Physics Unit 3 & 4 — Practice Exam 4 — Answers & Explanations

Answers to the 18 questions in the free preview.

Section A — multiple choice

1. A. The air resistance on the skydiver is equal in size to the skydiver's weight.

Constant velocity means zero acceleration, so by Newton's first law the net force is zero: the upward air resistance balances the weight. The weight is unchanged.

2. B. 5.25 kg m s⁻¹

The velocity reverses: $\Delta v = -15 - 20 = -35$ m s⁻¹, so $|\Delta p| = 0.15 \times 35 = 5.25$ kg m s⁻¹. 0.75 subtracts the speeds, ignoring the change of direction.

3. C. 486 N

At the lowest point the net force is upwards, towards the centre: $T - mg = \frac{mv^2}{r}$, so $T = 30 \times 9.81 + \frac{30 \times 4.0^2}{2.5} = 294 + 192 = 486$ N. 102 N subtracts the centripetal term, as if at the top.

4. A. four times as long

The work done by the braking force removes the kinetic energy: $Fs = \frac{1}{2}mv^2$, so $s \propto v^2$. Doubling v makes the stopping distance four times as long.

5. D. the same size

These forces are a Newton's third-law pair, so they are equal in size and opposite in direction. The car suffers the larger acceleration because its mass is smaller.

6. A. 1.09 N kg⁻¹

An altitude of $2R_E$ puts the satellite $3R_E$ from Earth's centre, so $g = \frac{9.81}{3^2} = 1.09$ N kg⁻¹. 2.45 N kg⁻¹ uses $2R_E$ from the centre; 3.27 N kg⁻¹ uses an inverse (not inverse-square) law.

7. C. 8

From $\frac{GMm}{r^2} = \frac{4\pi^2 mr}{T^2}$, $T^2 \propto r^3$, so $\frac{T_X}{T_Y} = 4^{\frac{3}{2}} = 8$.

8. C. towards the top plate

The field points from the positive to the negative plate (downwards); a negative charge experiences a force opposite to the field, so the electron is pushed up, towards the positive plate. A uniform field exerts a constant force, not zero force.

9. B. zero

A charge experiences a magnetic force only from the component of its velocity perpendicular to the field. Moving parallel to the field, that component is zero, so the force is zero.

10. B. the plane of the coil is parallel to the magnetic field

The forces on the sides of the coil are always perpendicular to the field. When the plane of the coil is parallel to the field, these forces act at the greatest distance from the axis and produce the most torque; when the plane is perpendicular, they act through the axis and produce none.

11. C. 5.89 A

$I_{\text{RMS}} = \frac{P}{V_{\text{RMS}}} = \frac{1000}{240} = 4.17$ A, and $I_{\text{peak}} = \sqrt{2} \times 4.17 = 5.89$ A. 4.17 A is the RMS value.

12. B. zero

The EMF depends on the rate of change of flux — the gradient of the flux–time graph. A sinusoid is steepest where it crosses zero and flat at its peaks, so the EMF is greatest when the flux is zero.

13. D. 90%

Input power $= 240 \times 0.50 = 120$ W; output power $= 12 \times 9.0 = 108$ W; efficiency $= \frac{108}{120} = 90\%$. The rest is lost as heat in the windings and the core.

PrepNest

14. A. 2.07 eV

$E = \frac{hc}{\lambda} = \frac{4.14\times10^{-15}\times3.00\times10^{8}}{600\times10^{-9}} = 2.07$ eV. 3.31 comes from the energy in joules (3.31×10^{-19} J) with the power of ten dropped; 2.07×10^{9} eV leaves the wavelength in nanometres.

15. D. provided strong evidence for the wave model of light

Bright and dark bands are an interference pattern, which only waves produce: the two paths reinforce or cancel depending on the path difference. Photons were proposed a century later to explain the photoelectric effect.

16. B. 1.14 × 10⁻³⁴ m

$\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}}{0.145\times40} = 1.14 \times 10^{-34}$ m — far smaller than any gap it could pass through, which is why everyday objects show no observable wave behaviour.

17. C. the speed of light in a vacuum

This is Einstein’s second postulate. Lengths, time intervals and energies all depend on the observer’s frame of reference.

18. D. 487 nm

$\Delta E = 13.6\left(\frac{1}{4} - \frac{1}{16}\right) = 2.55$ eV and $\lambda = \frac{hc}{\Delta E} = \frac{1.242\times10^{-6}}{2.55} = 4.87 \times 10^{-7}$ m. 435 nm is the $n = 5 \to 2$ line; 122 nm is $n = 2 \to 1$.

PrepNest

PREVIEW

That’s the end of the preview answers

These are the answers to the 18 preview questions. The full answer key covers all 35 questions in Physics Unit 3 & 4 — Practice Exam 4, with the working behind every mark.

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

PrepNest