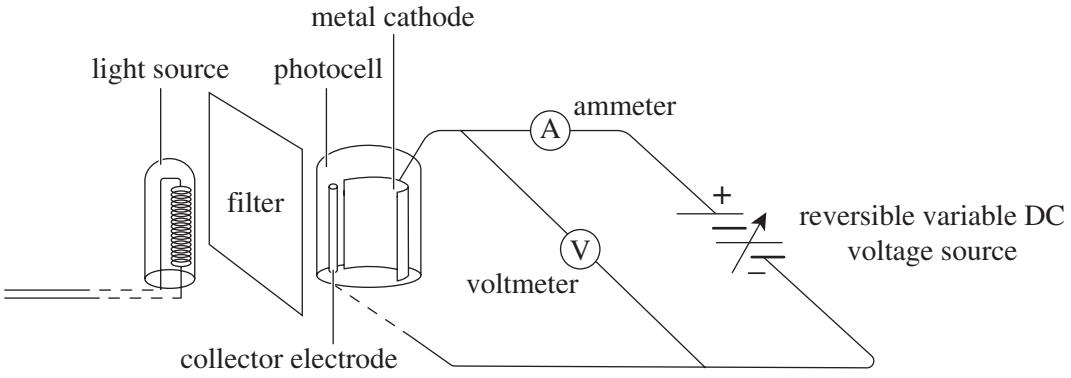


Figure 17

The data recorded is shown in Table 1. The intensity and photocurrent were qualitatively recorded.

Table 1

Trial	Colour and wavelength	Intensity	Stopping voltage (V)	Photocurrent
1	red light 650 nm, 4.615×10^{14} Hz	low	0.00 (no electrons released from cathode)	0
2	red light 650 nm, 4.615×10^{14} Hz	high	0.00 (no electrons released from cathode)	0
3	green light 500 nm, 6.000×10^{14} Hz	same as trial 1	0.38	low
4	green light 500 nm, 6.000×10^{14} Hz	same as trial 2	0.38	greater than trial 3
5	violet light 400 nm, 7.500×10^{14} Hz	same as trial 1	1.00	low
6	violet light 400 nm, 7.500×10^{14} Hz	same as trial 2	1.00	greater than trial 5

a. Does any of the data above conflict with the wave model of light? Explain your answer. 4 marks

b. Determine the work function of the metal in the metal cathode. Show your working. 3 marks

eV

Question 18 (5 marks)

An electron is accelerated from rest to a particular speed by an electric field with a potential difference of 10 000 V.

a. Determine the de Broglie wavelength of the electron accelerated by 10 000 V. Show your working. 3 marks

m

b. Calculate the momentum of a photon that has the same wavelength as the de Broglie wavelength of the electron in **part a.** Show your working. 2 marks

kg m s^{-1}

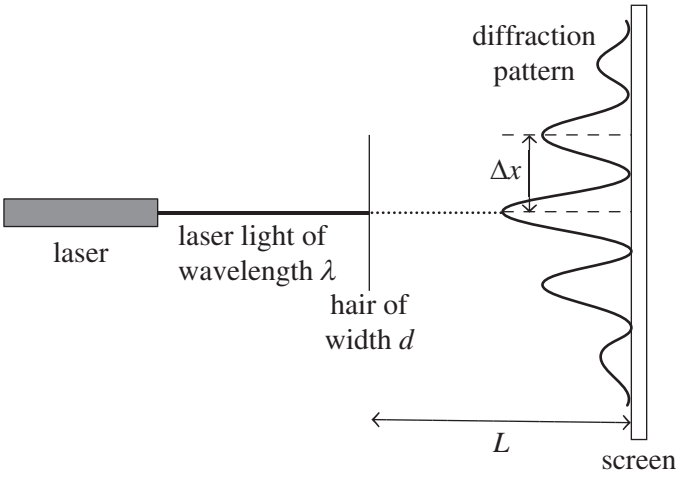
Question 19 (3 marks)
The visible section of the emission spectrum for hydrogen is shown in Figure 18.

Figure 18

Explain how the emission spectrum for hydrogen provides evidence that an electron has wave-like properties.

Question 20 (16 marks)

A group of students are interested in determining the wavelength of their class laser, λ. They set up the apparatus shown in Figure 19 to irradiate a hair of known width, d, and measure the distance between the central maximum and the first bright spot on a screen, Δx. L represents the distance between the plane of the hair and the screen.



Δx distance between the central and first maxima of intensity
L distance between plane of the hair and the screen
d width of the hair
λ wavelength of the laser light

Figure 19

The students become aware that the pattern observed on the screen would be identical to the pattern created when a laser is fired at two very small slits that are a distance apart equal to the width of the hair.

