



QUESTION WORKBOOK

Rates of change and building differential equations

Differentiation · Year 12–13

6 questions · 20 marks

NAVY SCREEN EDITION

SECTION A · Warm-up

- A1** A quantity V depends on r , and r depends on time. Write down the chain-rule link between dV/dt , dV/dr and dr/dt , and state which of the three a typical question gives you directly. [2]

- A2** A circular oil slick's area grows at a steady 10 m^2 per hour. Find the rate at which the radius grows when $r = 4 \text{ m}$, to 3 significant figures. [3]

SECTION B · Standard

- B1** A spherical balloon is inflated at a steady 120 cm^3 per second. Find the rate at which the radius grows when $r = 4 \text{ cm}$, to 3 significant figures. [4]

- B2** A cube's volume grows at 27 cm^3 per second. Find the rate at which the edge length grows when the edge is 3 cm, and the rate at which the surface area is growing at the same moment. [4]

- B3** Write down a differential equation for a population P whose growth rate is proportional to the population itself. [3]

SECTION C · Stretch

- C1** A hot drink cools so that the rate of decrease of its temperature T is proportional to how far T sits above the room temperature of 20°C . Build the differential equation, defining any constant you introduce. [4]