INKPHYSICS FLASHCARDS

Periodic motion

Year 13 · 14 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 mark-scheme wording, the equations that are not on the data sheet, each lesson's check question, and the misconceptions that lose marks. The same cards run on the website with spaced-repetition scheduling, at inkphysics.co.uk/flashcards.

DEFINITION

Define: The radian.

CIRCULAR MOTION

DEFINITION

Define: Angular speed.

CIRCULAR MOTION

CHECK YOURSELF

A 900 kg car takes a bend of radius 50 m at a steady 15 m s^{-1}. Find the centripetal force required, state what provides it, and explain what happens if the road cannot supply that much.

Hint: One formula, then think about which real force is doing the job on a flat road.

CIRCULAR MOTION

SPOT THE ERROR

Say what is wrong with this claim:

You're flung outwards by centrifugal force.

CIRCULAR MOTION

DEFINITION

Define: Simple harmonic motion.

SIMPLE HARMONIC MOTION

CHECK YOURSELF

A point oscillates in SHM with amplitude 0.040 m and frequency 1.5 Hz. Find its maximum speed and maximum acceleration, and state where each occurs.

Hint: Build ω first; both maxima follow in one line each.

SIMPLE HARMONIC MOTION

SPOT THE ERROR

Say what is wrong with this claim:

Bigger swings take longer.

SIMPLE HARMONIC MOTION

DEFINITION

Define: Damping.

SHM SYSTEMS: PENDULUMS AND SPRINGS

DEFINITION

The angle swept out per unit time: $\omega = \theta/t = 2\pi f$, in rad s^{-1}.

CIRCULAR MOTION

DEFINITION

The angle subtended at the centre of a circle by an arc equal in length to the radius.

CIRCULAR MOTION

SPOT THE ERROR

There is no outward force on you: your inertia carries you in a straight line while the car turns underneath you. The real force present is centripetal, pulling towards the centre — remove it and you travel straight, not outward.

CIRCULAR MOTION

CHECK YOURSELF

$F = mv^2/r = 900 \times 15^2 / 50 = 4100$ N (2 s.f.), directed towards the bend's centre.

On a flat road the provider is friction between the tyres and the surface.

If friction cannot reach 4100 N, on ice say, the car cannot follow that circle: it continues on a straighter path, drifting wide along a tangent, which is a skid described politely.

CIRCULAR MOTION

CHECK YOURSELF

$\omega = 2\pi f = 2\pi \times 1.5 = 9.4$ rad s^{-1}.

Maximum speed: $\omega A = 9.4 \times 0.040 = 0.38$ m s^{-1}, at the centre, where all the energy is kinetic.

Maximum acceleration: $\omega^2 A = 9.42^2 \times 0.040 = 3.6$ m s^{-2}, at the extremes, where the displacement and the restoring pull are greatest.

SIMPLE HARMONIC MOTION

DEFINITION

Oscillation in which the acceleration is proportional to the displacement from equilibrium and directed towards it: $a = -\omega^2 x$.

SIMPLE HARMONIC MOTION

DEFINITION

The loss of energy from an oscillating system to resistive forces, reducing the amplitude over time.

SHM SYSTEMS: PENDULUMS AND SPRINGS

SPOT THE ERROR

In SHM the period is independent of amplitude: a bigger swing travels further but moves proportionally faster, because the restoring force grows with displacement. That isochronism is what made pendulum clocks possible.

SIMPLE HARMONIC MOTION

CHECK YOURSELF

What length of simple pendulum has a period of 2.0 s? Take $g = 9.81\ m\ s^{-2}$. Would the answer change on the Moon?

Hint: Rearrange for l, and remember what sits inside the square root.

SHM SYSTEMS: PENDULUMS AND SPRINGS

SPOT THE ERROR

Say what is wrong with this claim:

Heavier pendulums swing slower.

SHM SYSTEMS: PENDULUMS AND SPRINGS

DEFINITION

Define: Natural frequency.

FORCED VIBRATIONS AND RESONANCE

DEFINITION

Define: Resonance.

FORCED VIBRATIONS AND RESONANCE

CHECK YOURSELF

A washing machine vibrates violently at one particular spin speed and is calmer both above and below it. Explain the violence, and one design change that would reduce it.

Hint: One special frequency, and one knob that reshapes the response curve.

FORCED VIBRATIONS AND RESONANCE

SPOT THE ERROR

Say what is wrong with this claim:

Pushing harder is all that matters.

FORCED VIBRATIONS AND RESONANCE

SPOT THE ERROR

A pendulum's period depends only on its length and g — the mass cancels, just as all masses fall at the same rate. Only for a mass on a spring does m appear in the period.

SHM SYSTEMS: PENDULUMS AND SPRINGS

CHECK YOURSELF

Rearranging: $l = g(T/2\pi)^2 = 9.81 \times (2.0/2\pi)^2 = 0.99$ m, the metre-long "seconds pendulum" of old clocks.

On the Moon, yes: g is about a sixth, so the same 2.0 s period needs $l = 1.62 \times (0.318)^2 \approx 0.16$ m. The pendulum reads its local gravity.

The bob's mass, note, was never asked for and never needed.

SHM SYSTEMS: PENDULUMS AND SPRINGS

DEFINITION

The large-amplitude response of a system driven at its natural frequency, when energy transfer from the driver is most efficient.

FORCED VIBRATIONS AND RESONANCE

DEFINITION

The frequency at which a system oscillates freely after a single displacement, with no driving force.

FORCED VIBRATIONS AND RESONANCE

SPOT THE ERROR

Timing beats force: a system responds hugely only when driven at its natural frequency. Small pushes at the right rhythm build a large amplitude; large pushes at the wrong rhythm achieve little.

FORCED VIBRATIONS AND RESONANCE

CHECK YOURSELF

At that spin speed the drum's driving frequency matches the machine's natural frequency: resonance. Each cycle of the imbalance feeds energy in exactly in step, so the amplitude builds to a maximum.

Above and below, the pushes fall out of step with the motion and partly cancel, so the response is far smaller: the machine is off the peak of its resonance curve.

Adding damping, stiffer mounts or shock absorbers, lowers and broadens the peak, so even at the unlucky speed the amplitude stays modest.

FORCED VIBRATIONS AND RESONANCE