The experiment is repeated with a number of hairs of different widths. The width of each hair is determined using a microscope measurement system. $L = 5.50$ m for each hair used.

a. Explain, using physics principles, the effect of increasing the width of the hair on the pattern produced on the screen. 3 marks

b. Identify the dependent and independent variables in this experiment. Give your reasoning. 2 marks

The results are shown in Table 2. The heading of the last column shows the uncertainty for quantity.

Table 2

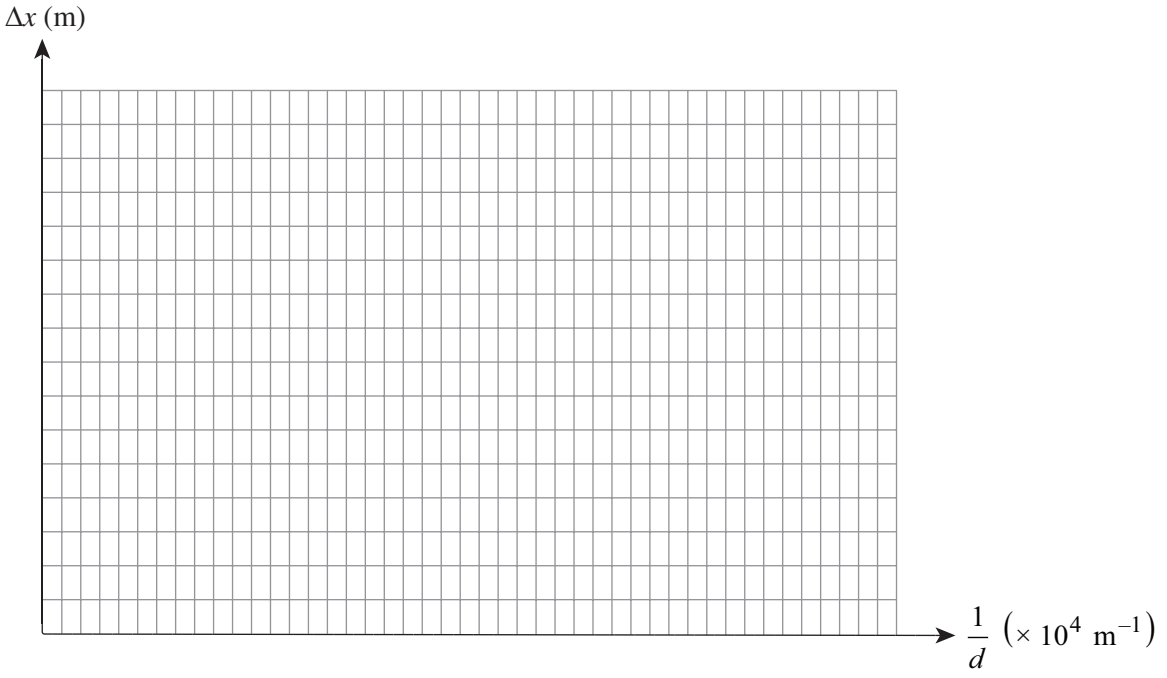
Δx (m)	d (m)	$\frac{1}{d}$ (m^{-1}) $\pm 0.1 \times 10^4$
0.146	25×10^{-6}	
0.111	33×10^{-6}	
0.072	51×10^{-6}	
0.048	76×10^{-6}	
0.037	98×10^{-6}	

c. Calculate the values of $\frac{1}{d}$ and write them in the spaces provided in Table 2. Express values to the correct number of significant figures. Do **not** determine the uncertainties for the $\frac{1}{d}$ values calculated. 2 marks

d. Plot a graph of Δx on the y-axis against $\frac{1}{d}$ on the x-axis on the grid provided below.

On your graph:

- include an appropriate scale for the y-axis
- include an appropriate scale for the x-axis
- draw a straight line of best fit through the plotted points
- include uncertainty bars for the x-axis only (uncertainty bars for the y-axis are not required). 6 marks



e. Use the straight line of best fit drawn in **part d.** to find the value of the wavelength of the laser light. 3 marks

m

END OF QUESTION AND ANSWER BOOKLET

Neap

Trial Examination 2021

VCE Physics Units 3&4

Written Examination

Formula Sheet

Instructions

This formula sheet is provided for your reference.
A question and answer booklet is provided with this formula sheet.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

