



QUESTION WORKBOOK

Rectification and smoothing

Magnetic fields · Year 13

CIE 21.2.1, 21.2.2, 21.2.3, 21.2.4

19 questions · 50 marks

NAVY SCREEN EDITION

SECTION A · Warm-up

A1 State the function of a diode in a circuit and explain why a single diode in series with an alternating supply produces half-wave rectification. [2]

A2 Sketch the output of a half-wave rectifier fed with a sinusoidal input, and the output of a full-wave rectifier fed with the same input. Label the difference between them. [2]

A3 State one disadvantage of half-wave rectification compared with full-wave rectification, and one advantage in terms of components. [2]

A4 A sinusoidal 50 Hz supply is full-wave rectified. State the number of voltage peaks per second in the output. [1]

A5 A sinusoidal 50 Hz supply is half-wave rectified, with no smoothing. State the time between successive peaks of the output, and the length of time in each cycle for which the output is zero. [2]

A6 State what is meant by the ripple of a smoothed supply and what causes it. [2]

SECTION B · Standard

B1 A bridge rectifier contains four diodes. Explain how it produces full-wave rectification. Refer to which diodes conduct in each half-cycle. [3]

B2 Explain how a capacitor connected across the load smooths the output of a full-wave rectifier. [3]

- B3** A smoothing capacitor of $2200\ \mu\text{F}$ discharges through a load of $500\ \Omega$. Calculate the time constant of the discharge. [2]

- B4** State and explain the effect on the ripple of a smoothed supply of increasing the capacitance of the reservoir capacitor. [2]

- B5** A smoothed power supply works well with a $2.0\ \text{k}\Omega$ load. Explain why the ripple increases when the load is changed to $200\ \Omega$. [2]

- B6** An oscilloscope connected across the load of a rectifier circuit shows positive humps $10\ \text{ms}$ apart. The ac supply has a frequency of $50\ \text{Hz}$. Deduce whether the rectification is half-wave or full-wave. [2]

- B7** A smoothed full-wave supply holds its output near 15 V across a load that draws an almost steady current of 60 mA. The reservoir capacitor is 1000 μF and peaks arrive every 10 ms. Estimate the fall in the output voltage between successive peaks.

[3]

- B8** A student smooths a half-wave rectified 50 Hz supply and a full-wave rectified 50 Hz supply using identical capacitors and identical loads. Explain which output shows the larger ripple.

[3]

SECTION C · Stretch

- C1** A full-wave rectified 50 Hz supply is smoothed by a 470 μF capacitor across a 1.0 k Ω load. Calculate the time between successive peaks and the discharge time constant, and use the two values to justify whether the smoothing is effective.

[4]

- C2** An unsmoothed full-wave rectifier is fed from a supply of rms voltage 12 V. State the peak output voltage, and describe how the smoothed output would sit relative to the unsmoothed humps if both were drawn on the same axes. [3]

- C3** A 100 μF capacitor smooths a full-wave rectified 50 Hz supply across a 2.0 k Ω load. Calculate the fraction of the peak voltage remaining after one 10 ms interval between peaks, and comment on the size of the ripple. [4]

- C4** A full-wave rectified 50 Hz supply feeds a 500 Ω load. The design requires the output to stay above 95% of the peak voltage at all times. Three reservoir capacitors are available: 100 μF , 220 μF and 470 μF . Using $V = V_0 e^{-t/RC}$, deduce the smallest of the three capacitors that meets the requirement. [5]

- C5** One of the four diodes in a bridge rectifier fails so that it no longer conducts. Deduce and explain the effect on the smoothed output across the load. [3]
