INKPHYSICS FLASHCARDS

Magnetic fields

Year 13 · 46 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: Magnetic flux density.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

DEFINITION

Define: Fleming's left hand rule.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

State the condition for zero force on a current-carrying wire.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

State the general force on a current-carrying wire, with the angle defined.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

DEFINITION

Define: Describe the magnetic field pattern of a flat circular coil.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

State the diagram symbols for field into and out of the page.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

SPOT THE ERROR

Say what is wrong with this claim:

Fields always push along their field lines.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

State the magnetic force on a moving charge, with its condition.

FORCE ON A MOVING CHARGE

DEFINITION

First finger along the field, second finger along the conventional current, thumb gives the direction of the force, all three at right angles.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

DEFINITION

The force per unit current per unit length on a wire carrying current at right angles to the field: $B = F/IL$, in tesla.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

$F = BIl \sin\theta$, with θ the angle between the wire and the magnetic field. $\theta = 90°$ returns the perpendicular case $F = BIl$, and $\theta = 0$ gives zero force. CIE, Edexcel and OCR all set it; OCR and Edexcel print it and CIE makes you recall it. AQA examines only the perpendicular form.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

The wire lies parallel to the magnetic field, so $\sin\theta = 0$ in $F = BIl \sin\theta$.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

A circled cross shows a field into the page; a circled dot shows a field out of the page.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

DEFINITION

The field runs through the centre of the coil, straightest and strongest there, then spreads out and loops back round the outside, so one face is north and the other south, like a flattened bar magnet. The right-hand grip rule fixes which face is which. (CIE only.)

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

$F = BQv$, for a charge moving at right angles to the field; only the component of velocity perpendicular to the field counts, and the force acts at right angles to both.

FORCE ON A MOVING CHARGE

SPOT THE ERROR

The magnetic force does not act along the field lines: it acts at right angles to both the field and the current, as Fleming's left-hand rule shows.

MAGNETIC FLUX DENSITY AND THE FORCE ON A WIRE

RECALL

State the condition for zero magnetic force on a charged particle.

FORCE ON A MOVING CHARGE

RECALL

State the speed selected by a velocity selector.

FORCE ON A MOVING CHARGE

RECALL

State the period of a charge circling in a magnetic field.

FORCE ON A MOVING CHARGE

RECALL

State the general magnetic force on a moving charge, with the angle defined.

FORCE ON A MOVING CHARGE

EQUATION · NOT ON THE AQA DATA SHEET

Radius of a charge's circular path in a field:

r = ?

FORCE ON A MOVING CHARGE

SPOT THE ERROR

Say what is wrong with this claim:

Magnetic fields can speed particles up.

FORCE ON A MOVING CHARGE

DEFINITION

Define: Magnetic flux.

MAGNETIC FLUX AND FLUX LINKAGE

DEFINITION

Define: Flux linkage.

MAGNETIC FLUX AND FLUX LINKAGE

RECALL

v = E/B, the one speed at which the electric and magnetic forces balance so the particle passes undeflected.

FORCE ON A MOVING CHARGE

RECALL

The particle is stationary or moves parallel to the field.

FORCE ON A MOVING CHARGE

RECALL

F = BQv sin θ, with θ the angle between the velocity and the magnetic field. θ = 90° returns the perpendicular case F = BQv, and θ = 0 gives zero force on a charge flying along the field. CIE and Edexcel both set it; Edexcel prints it on its sheet and CIE makes you recall it. AQA and OCR examine only the perpendicular form.

FORCE ON A MOVING CHARGE

RECALL

T = 2πm/BQ, independent of the particle's speed, provided that speed stays well below the speed of light.

FORCE ON A MOVING CHARGE

SPOT THE ERROR

A magnetic field cannot speed a particle up: the force is always perpendicular to the velocity, so it does no work and only changes the direction of motion.

FORCE ON A MOVING CHARGE

EQUATION · NOT ON THE AQA DATA SHEET

r = (mv)/(BQ)

FORCE ON A MOVING CHARGE

DEFINITION

The flux through a coil multiplied by its number of turns: NΦ.

MAGNETIC FLUX AND FLUX LINKAGE

DEFINITION

The product of flux density and the area it passes through at right angles: Φ = BA, in webers.

MAGNETIC FLUX AND FLUX LINKAGE

RECALL

State the unit of flux linkage.

MAGNETIC FLUX AND FLUX LINKAGE

DEFINITION

Define: The weber.

MAGNETIC FLUX AND FLUX LINKAGE

RECALL

State what a search coil's oscilloscope amplitude shows.

MAGNETIC FLUX AND FLUX LINKAGE

SPOT THE ERROR

Say what is wrong with this claim:

θ is the angle between the field and the coil.

MAGNETIC FLUX AND FLUX LINKAGE

DEFINITION

Define: Faraday's law.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

DEFINITION

Define: Lenz's law.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

RECALL

State the emf across a conductor moving through a magnetic field.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

RECALL

Explain why Lenz's law follows from energy conservation.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

DEFINITION

The flux through one square metre held at right angles to a field of one tesla: 1 Wb = 1 T m^2.

MAGNETIC FLUX AND FLUX LINKAGE

RECALL

The weber-turn (Wb turns).

MAGNETIC FLUX AND FLUX LINKAGE

SPOT THE ERROR

θ in Φ = BA cos θ is the angle between the field and the normal to the coil's plane, not the plane itself; field straight through the coil gives θ = 0 and maximum flux.

MAGNETIC FLUX AND FLUX LINKAGE

RECALL

In an alternating field the amplitude of the induced trace is proportional to the flux linkage through the coil.

