INKPHYSICS FLASHCARDS

Electronics

Year 13 · 34 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: Threshold voltage.

DISCRETE SEMICONDUCTOR DEVICES

DEFINITION

Define: Zener diode.

DISCRETE SEMICONDUCTOR DEVICES

DEFINITION

Define: Photodiode.

DISCRETE SEMICONDUCTOR DEVICES

DEFINITION

Define: Hall voltage.

DISCRETE SEMICONDUCTOR DEVICES

EQUATION · NOT ON THE AQA DATA SHEET

Current in a zener regulator's series resistor:

I = ?

DISCRETE SEMICONDUCTOR DEVICES

SPOT THE ERROR

Say what is wrong with this claim:

Switching a heavy load needs a heavy current into the transistor's control terminal.

DISCRETE SEMICONDUCTOR DEVICES

DEFINITION

Define: Resonance in an LC circuit.

RESONANT CIRCUITS AND FILTERS

DEFINITION

Define: Bandwidth of a resonant circuit.

RESONANT CIRCUITS AND FILTERS

DEFINITION

A diode built to break down at a chosen reverse voltage without damage, holding its pd nearly constant while the current through it varies widely.

DISCRETE SEMICONDUCTOR DEVICES

DEFINITION

The gate-source voltage at which a MOSFET first forms a conducting channel. Below it no channel exists and the drain current is zero, however large the drain voltage.

DISCRETE SEMICONDUCTOR DEVICES

DEFINITION

The steady pd produced across a current-carrying slab, at right angles to both the current and an applied magnetic field, and proportional to the flux density at constant current.

DISCRETE SEMICONDUCTOR DEVICES

DEFINITION

A diode used in reverse bias, in which absorbed photons free electron-hole pairs so that the reverse current, the photocurrent, is proportional to the intensity of the light.

DISCRETE SEMICONDUCTOR DEVICES

SPOT THE ERROR

A MOSFET is controlled by a voltage, not a current. Its gate sits on an insulating oxide layer, so only a negligible leakage current enters it: the driver supplies the brief charge the gate capacitance needs, and a logic pin rated at a milliamp can switch amps.

DISCRETE SEMICONDUCTOR DEVICES

EQUATION · NOT ON THE AQA DATA SHEET

$$I = (V_S - V_Z)/(R_S)$$

DISCRETE SEMICONDUCTOR DEVICES

DEFINITION

The width in frequency between the two points either side of the peak at which the current has fallen to $1/\sqrt{2}$ of its maximum, where the power delivered is half its peak.

RESONANT CIRCUITS AND FILTERS

DEFINITION

The condition in which the inductive and capacitive reactances are equal and opposite, so they cancel, the impedance falls to a minimum and the current is a maximum.

RESONANT CIRCUITS AND FILTERS

DEFINITION

Define: Q factor.

RESONANT CIRCUITS AND FILTERS

DEFINITION

Define: Cut-off frequency of an RC filter.

RESONANT CIRCUITS AND FILTERS

EQUATION · NOT ON THE AQA DATA SHEET

Cut-off frequency of an RC filter:

$f_c = ?$

RESONANT CIRCUITS AND FILTERS

SPOT THE ERROR

Say what is wrong with this claim:

A tuned circuit responds at one frequency and rejects everything else.

RESONANT CIRCUITS AND FILTERS

DEFINITION

Define: Ideal operational amplifier.

OPERATIONAL AMPLIFIERS

DEFINITION

Define: Saturation.

OPERATIONAL AMPLIFIERS

DEFINITION

Define: Virtual earth.

OPERATIONAL AMPLIFIERS

DEFINITION

Define: Gain-bandwidth product.

OPERATIONAL AMPLIFIERS

DEFINITION

The frequency at which the reactance equals the resistance, so the output has fallen to $1/\sqrt{2}$, about 0.71, of its full value.

RESONANT CIRCUITS AND FILTERS

DEFINITION

The resonant frequency divided by the bandwidth. A high Q means a narrow, sharp peak and little energy lost from the circuit each cycle.

RESONANT CIRCUITS AND FILTERS

SPOT THE ERROR

It passes a band, not a line. The response falls to $1/\sqrt{2}$ of the peak a half bandwidth either side of f_0, and $f_B = f_0/Q$, so a real signal with its own spread of frequencies needs the band wide enough to carry it.

RESONANT CIRCUITS AND FILTERS

EQUATION · NOT ON THE AQA DATA SHEET

$$f_c = (1)/(2\pi RC)$$

RESONANT CIRCUITS AND FILTERS

DEFINITION

The state in which the output demanded by the gain would pass the supply rails, so the output sticks just inside a rail and no longer follows the input.

OPERATIONAL AMPLIFIERS

DEFINITION

An amplifier of the difference between its two inputs, taken to have infinite open-loop gain, infinite input resistance, zero output resistance and infinite bandwidth.

OPERATIONAL AMPLIFIERS

DEFINITION

The constant product of closed-loop gain and bandwidth for a given op-amp, so a gain raised by a factor of ten cuts the bandwidth by the same factor.

OPERATIONAL AMPLIFIERS

DEFINITION

The inverting input of an inverting amplifier, held within microvolts of 0 V by negative feedback although it carries no connection to earth.

OPERATIONAL AMPLIFIERS

EQUATION · NOT ON THE AQA DATA SHEET

Gain-bandwidth product:

gain × bandwidth = ?

OPERATIONAL AMPLIFIERS

SPOT THE ERROR

Say what is wrong with this claim:

An op-amp with an open-loop gain of 100 000 multiplies any input by 100 000.

OPERATIONAL AMPLIFIERS

RECALL

Explain why the currents add at the virtual earth.

