EXAM PAPER

Physics Unit 3 & 4 — Practice Exam 4

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 skydiver falls vertically at a constant (terminal) velocity. Which one of the following statements is correct?

A. The air resistance on the skydiver is equal in size to the skydiver's weight.
B. The net force on the skydiver is downwards.
C. The skydiver's weight is zero.
D. The air resistance on the skydiver is greater than the skydiver's weight.

Question 2

A 0.15 kg ball hits a wall at 20 m s^{-1} and rebounds along the same line at 15 m s^{-1}. The magnitude of the change in momentum of the ball is

A. 0.75 kg m s^{-1}
B. 5.25 kg m s^{-1}
C. 35.0 kg m s^{-1}
D. 525 kg m s^{-1}

Question 3

A 30 kg child on a swing moves through the lowest point at 4.0 m s^{-1}. The ropes are 2.5 m long. The total tension in the ropes at the lowest point is closest to

A. 102 N
B. 294 N
C. 486 N
D. 678 N

Question 4

A car travelling on a level road brakes with a constant braking force and stops. If the car had been travelling at twice the speed, with the same braking force, its stopping distance would have been

A. four times as long
B. twice as long
C. the same
D. half as long

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Question 5

A large truck collides head-on with a small car. During the collision, compared with the force that the truck exerts on the car, the force that the car exerts on the truck is

A. much smaller
B. slightly smaller
C. larger
D. the same size

Question 6

A satellite orbits at an altitude equal to twice Earth’s radius. The gravitational field strength at the satellite is closest to

A. 1.09 N kg^{-1}
B. 2.45 N kg^{-1}
C. 3.27 N kg^{-1}
D. 4.91 N kg^{-1}

Question 7

Satellite X orbits Earth at four times the orbital radius of satellite Y. The ratio of their periods, $\frac{T_X}{T_Y}$, is

A. 2
B. 4
C. 8
D. 16

Question 8

An electron is between two horizontal parallel plates. The top plate is positive and the bottom plate is negative. The electric force on the electron is directed

A. towards the bottom plate
B. parallel to the plates
C. towards the top plate
D. nowhere — it is zero because the field is uniform

Question 9

A proton moves parallel to the field lines of a uniform magnetic field. The magnetic force on the proton is

A. perpendicular to the field
B. zero
C. in the direction of the field
D. opposite to the direction of the field

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Question 10

The coil of a simple DC motor rotates in a uniform magnetic field. The turning effect (torque) on the coil is greatest when

A. the plane of the coil is perpendicular to the magnetic field
B. the plane of the coil is parallel to the magnetic field
C. the current in the coil is zero
D. the brushes are in the gaps of the split ring

Question 11

A 1000 W heater operates from a 240 V RMS supply. The peak current in the heater is closest to

A. 2.95 A
B. 4.17 A
C. 5.89 A
D. 8.33 A

Question 12

The magnetic flux through a rotating coil varies sinusoidally with time. The EMF induced in the coil is greatest at the instants when the flux through the coil is

A. a maximum
B. zero
C. half its maximum value
D. a maximum in the opposite direction

Question 13

A step-down transformer draws 0.50 A from a 240 V supply. Its output is 12 V at 9.0 A. The efficiency of the transformer is

A. 50%
B. 75%
C. 80%
D. 90%

Question 14

The energy of a photon of light of wavelength 600 nm is closest to

A. 2.07 eV
B. 3.31 eV
C. 6.21 eV
D. 2.07×10^{9} eV

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Question 15

Young’s double-slit experiment was historically significant because it

A. proved the existence of photons
B. gave the first measurement of the speed of light
C. showed that light is made of particles
D. provided strong evidence for the wave model of light

Question 16

The de Broglie wavelength of a 0.145 kg baseball travelling at 40 m s^{-1} is closest to

A. 2.86×10^{-36} m
B. 1.14×10^{-34} m
C. 4.57×10^{-33} m
D. 1.83×10^{-31} m

Question 17

Two inertial observers are moving relative to each other. According to special relativity, which one of the following quantities will they always measure to be the same?

A. the length of an object moving relative to one of them
B. the time between two events
C. the speed of light in a vacuum
D. the total energy of a moving particle

Question 18

The energy levels of hydrogen are $E_n = -\frac{13.6}{n^2}$ eV. The wavelength of the photon emitted when an electron in hydrogen moves from the $n = 4$ level to the $n = 2$ level is closest to

A. 122 nm
B. 365 nm
C. 435 nm
D. 487 nm

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FORMULA SHEET

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.

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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 4. 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_12-4

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