

INKMATHS FLASHCARDS

Further Mechanics 1

impulse, energy and collisions

13 cards · fronts and backs

Print double-sided, flipping on the long edge, and each answer lands behind its question. Cut along the card borders.

Definitions in precise wording, the standard results the formulae booklet does not print, a check-yourself question per topic, and the slips that lose marks. The same cards run on the website with spaced-repetition scheduling, at inkmaths.co.uk/flashcards.

STANDARD RESULT

Impulse:

$$I = ?$$

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

Define: Conservation of momentum.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

Define: Impulse in two dimensions.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

Work and power:

$$\text{work} = ?, P = ?$$

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

Define: Work-energy principle.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

Hooke's law:

$$T = ?$$

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

Elastic energy:

$$\text{EPE} = ?$$

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

Newton's law of restitution:

$$e = ?, \text{ range?}$$

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

In a collision the internal forces are equal and opposite for the same time, so the impulses cancel and the total momentum before equals the total after. It holds whatever happens to the energy.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

$Ft = mv - mu$: a vector, in N s

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

$Fd \cos \theta, Fv$

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

The i components and the j components each obey $I = mv - mu$ on their own. Take magnitudes only at the end: a change of direction at constant speed still needs an impulse.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

$(\lambda x)/(l)$: x is the extension, l the natural length

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

The total work done by all the forces equals the change in kinetic energy. The normal reaction never contributes, since it acts at right angles to the motion.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

$(\text{separation speed})/(\text{approach speed}), 0 \leq e \leq 1$

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

$(\lambda x^2)/(2l)$: the triangle under the Hooke line

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

Define: Kinetic energy in an impact.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

Bouncing ball:

dropped from h: next height? total distance?

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

Define: Oblique impact.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

SPOT THE ERROR

Say what is wrong with this claim:

A ball that bounces back off a wall at the speed it arrived has received no impulse.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

CHECK YOURSELF

Why is momentum not conserved when a ball bounces off the floor?

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

STANDARD RESULT

$$e^2h, (h(1 + e^2))/(1 - e^2)$$

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

Momentum is always conserved; kinetic energy is lost unless $e = 1$. Find the loss by adding $\frac{1}{2}mv^2$ for both spheres before and after and subtracting.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

SPOT THE ERROR

Momentum is a vector. Reversing it removes the original momentum and supplies the same again the other way, so the impulse is the mass times the sum of the two speeds, not their difference.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

DEFINITION

A smooth surface leaves the parallel component untouched and multiplies the perpendicular one by $-e$. The outgoing path therefore always hugs the surface more closely than the incoming one.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS

CHECK YOURSELF

The floor is attached to the Earth, so the ball alone is not an isolated system and receives an external impulse. Only the law of restitution applies.

FURTHER MECHANICS 1: IMPULSE, ENERGY AND COLLISIONS