Question 9 (Answer: **C**)

- Momentum is conserved whenever no external resultant force acts – that is what isolated means.
- It holds for elastic and inelastic collisions alike, so the type of collision is irrelevant.
- A is too broad: friction or another external force can act during a collision.

Question 10 (Answer: **D**)

- For an elastic collision the relative speed of separation equals the approach speed, 9.0 m s^{-1}.
- Momentum gives $m(9.0) = mv_1' + 2mv_2'$.
- Solving the pair gives $v_2' = 6.0$ m s^{-1}, with the first object rebounding at -3.0 m s^{-1}.

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Question 9 (Answer: **D**)

- The principle states that the total momentum of an isolated system does not change.
- A is too narrow – momentum is conserved in inelastic collisions too.
- B is the definition of momentum and C is Newton's second law.

Question 10 (Answer: **B**)

- Resolve: the 4.0 N s is $(+4.0, 0)$ and the 8.0 N s at 45° up-left is $(-5.7, +5.7)$.
- Adding gives $(-1.7, +5.7)$ N s – about 5.9 N s, mostly upwards and slightly to the left.
- Momentum is conserved, so the combined momentum after the collision is that same vector.

Question 12 (Answer: **D**)

- In an elastic collision the relative speed of separation equals the relative speed of approach.
- After the collision the blocks separate at $70 + 20 = 90$ cm s^{-1}.
- Only D approaches at $60 + 30 = 90$ cm s^{-1}; in C the blocks are already moving apart.

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Question 10 (Answer: **D**)

- They stick together, so momentum gives $v = (2.0 \times 3.0)/3.0 = 2.0$ m s^{-1}.
- Before: $\frac{1}{2}(2.0)(3.0)^2 = 9.0$ J. After: $\frac{1}{2}(3.0)(2.0)^2 = 6.0$ J.
- The kinetic energy lost is $9.0 - 6.0 = 3.0$ J.

Question 11 (Answer: **B**)

- For an elastic collision the relative speed of approach *equals* the relative speed of separation.
- Written as speeds both are positive, so their sum cannot be zero – their difference is.
- A, C and D are all correct statements about the collision.

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Question 9 (Answer: **B**)

- An elastic collision is defined by the total kinetic energy being conserved.
- "Total velocity" is not a conserved quantity at all – momentum is.
- So the row reads yes for kinetic energy and no for velocity.

Question 10 (Answer: **C**)

- In an elastic collision the total kinetic energy is unchanged, not reduced.
- A reduction in kinetic energy is exactly what makes a collision inelastic.
- A, B and D are all true of an elastic collision.

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Question 9 (Answer: **C**)

- Momentum: $0.30(1.2) - 0.60(1.8) = -0.72$ kg m s^{-1}, taking P's direction as positive.
- Elastic, so the relative speed of separation equals the approach speed, $1.2 + 1.8 = 3.0$ m s^{-1}.
- Solving the two together gives P at 2.8 m s^{-1} and Q at 0.2 m s^{-1}.

A-Level Physics: **s25 23**

4(a)	sum / total momentum (of a system of bodies) is constant **or** sum / total momentum before = sum / total momentum after
	for an isolated system / no (resultant) external force
4(b)(i)	$p = mv$ **or** 4.0 × 6.0 or 2.0 × 3.0 (4.0 × 6.0) + (2.0 × 3.0) = 6.0 × v
	so v = 5.0 m s^{-1}
4(b)(ii)	KE before = $(0.5 \times 4.0 \times 6.0^2) + (0.5 \times 2.0 \times 3.0^2)$ = 81 J
	KE after = $(0.5 \times 6.0 \times 5.0^2)$ = 75 J
	percentage transferred = [(81 – 75) / 81] × 100 = 7%

A-Level Physics: **m25 22**

7(a)	nucleon number of Q = 226 and proton number of R = 86
7(b)	4(u) × 1.5 × 10^7 or 222(u) × v
	v = 4(u) × 1.5 × 10^7 / 222(u)
	= 2.7 × 10^5 m s^{-1}
7(c)	Any three from: • momentum • charge • nucleon number • neutron number • proton number