INKPHYSICS FLASHCARDS

Waves

Year 12 · 81 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 AQA 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/physics/flashcards.

DEFINITION

Define: Amplitude.

PROGRESSIVE WAVES

DEFINITION

Define: Wavelength.

PROGRESSIVE WAVES

DEFINITION

Define: Frequency.

PROGRESSIVE WAVES

RECALL

State the unit of frequency.

PROGRESSIVE WAVES

DEFINITION

Define: Phase difference.

PROGRESSIVE WAVES

DEFINITION

Define: Period of a wave.

PROGRESSIVE WAVES

RECALL

State what a progressive wave transfers.

PROGRESSIVE WAVES

RECALL

State what the time-base of an oscilloscope sets.

PROGRESSIVE WAVES

DEFINITION

The distance between two adjacent points on a wave oscillating in phase, such as crest to crest.

PROGRESSIVE WAVES

DEFINITION

The maximum displacement of a particle from its equilibrium position.

PROGRESSIVE WAVES

RECALL

The hertz, Hz: one complete oscillation per second.

PROGRESSIVE WAVES

DEFINITION

The number of complete oscillations per second; equivalently, the number of complete waves passing a point per second.

PROGRESSIVE WAVES

DEFINITION

The time taken for one complete oscillation: $T = 1/f$.

PROGRESSIVE WAVES

DEFINITION

The fraction of a cycle by which one oscillation leads or lags another, in radians or degrees.

PROGRESSIVE WAVES

RECALL

The horizontal scale of the trace, in seconds per division, so divisions across one cycle × time-base = the period.

PROGRESSIVE WAVES

RECALL

Energy, without transferring the medium itself.

PROGRESSIVE WAVES

RECALL

State what the y-gain of an oscilloscope sets.

PROGRESSIVE WAVES

RECALL

State the quantity read from the repeat of a displacement-distance graph.

PROGRESSIVE WAVES

RECALL

State the quantity read from the repeat of a displacement-time graph.

PROGRESSIVE WAVES

EQUATION · NOT ON THE AQA DATA SHEET

Phase difference from path difference d:

phase difference = ?

PROGRESSIVE WAVES

SPOT THE ERROR

Say what is wrong with this claim:

The wave carries the water along with it.

PROGRESSIVE WAVES

DEFINITION

Define: Transverse wave.

LONGITUDINAL, TRANSVERSE AND POLARISATION

DEFINITION

Define: Longitudinal wave.

LONGITUDINAL, TRANSVERSE AND POLARISATION

DEFINITION

Define: Polarised wave.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

The wavelength, because the graph is a snapshot of every particle at one instant.

PROGRESSIVE WAVES

RECALL

The vertical scale of the trace, in volts per division, so divisions from the centre line to a peak × y-gain = the amplitude.

PROGRESSIVE WAVES

EQUATION · NOT ON THE AQA DATA SHEET

phase difference = (2π d)/(λ)

PROGRESSIVE WAVES

RECALL

The period, because the graph follows a single particle through time.

PROGRESSIVE WAVES

DEFINITION

A wave whose oscillations are perpendicular to the direction of energy transfer.

LONGITUDINAL, TRANSVERSE AND POLARISATION

SPOT THE ERROR

The wave does not carry the water along: each particle only oscillates about a fixed equilibrium position while the pattern travels. A progressive wave transfers energy, not matter.

PROGRESSIVE WAVES

DEFINITION

A transverse wave whose oscillations are confined to a single plane containing the direction of travel.

LONGITUDINAL, TRANSVERSE AND POLARISATION

DEFINITION

A wave whose oscillations are parallel to the direction of energy transfer, as compressions and rarefactions.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

State the evidence that light is a transverse wave.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

State the speed of electromagnetic waves in a vacuum.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

State the wavelength range of visible light.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

State the best orientation of a receiving aerial.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

State where a compression lies on a displacement-distance graph of a longitudinal wave.

LONGITUDINAL, TRANSVERSE AND POLARISATION

SPOT THE ERROR

Say what is wrong with this claim:

Any wave can be polarised if you build the right filter.

LONGITUDINAL, TRANSVERSE AND POLARISATION

DEFINITION

Define: Node.

STATIONARY WAVES

DEFINITION

Define: Antinode.

STATIONARY WAVES

RECALL

All electromagnetic waves travel at 3.00×10^8 m s^{-1} in a vacuum.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

Light can be polarised, which is possible only for transverse waves.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

With its rods parallel to the plane of polarisation of the incoming signal.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

About 400 nm at the violet end to 700 nm at the red end.