MAGNETIC FLUX AND FLUX LINKAGE

DEFINITION

The induced emf acts in the direction that opposes the change of flux producing it.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

DEFINITION

The magnitude of the induced emf equals the rate of change of flux linkage.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

RECALL

A current aiding the change would create electrical energy from nothing, so the induced current must oppose the change.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

RECALL

ε = Blv for a conductor of length l moving at speed v at right angles to the field.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

RECALL

State the unit of rate of change of flux linkage.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

SPOT THE ERROR

Say what is wrong with this claim:

The emf is biggest when the most flux passes through the coil.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

DEFINITION

Define: Root-mean-square value.

ALTERNATING CURRENTS

DEFINITION

Define: Peak-to-peak value.

ALTERNATING CURRENTS

RECALL

State how mean power compares with peak power in a resistor.

ALTERNATING CURRENTS

RECALL

State the condition for the root-two rms relations.

ALTERNATING CURRENTS

RECALL

State what the oscilloscope timebase sets.

ALTERNATING CURRENTS

SPOT THE ERROR

Say what is wrong with this claim:

Mains is 230 volts at its peak.

ALTERNATING CURRENTS

SPOT THE ERROR

Flux itself induces nothing: the emf equals the rate of change of flux linkage, so it is greatest where the flux is changing fastest and zero at maximum flux.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

RECALL

The volt: 1 Wb s^{-1} is 1 V.

ELECTROMAGNETIC INDUCTION: FARADAY AND LENZ

DEFINITION

The full span from minimum to maximum of the waveform, twice the peak value for a sinusoid.

ALTERNATING CURRENTS

DEFINITION

The value of the steady direct current that would dissipate the same average power in a resistor. For a sinusoid, and only for a sinusoid, $I_{rms} = I_0/\sqrt{2}$.

ALTERNATING CURRENTS

RECALL

$I_{rms} = I_0/\sqrt{2}$ and $V_{rms} = V_0/\sqrt{2}$ hold for sinusoidal waveforms only.

ALTERNATING CURRENTS

RECALL

For a sinusoidal supply the mean power dissipated is half the peak power.

ALTERNATING CURRENTS

SPOT THE ERROR

230 V is the rms value of the mains, not the peak: the peak voltage is $\sqrt{2}$ times larger, about 325 V.

ALTERNATING CURRENTS

RECALL

The time represented by each horizontal division of the screen, in seconds per division.

ALTERNATING CURRENTS

DEFINITION

Define: Rectification.

RECTIFICATION AND SMOOTHING

DEFINITION

Define: Half-wave rectification.

RECTIFICATION AND SMOOTHING

DEFINITION

Define: Full-wave rectification.

RECTIFICATION AND SMOOTHING

DEFINITION

Define: Smoothing.

RECTIFICATION AND SMOOTHING

DEFINITION

Define: Reservoir capacitor.

RECTIFICATION AND SMOOTHING

DEFINITION

Define: Ripple.

RECTIFICATION AND SMOOTHING

RECALL

State the condition for effective smoothing.

RECTIFICATION AND SMOOTHING

RECALL

State the time between peaks of a full-wave rectified 50 Hz supply.

RECTIFICATION AND SMOOTHING

DEFINITION

Rectification using a single diode, so only one half of each cycle passes and the other half is blocked.

RECTIFICATION AND SMOOTHING

DEFINITION

Conversion of alternating current to direct current.

RECTIFICATION AND SMOOTHING

DEFINITION

Reducing the variation of a rectified supply using a reservoir capacitor across the load.

RECTIFICATION AND SMOOTHING

DEFINITION

Rectification using a bridge of four diodes, which reverses the negative half-cycles so both halves of the cycle drive current one way through the load.

RECTIFICATION AND SMOOTHING

DEFINITION

The small periodic variation left in a smoothed output as the capacitor discharges between peaks.

RECTIFICATION AND SMOOTHING

DEFINITION

The capacitor across the load that charges near each peak of the rectified supply and discharges through the load between the peaks.

RECTIFICATION AND SMOOTHING

RECALL

10 ms: full-wave rectification gives a peak every half-cycle.

RECTIFICATION AND SMOOTHING

RECALL

The time constant RC must be long compared with the time between peaks of the rectified supply.

RECTIFICATION AND SMOOTHING

SPOT THE ERROR

Say what is wrong with this claim:

Rectified ac is direct current, so it is steady.

RECTIFICATION AND SMOOTHING

RECALL

Explain why a transformer needs ac.

TRANSFORMERS

DEFINITION

Define: Eddy currents.

TRANSFORMERS

RECALL

State the purpose of laminating a transformer core.

TRANSFORMERS

RECALL

Explain why grid transmission uses high voltage.

TRANSFORMERS

SPOT THE ERROR

Say what is wrong with this claim:

A transformer can step up power.

TRANSFORMERS

RECALL

Only an alternating current produces a changing core flux, and only changing flux linkage induces an emf in the secondary.

TRANSFORMERS

SPOT THE ERROR

Rectified current is one-directional but not steady: it still rises and falls each half-cycle. A reservoir capacitor smooths it towards steady dc, and some ripple always remains.

RECTIFICATION AND SMOOTHING

RECALL

Thin insulated layers break eddy-current loops into small ones, cutting the energy lost heating the core.

TRANSFORMERS

DEFINITION

Currents induced in the iron core itself by the changing flux, which waste energy by heating the core.

TRANSFORMERS

SPOT THE ERROR

A transformer cannot step up power: stepping the voltage up steps the current down in the same ratio, and a real transformer delivers slightly less power than it takes in.

TRANSFORMERS

RECALL

For a fixed power a higher voltage means a smaller current, and the cable loss I^2R falls with the square of the current.

TRANSFORMERS