SUMMING AND DIFFERENCE AMPLIFIERS

RECALL

State the summing amplifier equation.

SUMMING AND DIFFERENCE AMPLIFIERS

DEFINITION

Define: Common-mode signal.

SUMMING AND DIFFERENCE AMPLIFIERS

RECALL

Explain what happens when an amplifier saturates.

SUMMING AND DIFFERENCE AMPLIFIERS

SPOT THE ERROR

Say what is wrong with this claim:

A summing amplifier simply adds up its input voltages.

SUMMING AND DIFFERENCE AMPLIFIERS

RECALL

Explain what regeneration does that amplification cannot.

DIGITAL SIGNAL PROCESSING

SPOT THE ERROR

Only for inputs under about 130 µV. An open-loop gain of 100 000 multiplied by more than that asks for an output beyond the supply rails, so the amplifier saturates. Useful gain comes from negative feedback, and then the resistors set it, not the chip.

OPERATIONAL AMPLIFIERS

EQUATION · NOT ON THE AQA DATA SHEET

gain × bandwidth = constant

OPERATIONAL AMPLIFIERS

RECALL

$V_{out} = -R_f(V_1/R_1 + V_2/R_2 + \ldots)$: each input is amplified by R_f divided by its own input resistor, and the weighted total is inverted.

SUMMING AND DIFFERENCE AMPLIFIERS

RECALL

The inverting input sits at 0 V, so each input resistor carries V/R regardless of the others, and since the op-amp inputs draw no current every one of those currents flows on through the feedback resistor.

SUMMING AND DIFFERENCE AMPLIFIERS

RECALL

The output cannot pass the supply rails, so once the equation demands more than the rail voltage the output sticks about a volt inside that rail and the waveform is clipped.

SUMMING AND DIFFERENCE AMPLIFIERS

DEFINITION

A signal appearing identically on both inputs, such as mains hum induced equally on both leads of a cable. It appears in both terms of $(V_+ - V_-)$ and so cancels before the gain is applied.

SUMMING AND DIFFERENCE AMPLIFIERS

RECALL

A regenerator decides whether each incoming pulse is 0 or 1 and issues a brand-new, full-height, noise-free pulse, so the noise collected so far is discarded. An amplifier raises the signal and the accumulated noise together.

DIGITAL SIGNAL PROCESSING

SPOT THE ERROR

It adds weighted voltages, and inverts the total. Each input reaches the virtual earth through its own resistor, so it arrives with its own gain R_f/R_{in}: equal weights happen only if you choose equal resistors.

SUMMING AND DIFFERENCE AMPLIFIERS

DEFINITION

Define: EOR gate.

DIGITAL SIGNAL PROCESSING

DEFINITION

Define: Half-adder.

DIGITAL SIGNAL PROCESSING

DEFINITION

Define: D-type flip-flop.

DIGITAL SIGNAL PROCESSING

EQUATION · NOT ON THE AQA DATA SHEET

Frequency after n dividing stages:

$f_{out} = ?$

DIGITAL SIGNAL PROCESSING

SPOT THE ERROR

Say what is wrong with this claim:

Digital signals survive long distances because they are transmitted at higher power.

DIGITAL SIGNAL PROCESSING

DEFINITION

Define: Modulation.

DATA COMMUNICATION

DEFINITION

Define: Sideband.

DATA COMMUNICATION

RECALL

State the sampling rule.

DATA COMMUNICATION

DEFINITION

A circuit that adds two bits: an EOR gate on the two inputs gives the sum and an AND gate on the same two inputs gives the carry.

DIGITAL SIGNAL PROCESSING

DEFINITION

A two-input gate whose output is 1 when the inputs differ and 0 when they are the same.

DIGITAL SIGNAL PROCESSING

EQUATION · NOT ON THE AQA DATA SHEET

$f_{out} = (f_{in})/(2^n)$

DIGITAL SIGNAL PROCESSING

DEFINITION

A one-bit memory: on each rising clock edge it copies D to Q, then holds Q unchanged, ignoring D, until the next edge.

DIGITAL SIGNAL PROCESSING

DEFINITION

Printing a signal onto a higher-frequency carrier wave by varying the carrier amplitude or frequency, so that aerials can be a practical length and each station can be given a frequency of its own.

DATA COMMUNICATION

SPOT THE ERROR

Transmitted power is beside the point, and digital links usually use less of it. Two levels with a threshold between them leave a margin for noise, and a repeater regenerates each pulse as a new clean one, throwing the accumulated noise away.

DIGITAL SIGNAL PROCESSING

RECALL

The sampling rate must be greater than twice the highest frequency present in the signal; sampled more slowly, a high frequency is recorded as a lower one and cannot be recovered.

DATA COMMUNICATION

DEFINITION

One of the two frequencies produced either side of the carrier by amplitude modulation, at $f_c + f_M$ and $f_c - f_M$; they carry the information, the carrier itself carries none.

DATA COMMUNICATION

DEFINITION

Define: Time-division multiplexing.

DATA COMMUNICATION

SPOT THE ERROR

Say what is wrong with this claim:

FM radio sounds cleaner than AM because it is broadcast at higher power.

DATA COMMUNICATION

SPOT THE ERROR

The advantage lies in what the receiver reads. Noise adds to a wave's amplitude; an FM receiver clips the amplitude flat and detects only the frequency, so nearly all of that noise is removed, and the wide FM channel also carries audio to 15 kHz.

DATA COMMUNICATION

DEFINITION

Sharing one channel by giving each user the whole channel for a brief repeating time slot, which suits digital signals because their samples are short pulses with gaps between them.

DATA COMMUNICATION