EXAM PAPER

Physics Unit 3 & 4 — Practice Exam 1

PREVIEW
This file has the first 18 of the 35 questions in this paper. The rest is locked: it comes with a PrepNest plan, or with the paper itself for VCE.

Reading time: 15 minutes (no writing)
Writing time: 150 minutes
Total time: 165 minutes

SECTIONS IN THIS PAPER

- Section A — multiple choice — 25 min (calculator allowed) — 18 questions, 18 marks
- Section B — short answer — 125 min (calculator allowed) — 0 questions, 0 marks

A formula sheet is printed at the end of this paper.

INSTRUCTIONS

You are not permitted to write during reading time — you may only read the paper and plan your approach. Answer every question you can. Write your working in the space provided for long-answer questions. Marking guidance and full explanations are provided in the separate answer key.

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Section A — multiple choice

25 minutes • Calculator allowed

INSTRUCTIONS

- Answer all 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.
- Unless otherwise indicated, the diagrams in this book are not drawn to scale.

Question 1

A book rests on a horizontal table. According to Newton’s third law, the force that pairs with the gravitational force of Earth on the book is

A. the normal force of the table on the book
B. the gravitational force of the book on Earth
C. the normal force of the book on the table
D. the weight of the table

Question 2

A ball is kicked from level ground with a speed of 20.0 m s^{-1} at 30.0° above the horizontal. Ignoring air resistance, the ball is in the air for

A. 1.02 s
B. 1.77 s
C. 2.04 s
D. 3.53 s

Question 3

A curve on a racetrack has a radius of 80.0 m and is banked at 12.0° to the horizontal. The speed at which a car can take the curve with no sideways friction is closest to

A. 4.12 m s^{-1}
B. 12.9 m s^{-1}
C. 28.0 m s^{-1}
D. 60.8 m s^{-1}

Question 4

A 2.0 kg trolley moving at 3.0 m s^{-1} collides with a stationary 1.0 kg trolley. The trolleys stick together. The kinetic energy lost in the collision is

A. 0 J
B. 3.0 J
C. 6.0 J
D. 9.0 J

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Question 5

A spring with spring constant 200 N m^{-1} is compressed by 0.10 m and used to launch a 0.050 kg ball along a smooth horizontal surface. The speed of the ball as it leaves the spring is

A. 4.47 m s^{-1}
B. 6.32 m s^{-1}
C. 8.94 m s^{-1}
D. 20.0 m s^{-1}

Question 6

A satellite orbits at an altitude of 6.37×10^{6} m above Earth's surface. The strength of Earth's gravitational field at the satellite is closest to

A. 2.45 N kg^{-1}
B. 4.91 N kg^{-1}
C. 9.81 N kg^{-1}
D. 19.6 N kg^{-1}

Question 7

A charge $+Q$ and a charge $+4Q$ are fixed 3.0 m apart. At a point P on the line between them, the electric field is zero. The distance of P from the $+4Q$ charge is

A. 0.75 m
B. 1.0 m
C. 1.5 m
D. 2.0 m

Question 8

An electron moves to the right across the page through a uniform magnetic field directed into the page. As it enters the field, the magnetic force on the electron is directed

A. into the page
B. out of the page
C. towards the top of the page
D. towards the bottom of the page

Question 9

Which one of the following statements about gravitational, electric and magnetic fields is correct?

A. Electric field lines begin on positive charges and end on negative charges.
B. Gravitational forces can be attractive or repulsive.
C. An isolated magnetic pole produces a radial magnetic field.
D. A stationary charged particle in a uniform magnetic field experiences a force perpendicular to the field.

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Question 10

An ideal transformer has 1200 turns on its primary coil and 60 turns on its secondary coil. The primary is connected to a 240 V RMS supply. The peak voltage across the secondary is closest to

A. 8.49 V
B. 12.0 V
C. 17.0 V
D. 339 V

Question 11

The rate at which the coil of an AC generator rotates is doubled. The magnetic field and the coil are unchanged. Which one of the following gives the effect on the output?

	Peak EMF	**Frequency of the output**
A.	unchanged	doubled
B.	doubled	unchanged
C.	halved	doubled
D.	doubled	doubled

Question 12

A power station transmits 50 kW at 5000 V through transmission lines with a total resistance of 4.0 Ω. The power lost in the lines is

A. 40 W
B. 400 W
C. 4.0 kW
D. 6.25 MW

Question 13

In a DC motor, the split-ring commutator

A. reverses the direction of the current in the coil every half-turn, so the coil keeps turning in the same direction
B. keeps the current in the coil flowing in the same direction at all times
C. increases the magnetic field whenever the coil is parallel to it
D. stops the coil at the position where the net force on it is zero

Question 14

Light of wavelength 600 nm passes through two slits 0.40 mm apart and falls on a screen 2.0 m away. The distance between adjacent bright bands on the screen is

A. 0.30 mm
B. 1.5 mm
C. 3.0 mm
D. 6.0 mm

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Question 15

In a photoelectric experiment, the intensity of the light is increased while its frequency is kept constant (and above the threshold frequency). Which one of the following gives the effect?

