Physics Unit 3 & 4 — Practice Exam 5 — Answers & Explanations

Answers to the 18 questions in the free preview.

Section A — multiple choice

1. C. 12 N

Both blocks accelerate together at $a = \frac{20}{5.0} = 4.0$ m s⁻². The only horizontal force on the 3.0 kg block is the contact force, so it is $3.0 \times 4.0 = 12$ N. 8.0 N is the net force on the 2.0 kg block; 4.0 is the acceleration.

2. D. 7.42 m s⁻¹

The work done by the net force, $10 \times 3.0 = 30$ J, adds to the initial kinetic energy of $\frac{1}{2}(2.0)(5.0)^2 = 25$ J: $\frac{1}{2}(2.0)v^2 = 55$, so $v = 7.42$ m s⁻¹. 5.48 m s⁻¹ ignores the initial kinetic energy.

3. A. 12.6 s

$T = \frac{2\pi r}{v} = \frac{2\pi \times 12}{6.0} = 12.6$ s. 75.4 s multiplies the circumference by the speed.

4. C. 39 N m⁻¹

At equilibrium $kx = mg$: $k = \frac{0.20 \times 9.81}{0.050} = 39$ N m⁻¹. 392 N m⁻¹ uses 5.0 mm; 4.0 N m⁻¹ leaves out g.

5. D. increases the time over which the driver's momentum changes, reducing the average force

The driver's change in momentum (the impulse) is the same with or without the airbag. Because $F\Delta t = m\Delta v$, spreading that change over a longer time reduces the average force.

6. D. $16F$

$F = \frac{Gm_1m_2}{r^2}$: doubling both masses multiplies F by 4, and halving r multiplies it by another 4, giving $16F$.

7. A. zero

At the midpoint the two fields are equal in magnitude and point in opposite directions (each away from its own positive charge), so they cancel. This is a null point.

8. B. doubles

$r = \frac{mv}{qB}$, so the radius is directly proportional to the speed.

9. C. $\frac{v}{2}$

$\frac{GMm}{r^2} = \frac{mv^2}{r}$ gives $v = \sqrt{\frac{GM}{r}}$, so four times the radius gives half the speed. Satellites further out move more slowly.

10. A. increasing the resistance of the circuit connected to the generator

The EMF is $\varepsilon = -N\frac{\Delta\Phi_B}{\Delta t}$: more turns, a stronger field (larger flux) and faster rotation (less time) all increase it. The external resistance affects the current, not the induced EMF.

11. B. 12 V

$V_2 = V_1\frac{N_2}{N_1} = 240 \times \frac{24}{480} = 12$ V. 4800 V inverts the ratio.

12. C. 34.7 W

$I = \frac{2000}{240} = 8.33$ A and $P_{\text{loss}} = I^2R = 8.33^2 \times 0.50 = 34.7$ W. 4.17 is the voltage drop in volts; 1.15×10^5 W wrongly uses $\frac{V^2}{R}$ with the supply voltage.

13. D. always has the same polarity, although it still varies in size

The commutator reverses the connections every half-turn, so the negative half-cycles are flipped: the output is DC that fluctuates between zero and the peak. The peak value is unchanged.

14. B. 1.6 × 10¹⁶

Each photon carries $E = \frac{hc}{\lambda} = \frac{6.63\times10^{-34}\times3.00\times10^{8}}{650\times10^{-9}} = 3.06 \times 10^{-19}$ J, so $n = \frac{5.0\times10^{-3}}{3.06\times10^{-19}} = 1.6 \times 10^{16}$ per second.

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15. C. 540 nm

At the threshold $hf_0 = \phi$: $\lambda_0 = \frac{hc}{\phi} = \frac{4.14\times10^{-15}\times3.00\times10^{8}}{2.3} = 5.4 \times 10^{-7}$ m. Longer wavelengths have photons with too little energy.

16. B. the frequency of the light and the work function of the metal

$E_{k\max} = hf - \phi$. The intensity changes the number of photoelectrons, not their maximum energy; the voltage across the cell affects how many reach the collector, not the energy with which they are emitted.

17. B. 1.0 × 10⁻¹⁰ J

$\gamma = \frac{1}{\sqrt{1-0.80^2}} = 1.67$ and $E_k = (\gamma - 1)mc^2 = 0.667 \times 1.50 \times 10^{-10} = 1.0 \times 10^{-10}$ J. 4.8×10^{-11} J is the classical $\frac{1}{2}mv^2$; 1.5×10^{-10} J is the rest energy and 2.5×10^{-10} J the total energy.

18. A. the width of the gap is similar to the wavelength of the light

The amount of diffraction depends on $\frac{\lambda}{w}$; it is significant when the gap width is comparable to (or smaller than) the wavelength.

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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 5, with the working behind every mark.

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

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