LONGITUDINAL, TRANSVERSE AND POLARISATION

SPOT THE ERROR

Only transverse waves can be polarised: polarisation confines the oscillations to a single plane. A longitudinal wave oscillates parallel to the direction of travel, so there is no plane of oscillation to select.

LONGITUDINAL, TRANSVERSE AND POLARISATION

RECALL

Where the curve crosses the axis running from positive displacement to negative, taking positive as displacement along the direction of travel. A rarefaction is the crossing the other way. The crests and troughs are maximum displacement at ordinary pressure.

LONGITUDINAL, TRANSVERSE AND POLARISATION

DEFINITION

A point on a stationary wave where the amplitude of oscillation is maximum.

STATIONARY WAVES

DEFINITION

A point on a stationary wave where the displacement is always zero.

STATIONARY WAVES

DEFINITION

Define: Stationary wave.

STATIONARY WAVES

RECALL

State what happens to energy in a stationary wave.

STATIONARY WAVES

RECALL

State the distance between adjacent nodes.

STATIONARY WAVES

RECALL

State the phase of points between one pair of adjacent nodes.

STATIONARY WAVES

RECALL

State what a closed end and an open end of a pipe must be.

STATIONARY WAVES

RECALL

State the first-harmonic wavelength of a tube closed at one end.

STATIONARY WAVES

RECALL

State which harmonics a tube closed at one end can sound.

STATIONARY WAVES

RECALL

State how the wavelength is found in the resonance-tube experiment.

STATIONARY WAVES

RECALL

A stationary wave stores energy rather than transferring it along the wave.

STATIONARY WAVES

DEFINITION

The superposition of two progressive waves of the same frequency and equal amplitude travelling in opposite directions.

STATIONARY WAVES

RECALL

They all oscillate in phase, each with its own amplitude.

STATIONARY WAVES

RECALL

Half a wavelength, $\lambda/2$.

STATIONARY WAVES

RECALL

Four times the tube length, $\lambda = 4L$, because a quarter of a wavelength fits between the node at the closed end and the antinode at the open end.

STATIONARY WAVES

RECALL

A closed end is always a displacement node; an open end is always a displacement antinode.

STATIONARY WAVES

RECALL

From the two resonance lengths, $\lambda = 2(L_2 - L_1)$, so that the offset of the antinode beyond the open end cancels.

STATIONARY WAVES

RECALL

Only the odd harmonics, f_1, $3f_1$, $5f_1$, because the tube must hold an odd number of quarter wavelengths to have a node at one end and an antinode at the other.

STATIONARY WAVES

RECALL

State the phase difference across a node.

STATIONARY WAVES

RECALL

State what μ means in the first-harmonic equation.

STATIONARY WAVES

RECALL

State the speed of a transverse wave on a stretched string.

STATIONARY WAVES

EQUATION · NOT ON THE AQA DATA SHEET

Harmonic wavelengths on a string of length L:

λ_n = ?

STATIONARY WAVES

SPOT THE ERROR

Say what is wrong with this claim:

A stationary wave is a wave that has stopped moving.

STATIONARY WAVES

DEFINITION

Define: Refractive index.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

Define: Critical angle.

REFRACTION AND TOTAL INTERNAL REFLECTION

RECALL

State the condition for total internal reflection.

REFRACTION AND TOTAL INTERNAL REFLECTION

RECALL

The mass per unit length of the string, in kg m^{-1}.

STATIONARY WAVES

RECALL

Points on opposite sides of a node oscillate in antiphase, π rad apart.

STATIONARY WAVES

EQUATION · NOT ON THE AQA DATA SHEET

$$\lambda_n = \frac{2L}{n}$$

STATIONARY WAVES

RECALL

$v = \sqrt{(T/\mu)}$, with T the tension in newtons and μ the mass per unit length in kg m^{-1}. It is the speed of the travelling waves along the string, not the speed of any point of the string.

STATIONARY WAVES

DEFINITION

The ratio of the speed of light in a vacuum to its speed in the material: $n = c/v$.

REFRACTION AND TOTAL INTERNAL REFLECTION

SPOT THE ERROR

Nothing has stopped: two progressive waves are still travelling in opposite directions through each other. Their superposition holds a fixed pattern of nodes and antinodes: the pattern stands still, not the waves.

STATIONARY WAVES

RECALL

Light in the denser medium must meet the boundary at an angle of incidence greater than the critical angle.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

The angle of incidence in the denser medium for which the angle of refraction is 90°.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

Define: Step-index optical fibre.

REFRACTION AND TOTAL INTERNAL REFLECTION

RECALL

State the quantity unchanged when light enters a new medium.

REFRACTION AND TOTAL INTERNAL REFLECTION

RECALL

State the equation for the critical angle.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

Define: Modal dispersion.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

Define: Material dispersion.