	Maximum kinetic energy of photoelectrons	Photocurrent
A.	unchanged	increases
B.	increases	increases
C.	increases	unchanged
D.	unchanged	unchanged

Question 16

An electron is accelerated from rest through a potential difference of 150 V. Its de Broglie wavelength is closest to

A. 4.01×10^{-20} m
B. 7.09×10^{-11} m
C. 1.00×10^{-10} m
D. 8.28×10^{-9} m

Question 17

The energy levels of hydrogen are $E_n = -\frac{13.6}{n^2}$ eV. The wavelength of the photon emitted when an electron moves from the $n = 3$ level to the $n = 1$ level is closest to

A. 91.3 nm
B. 97.4 nm
C. 103 nm
D. 122 nm

Question 18

Muons have a lifetime of 2.2 μs in their own frame of reference. For muons travelling at $0.98c$, the lifetime measured by an observer on Earth is closest to

A. 0.44 μs
B. 2.2 μs
C. 5.0 μs
D. 11 μs

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Physics formulas

Motion and related energy transformations	
velocity; acceleration	$v = \dfrac{\Delta s}{\Delta t}; \quad a = \dfrac{\Delta v}{\Delta t}$
equations for constant acceleration	$v = u + at \qquad s = ut + \frac{1}{2}at^2 \qquad s = vt - \frac{1}{2}at^2$
	$v^2 = u^2 + 2as \qquad s = \frac{1}{2}(u + v)t$
Newton's second law	$\Sigma F = ma$
uniform circular motion	$F_{\text{net}} = \dfrac{mv^2}{r}; \quad v = \dfrac{2\pi r}{T}$
Hooke's law	$F = -kx$
elastic potential energy	$E_s = \frac{1}{2}kx^2$
gravitational potential energy	$E_g = mg\Delta h$
kinetic energy	$E_k = \frac{1}{2}mv^2$
Newton's law of universal gravitation	$F_g = G\dfrac{m_1 m_2}{r^2}$
gravitational field	$g = G\dfrac{M}{r^2}$
impulse	$F\Delta t = m\Delta v$
momentum	$p = mv$

Einstein's special theory of relativity	
Lorentz factor	$\gamma = \dfrac{1}{\sqrt{1 - \dfrac{v^2}{c^2}}}$
time dilation	$t = t_0\gamma$
length contraction	$L = \dfrac{L_0}{\gamma}$
relativistic rest energy	$E_0 = mc^2$
relativistic total energy	$E_{\text{total}} = E_k + E_0 = \gamma mc^2$
relativistic kinetic energy	$E_k = (\gamma - 1)mc^2$

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

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

Waves	
wave equation	$v = f\lambda$
constructive interference	path difference $= n\lambda$
destructive interference	path difference $= \left(n + \frac{1}{2}\right)\lambda$
interference pattern spacing	$\Delta x = \dfrac{\lambda L}{d}$ when $L \gg d$

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The nature of light and matter	
photoelectric effect	$E_{k\max} = hf - \phi$
photon energy	$E = hf = \dfrac{hc}{\lambda}$
photon momentum	$p = \dfrac{h}{\lambda}$
de Broglie wavelength	$\lambda = \dfrac{h}{p}$

Data		
acceleration due to gravity at Earth's surface	$g = 9.81\ \text{m s}^{-2}$	
mass of the electron	$m_e = 9.11 \times 10^{-31}\ \text{kg}$	
magnitude of the charge of the electron	$q_e = 1.60 \times 10^{-19}\ \text{C}$	
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	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$	
universal gravitation constant	$G = 6.67 \times 10^{-11}\ \text{N m}^2\,\text{kg}^{-2}$	
mass of Earth	$M_E = 5.97 \times 10^{24}\ \text{kg}$	
radius of Earth	$R_E = 6.37 \times 10^{6}\ \text{m}$	
Coulomb constant	$k = 8.99 \times 10^{9}\ \text{N m}^2\,\text{C}^{-2}$	

Metric (SI) multipliers			
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 = tera = 10^{12}

Unit conversions	
1 tonne (t) = 10^3 kg	1 kilowatt hour (kW h) = 3.6×10^6 J

Nomenclature	
force due to gravity	F_g
terminology for force	$F_{\text{on A by B}}$
normal force	F_N

END OF FORMULA SHEET

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17 questions locked, up to question 15.

PREVIEW

That’s the end of the preview

You’ve seen the first 18 of the 35 questions in Physics Unit 3 & 4 — Practice Exam 1. The full paper is worth 120 marks.

STILL TO COME	QUESTIONS	MARKS
Section A — multiple choice	2	2
Section B — short answer	15	100

The full paper comes with

- Every question, printed exactly like the ones in this preview
- The complete answer key, with the working behind every mark
- A topic report after marking, showing what to practice next

Get the full paper at

prepnest.com.au/practice/exams/physics-year_12-1

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