

AS Physics 9702

Unit 3 · Dynamics

Worked answers

Try the separate worksheet first. These worked answers explain methods as well as results. Equivalent valid reasoning and sensible rounding may also be correct. Suggested marks are RevisionTown practice guidance, not Cambridge marking instructions.

Scope: Cambridge International AS Physics 9702, 2025–2027 learning outcomes. The published 2028–2030 AS scope has been checked separately and is substantively unchanged. Version: 11 October 2026.

U3-Q1 · 6 marks

(a) Resultant = $180 - 60 = 120$ N forwards; $a = 120/40.0 = 3.00$ m s⁻². (b) Acceleration halves to 1.50 m s⁻²; the larger mass has greater inertia. (c) With zero resultant external force, a body stays at rest or moves at constant velocity. A 60 N push balances 60 N resistance, so the moving trolley continues at constant velocity in this model.

U3-Q2 · 6 marks

With upward positive, $N - mg = ma$. (a) $N = 60.0(9.81 + 1.20) = 660.6$ N ≈ 661 N. (b) $N = 60.0(9.81 - 1.20) = 516.6$ N ≈ 517 N. (c) $N = 60.0(9.81 - 9.81) = 0$. Weight remains $mg = 588.6$ N in all three cases; the support force changes.

U3-Q3 · 7 marks

(a) Initial momentum = $+1.80$ kg m s⁻¹; final = -1.20 kg m s⁻¹. Impulse = $-1.20 - 1.80 = -3.00$ N s. Average force = $-3.00/0.0250 = -120$ N, opposite the initial motion. (b) Triangle area magnitude = $\frac{1}{2}F_{\text{peak}}(0.0250) = 3.00$, so $F_{\text{peak}} = 240$ N. Peak force is twice average for this triangular pulse.

U3-Q4 · 6 marks

(a) Earth's downward gravitational force and the table's upward normal force act on the book. (b) Their partners are the book's gravitational force on Earth and the book's downward contact force on the table respectively. (c) Third-law forces act on different bodies; both forces in (a) act on the same book. During walking, the foot pushes the ground backwards while the ground pushes the person forwards. The backward partner acts on the ground, so it does not cancel the forward force on the person.

U3-Q5 · 8 marks

(a) With upthrust neglected, weight = 4.905 N; resultant downward force = $4.905 - 3.00 = 1.905$ N. Acceleration = $1.905/0.500 = 3.81 \text{ m s}^{-2}$ downward. (b) Drag = 4.905 N upward. (c) Speed initially rises with gradient near g ; increasing drag reduces the gradient until it approaches zero at constant terminal speed. (d) Opening increases drag, which may exceed weight. The upward resultant slows the downward motion. As speed falls, drag falls until it balances weight at a lower terminal speed.

U3-Q6 · 5 marks

(a) Constant speed along a straight line means constant velocity and hence zero resultant force, so resistance is 800 N. Immediately afterwards resultant = $900 - 800 = 100$ N and $a = 100/200 = 0.50 \text{ m s}^{-2}$. (b) Rising speed increases resistance and reduces the forward resultant. A new terminal velocity is reached if resistance becomes 900 N, giving zero acceleration.

U3-Q7 · 8 marks

(a) External impulse on the two-cart system must be negligible during the collision. (b) Initial momentum = $0.600(5.00) + 0.400(-1.00) = 2.60 \text{ kg m s}^{-1}$. Total mass = 1.000 kg, so $v = +2.60 \text{ m s}^{-1}$. (c) Initial kinetic energy = $\frac{1}{2}(0.600)(25.0) + \frac{1}{2}(0.400)(1.00) = 7.70 \text{ J}$. Final = $\frac{1}{2}(1.000)(2.60)^2 = 3.38 \text{ J}$. Decrease = 4.32 J, transferred to deformation, internal energy and sound; momentum remains conserved.

U3-Q8 · 9 marks

Momentum: $1.20 = 0.200v_1 + 0.300v_2$. Elastic relative-speed condition: $6.00 = v_2 - v_1$, so $v_2 = v_1 + 6.00$. Substitution gives $1.20 = 0.500v_1 + 1.80$, hence $v_1 = -1.20 \text{ m s}^{-1}$ and $v_2 = +4.80 \text{ m s}^{-1}$. Initial kinetic energy = $\frac{1}{2}(0.200)(6.00)^2 = 3.60 \text{ J}$. Final = $\frac{1}{2}(0.200)(1.20)^2 + \frac{1}{2}(0.300)(4.80)^2 = 0.144 + 3.456 = 3.60 \text{ J}$.

U3-Q9 · 9 marks

The external horizontal impulse is negligible. Taking east as x and north as y , initial momentum = (6.00, 3.00) kg m s^{-1} . Final velocity components = $(6.00/2.00, 3.00/2.00) = (3.00, 1.50) \text{ m s}^{-1}$. Speed = $\sqrt{9.00 + 2.25} = 3.35 \text{ m s}^{-1}$; direction = $\tan^{-1}(1.50/3.00) = 26.6^\circ$ north of east. Initial kinetic energy = $\frac{1}{2}(1.50)(4.00)^2 + \frac{1}{2}(0.500)(6.00)^2 = 12.0 + 9.00 = 21.0 \text{ J}$. Final = $\frac{1}{2}(2.00)(11.25) = 11.25 \text{ J}$. Decrease = 9.75 J.

U3-Q10 · 9 marks

Initial total momentum is $(4.00, 0) \text{ kg m s}^{-1}$. First puck's final velocity components are $(6.00, 2\sqrt{3}) = (6.00, 3.464) \text{ m s}^{-1}$, so its momentum is $(3.00, 1.732)$. The second puck therefore has momentum $(1.00, -1.732)$ and velocity $(2.00, -3.464) \text{ m s}^{-1}$. Its speed is 4.00 m s^{-1} , directed 60.0° below $+x$. Initial kinetic energy $= \frac{1}{2}(0.500)(8.00)^2 = 16.0 \text{ J}$. Final $= \frac{1}{2}(0.500)(48.0 + 16.0) = 16.0 \text{ J}$. It is elastic because total kinetic energy is unchanged.

U3-Q11 · 3 marks

Correct option: B. Slowing eastward motion has westward acceleration and hence westward resultant force. A reverses the given velocity. C confuses zero resultant with continued motion: zero resultant would mean constant velocity, not slowing. D wrongly assumes acceleration must point along velocity; acceleration follows the change of velocity.

U3-Q12 · 3 marks

Correct option: C. Internal impulses cancel for the two-cart system, while kinetic energy can become other energy forms. A treats an inelastic collision as elastic. B confuses kinetic-energy loss with loss of total momentum. D applies system conservation to individual carts, each of which experiences a large interaction impulse and changes momentum.

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