PHYSICS FORMULAS

Motion and related energy transformations

velocity; acceleration	$v = \frac{\Delta s}{\Delta t}; \quad a = \frac{\Delta v}{\Delta t}$
equations for constant acceleration	$v = u + at$ $s = ut + \frac{1}{2}at^2$ $s = vt - \frac{1}{2}at^2$ $v^2 = u^2 + 2as$ $s = \frac{1}{2}(v + u)t$
Newton's second law	$\Sigma F = ma$
circular motion	$a = \frac{v^2}{r} = \frac{4\pi^2 r}{T^2}$
Hooke's law	$F = -k\Delta x$
elastic potential energy	$\frac{1}{2}k(\Delta x)^2$
gravitational potential energy near the surface of Earth	$mg\Delta h$
kinetic energy	$\frac{1}{2}mv^2$
Newton's law of universal gravitation	$F = G\frac{m_1 m_2}{r^2}$
gravitational field	$g = G\frac{M}{r^2}$
impulse	$F\Delta t$
momentum	$mv\gamma$
Lorentz factor	$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$
time dilation	$t = t_o\gamma$
length contraction	$L = \frac{L_o}{\gamma}$
rest energy	$E_{rest} = mc^2$
relativistic total energy	$E_{total} = \gamma mc^2$
relativistic kinetic energy	$E_k = (\gamma - 1)mc^2$

Fields and application of field concepts

electric field between charged plates	$E = \frac{V}{d}$
energy transformations of charges in an electric field	$\frac{1}{2}mv^2 = qV$
field of a point charge	$E = \frac{kq}{r^2}$
force on an electric charge	$F = qE$
Coulomb's law	$F = \frac{kq_1q_2}{r^2}$
magnetic force on a moving charge	$F = qvB$
magnetic force on a current carrying conductor	$F = nIlB$
radius of a charged particle in a magnetic field	$r = \frac{mv}{qB}$

Generation and transmission of electricity

voltage; power	$V = RI$; $P = VI = I^2R$
resistors in series	$R_T = R_1 + R_2$
resistors in parallel	$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$
ideal transformer action	$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$
AC voltage and current	$V_{RMS} = \frac{1}{\sqrt{2}}V_{peak}$ $I_{RMS} = \frac{1}{\sqrt{2}}I_{peak}$
electromagnetic induction	EMF: $\varepsilon = -N\frac{\Delta\Phi_B}{\Delta t}$ flux: $\Phi_B = B_\perp A$
transmission losses	$V_{drop} = I_{line}R_{line}$ $P_{loss} = I^2_{line}R_{line}$

Wave concepts

wave equation	$v = f\lambda$
constructive interference	path difference = $n\lambda$
destructive interference	path difference = $\left(n - \frac{1}{2}\right)\lambda$
fringe spacing	$\Delta x = \frac{\lambda L}{d}$

The nature of light and matter

photoelectric effect	$E_{\text{k max}} = hf - \phi$
photon energy	$E = hf$
photon momentum	$p = \frac{h}{\lambda}$
de Broglie wavelength	$\lambda = \frac{h}{p}$

Data

acceleration due to gravity at Earth's surface	$g = 9.8 \text{ m s}^{-2}$
mass of the electron	$m_e = 9.1 \times 10^{-31} \text{ kg}$
magnitude of the charge of the electron	$e = 1.6 \times 10^{-19} \text{ C}$
Planck's constant	$h = 6.63 \times 10^{-34} \text{ J s}$ $h = 4.14 \times 10^{-15} \text{ eV s}$
speed of light in a vacuum	$c = 3.0 \times 10^{8} \text{ m s}^{-1}$
universal gravitational constant	$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$
mass of Earth	$M_E = 5.98 \times 10^{24} \text{ kg}$
radius of Earth	$R_E = 6.37 \times 10^{6} \text{ m}$
Coulomb constant	$k = 8.99 \times 10^{9} \text{ N m}^2 \text{ C}^{-2}$

Prefixes/Units

p = pico = 10^{-12}	n = nano = 10^{-9}	μ = micro = 10^{-6}	m = milli = 10^{-3}
k = kilo = 10^{3}	M = mega = 10^{6}	G = giga = 10^{9}	t = tonne = 10^{3} kg

END OF FORMULA SHEET

Neap

Trial Examination 2021

VCE Physics Units 3&4

Written Examination

Multiple-choice Answer Sheet

Student's Name: _____

Teacher's Name: _____

Instructions

Use a **pencil** for **all** entries. If you make a mistake, **erase** the incorrect answer – **do not** cross it out. Marks will **not** be deducted for incorrect answers.
No mark will be given if more than **one** answer is completed for any question.

All answers must be completed like this example: **A** B C D

Use pencil only

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

11	A	B	C	D
12	A	B	C	D
13	A	B	C	D
14	A	B	C	D
15	A	B	C	D
16	A	B	C	D
17	A	B	C	D
18	A	B	C	D
19	A	B	C	D
20	A	B	C	D