REFRACTION AND TOTAL INTERNAL REFLECTION

RECALL

State how the refractive index of a solid is measured from a graph.

REFRACTION AND TOTAL INTERNAL REFLECTION

SPOT THE ERROR

Say what is wrong with this claim:

Total internal reflection happens at any boundary, as long as you hit it steeply enough.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

Define: Diffraction.

DIFFRACTION AND THE SINGLE SLIT

RECALL

The frequency; the speed and wavelength both change in the same ratio.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

A thin glass core carrying light by total internal reflection, wrapped in cladding of slightly lower refractive index.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

Pulse broadening caused by rays taking paths of different lengths along the fibre.

REFRACTION AND TOTAL INTERNAL REFLECTION

RECALL

$\sin \theta_c = n_2/n_1$, valid only when $n_1 > n_2$.

REFRACTION AND TOTAL INTERNAL REFLECTION

RECALL

Trace the ray through a block for several angles of incidence, plot $\sin \theta_1$ against $\sin \theta_2$, and take the gradient of the straight line through the origin.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

Pulse broadening caused by different wavelengths travelling at slightly different speeds in the glass.

REFRACTION AND TOTAL INTERNAL REFLECTION

DEFINITION

The spreading of a wave as it passes through a gap or past an edge.

DIFFRACTION AND THE SINGLE SLIT

SPOT THE ERROR

A steep hit is not enough. Total internal reflection needs the light to travel towards a medium of lower refractive index, with the angle of incidence greater than the critical angle.

REFRACTION AND TOTAL INTERNAL REFLECTION

RECALL

State the condition for greatest diffraction.

DIFFRACTION AND THE SINGLE SLIT

RECALL

State the width of the central maximum in the single-slit pattern.

DIFFRACTION AND THE SINGLE SLIT

RECALL

State the effect of narrowing the slit on the single-slit pattern.

DIFFRACTION AND THE SINGLE SLIT

RECALL

State the colour order in the white-light single-slit side fringes.

DIFFRACTION AND THE SINGLE SLIT

DEFINITION

Define: Huygens' construction.

DIFFRACTION AND THE SINGLE SLIT

RECALL

Explain diffraction at a slit using Huygens' construction.

DIFFRACTION AND THE SINGLE SLIT

SPOT THE ERROR

Say what is wrong with this claim:

Waves only diffract when the gap is smaller than the wavelength.

DIFFRACTION AND THE SINGLE SLIT

DEFINITION

Define: Coherent sources.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

RECALL

The central maximum is twice the width of the other maxima, and far brighter.

DIFFRACTION AND THE SINGLE SLIT

RECALL

Diffraction is greatest when the gap width is comparable to the wavelength.

DIFFRACTION AND THE SINGLE SLIT

RECALL

Each side fringe is a spectrum with violet on its inner edge and red on its outer edge, because longer wavelengths diffract more.

DIFFRACTION AND THE SINGLE SLIT

RECALL

The pattern spreads out, with a wider central maximum, but becomes dimmer.

DIFFRACTION AND THE SINGLE SLIT

RECALL

The barrier deletes every wavelet source it covers, so only the wavelets inside the gap survive. The wavelet at each edge has no neighbour beyond it to bury its outer flank, so the envelope wraps round that flank and into the region the barrier shades.

DIFFRACTION AND THE SINGLE SLIT

DEFINITION

The rule that every point on a wavefront acts as a source of secondary circular wavelets, and that the wavefront a short time later is the envelope of those wavelets, the surface that touches all of them.

DIFFRACTION AND THE SINGLE SLIT

DEFINITION

Sources with the same frequency and a constant phase difference.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

SPOT THE ERROR

Diffraction happens at every gap, whatever its size, not only below the wavelength. The spreading is greatest when the gap width is comparable to the wavelength.

DIFFRACTION AND THE SINGLE SLIT

DEFINITION

Define: Path difference.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

DEFINITION

Define: Superposition.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

RECALL

State the appearance of double-slit fringes with monochromatic light.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

RECALL

State the colour of the central fringe of the white-light double-slit pattern.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

RECALL

State the safe practice for using a classroom laser.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

EQUATION · NOT ON THE AQA DATA SHEET

Constructive interference condition:

constructive: path difference = ?

INTERFERENCE AND YOUNG'S DOUBLE SLIT

EQUATION · NOT ON THE AQA DATA SHEET

Destructive interference condition:

destructive: path difference = ?

