Physics Unit 3 & 4 — Practice Exam 2 — Answers & Explanations

Answers to the 18 questions in the free preview.

Section A — multiple choice

1. D. 679 N

The scales read the normal force. With the acceleration upwards, $N - mg = ma$, so $N = m(g + a) = 60 \times 11.31 = 679$ N. 499 N is the reading when accelerating downwards and 589 N is the person's weight.

2. C. 5.79 m s⁻¹

The fall takes $t = \sqrt{\frac{2 \times 1.25}{9.81}} = 0.505$ s, so $v_y = 9.81 \times 0.505 = 4.95$ m s⁻¹. The horizontal velocity is still 3.0 m s⁻¹, so $v = \sqrt{3.0^2 + 4.95^2} = 5.79$ m s⁻¹. 7.95 m s⁻¹ adds the components as numbers instead of as vectors.

3. B. 14.0 m s⁻¹

At the maximum speed the normal force is zero and gravity alone provides the centripetal force: $mg = \frac{mv^2}{r}$, so $v = \sqrt{gr} = \sqrt{9.81 \times 20} = 14.0$ m s⁻¹. 196 is v^2.

4. C. 2.0 m s⁻¹

The total momentum stays zero: $0.020 \times 400 = 4.0v$, so $v = 2.0$ m s⁻¹, opposite to the bullet. 8.0 is the bullet's momentum in kg m s⁻¹.

5. A. 2.25 J

$k = \frac{30}{0.15} = 200$ N m⁻¹ and $E_s = \frac{1}{2}kx^2 = \frac{1}{2} \times 200 \times 0.15^2 = 2.25$ J — the area under the force–extension graph. 4.50 J forgets the $\frac{1}{2}$; 200 is the spring constant.

6. B. 2.18 N kg⁻¹

$g = \frac{GM}{r^2}$: doubling M doubles g and tripling r divides it by 9, so $g = 9.81 \times \frac{2}{9} = 2.18$ N kg⁻¹. 6.54 N kg⁻¹ uses an inverse (not inverse-square) law; 1.09 N kg⁻¹ ignores the doubled mass.

7. D. change in gravitational potential energy of the spacecraft

Force × distance is work, so the area under a force–distance graph is the work done against gravity, which is the change in gravitational potential energy. (The area under a field–distance graph gives the energy change per kilogram.)

8. D. $8F$

$F = \frac{kq_1q_2}{r^2}$: doubling a charge doubles the force and halving the distance multiplies it by 4, giving $8F$.

9. A. towards the top of the page

By the right-hand grip rule (thumb along the current, out of the page), the field lines circle the wire anticlockwise as seen here. At a point to the right of the wire, anticlockwise is towards the top of the page. The field is always tangent to a circle around the wire, never radial and never along the current.

10. A. 0.010 Wb

Only the field component perpendicular to the loop passes through it: $B_\perp = 0.40 \sin(30^\circ) = 0.20$ T, so $\Phi_B = B_\perp A = 0.20 \times 0.050 = 0.010$ Wb. 0.017 Wb uses $\cos(30^\circ)$; 0.020 Wb assumes the field is perpendicular to the loop.

11. B. Pole at the near end of the coil: north; Force on the magnet: repulsive

By Lenz's law the induced current opposes the change that produced it — here the increasing flux as the magnet approaches. The coil's near end becomes a north pole, which repels the approaching north pole, so work must be done to push the magnet in. That work becomes the electrical energy.

12. A. 0.10 A

An ideal transformer transfers power without loss: $V_1I_1 = V_2I_2$, so $I_1 = \frac{12 \times 2.0}{240} = 0.10$ A. Stepping the voltage down steps the current up, so the primary current is the smaller one; 40 A inverts the ratio.

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13. D. 42.4 V

$V_{\text{peak}} = \sqrt{2} \times 15.0 = 21.2$ V, and the peak-to-peak voltage runs from $+21.2$ V to -21.2 V: 42.4 V. 21.2 V is the peak only.

14. C. decreasing the width of the slit

The amount of diffraction depends on the ratio $\frac{\lambda}{w}$ of wavelength to gap width. Decreasing w increases the ratio. Blue light has a shorter wavelength, so it spreads less; intensity does not change the pattern's shape.

15. B. 2.67 V

$E = \frac{hc}{\lambda} = \frac{4.14\times10^{-15}\times3.00\times10^{8}}{250\times10^{-9}} = 4.97$ eV, so $E_{k\,\max} = 4.97 - 2.30 = 2.67$ eV and the stopping voltage is 2.67 V. 7.27 V adds the work function instead of subtracting it.

16. B. 1.33 × 10^{-27} kg m s^{-1}

$p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{500\times10^{-9}} = 1.33 \times 10^{-27}$ kg m s^{-1}. 3.98×10^{-19} is the photon's energy in joules, not its momentum.

17. D. a continuous spectrum crossed by dark lines at the wavelengths that hydrogen emits

The hydrogen atoms absorb only photons whose energies exactly match the gaps between their energy levels — the same gaps that produce hydrogen's emission lines. Those wavelengths are missing, giving an absorption spectrum. Bright lines on a dark background is the emission spectrum of hot gas.

18. C. 80 m

$\gamma = \frac{1}{\sqrt{1-0.60^2}} = 1.25$ and $L = \frac{L_0}{\gamma} = \frac{100}{1.25} = 80$ m. Moving objects are contracted along the direction of motion, never lengthened, so 125 m is wrong.

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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 2, 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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