INTERFERENCE AND YOUNG'S DOUBLE SLIT

SPOT THE ERROR

Say what is wrong with this claim:

Shine two lights on the same spot and you simply get a brighter spot.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

DEFINITION

When two waves meet, the resultant displacement is the vector sum of the individual displacements.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

DEFINITION

The difference in the distances from two sources to a point, often expressed in wavelengths.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

RECALL

White, because the path difference there is zero for every wavelength.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

RECALL

Bright fringes that are evenly spaced and equally bright.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

EQUATION · NOT ON THE AQA DATA SHEET

constructive: path difference = nλ

INTERFERENCE AND YOUNG'S DOUBLE SLIT

RECALL

Never look along the beam or point it at anyone, and keep it away from reflective surfaces.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

SPOT THE ERROR

Ordinary lamps have no constant phase difference, so no steady fringes form; only coherent sources hold a fixed phase relationship long enough for a stable pattern.

INTERFERENCE AND YOUNG'S DOUBLE SLIT

EQUATION · NOT ON THE AQA DATA SHEET

destructive: path difference = (n + (1)/(2))λ

INTERFERENCE AND YOUNG'S DOUBLE SLIT

DEFINITION

Define: Diffraction grating.

DIFFRACTION GRATINGS

DEFINITION

Define: The order n of a grating maximum.

DIFFRACTION GRATINGS

RECALL

State the highest order a grating can produce.

DIFFRACTION GRATINGS

RECALL

State the main use of a diffraction grating.

DIFFRACTION GRATINGS

EQUATION · NOT ON THE AQA DATA SHEET

Grating spacing from N lines per metre:

d = ?

DIFFRACTION GRATINGS

SPOT THE ERROR

Say what is wrong with this claim:

Adding thousands more slits should smear the pattern into a blur.

DIFFRACTION GRATINGS

DEFINITION

Define: Principal focus.

LENSES AND IMAGES

DEFINITION

Define: Power of a lens.

LENSES AND IMAGES

DEFINITION

The whole number in d sin θ = nλ; n = 0 is the straight-through maximum along the normal.

DIFFRACTION GRATINGS

DEFINITION

A plate ruled with a very large number of equally spaced slits, typically hundreds per millimetre.

DIFFRACTION GRATINGS

RECALL

Splitting light into its line spectrum so wavelengths can be measured precisely and elements identified.

DIFFRACTION GRATINGS

RECALL

The whole-number part of d/λ, because sin θ can never exceed 1.

DIFFRACTION GRATINGS

SPOT THE ERROR

More slits sharpen the maxima, not smear them: away from the exact angle the many contributions fall out of step and cancel, leaving light only where d sin θ = nλ.

DIFFRACTION GRATINGS

EQUATION · NOT ON THE AQA DATA SHEET

d = (1)/(N)

DIFFRACTION GRATINGS

DEFINITION

One over the focal length in metres: P = 1/f, measured in dioptres.

LENSES AND IMAGES

DEFINITION

The point where rays arriving parallel to the principal axis are brought together by a converging lens (or appear to come from, for a diverging lens).

LENSES AND IMAGES

RECALL

State the sign convention for lens power.

LENSES AND IMAGES

RECALL

State how the powers of thin lenses in contact combine.

LENSES AND IMAGES

DEFINITION

Define: Real image.

LENSES AND IMAGES

DEFINITION

Define: Virtual image.

LENSES AND IMAGES

DEFINITION

Define: Focal length of a lens.

LENSES AND IMAGES

RECALL

State the unit of magnification.

LENSES AND IMAGES

RECALL

State the sign convention for image distance.

LENSES AND IMAGES

RECALL

State what happens to a ray through the centre of a thin lens.

LENSES AND IMAGES

RECALL

The powers of thin lenses in contact add: $P = P_1 + P_2$.

LENSES AND IMAGES

RECALL

A converging lens has positive power; a diverging lens has negative power.

LENSES AND IMAGES

DEFINITION

An image formed where rays only appear to come from when projected backwards; it cannot be caught on a screen.

LENSES AND IMAGES

DEFINITION

An image formed where rays actually meet, so it can be caught on a screen.

LENSES AND IMAGES

RECALL

None: magnification is a ratio of lengths, v/u or image height over object height.

LENSES AND IMAGES

DEFINITION

The distance from the centre of the lens to the principal focus.

LENSES AND IMAGES

RECALL

Passes straight on, undeviated.

LENSES AND IMAGES

RECALL

Real is positive: a negative image distance v means the image is virtual, on the same side as the object.

LENSES AND IMAGES

SPOT THE ERROR

Say what is wrong with this claim:

Cover half a lens and you lose half the image.

LENSES AND IMAGES

SPOT THE ERROR

Every point of the object sends rays through every part of the lens, so the uncovered half still forms the complete image. Covering half a lens costs brightness, never half the picture.

LENSES AND IMAGES