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A LEVEL MATHS

(55) Rates of Change (Differentiation)

WORKING AT D/E

(1) Given that $y = x^3 + 2x^2$ and that $\frac{dx}{dt} = 4$, show that $\frac{dy}{dt} = 28$ when $x = 1$.

(2) Given that $y = e^x + \sin x$ and that $\frac{dx}{dt} = -1$, show that $\frac{dy}{dt} = -2$ when $x = 0$.

(3) Given that $A = \pi r^2 + 4\pi r$ and $\frac{dA}{dt} = 6$, find the value of $\frac{dr}{dt}$ when $r = 1$ giving your answer to 3 SF.

WORKING AT B/C

(1) A sphere with radius r has volume , $V = \frac{4}{3}\pi r^3$
The volume of the sphere is increasing at a constant rate of $16cm^3s^{-1}$

Find the rate of change of the radius when the radius is $2cm$.

(2) A curve has equation $y = f(x),\ x > 0$. The gradient of the curve at any point on the curve is proportional to xy.

Point P on the curve has coordinates $(3, -4)$ and the gradient at P is $\frac{1}{3}$..

Show that $\frac{dy}{dx} = -\frac{xy}{36}$

(3) A circle has area A, circumference C and radius r. The area of the circle is increasing at a constant rate of $6cm^2s^{-1}$

(a) Find a formula for A in terms of r.

(b) Find a formula for C in terms of r.

(c) Show that the rate of change of the circumference when the radius is $4cm$ is $1.5cms^{-1}$

WORKING AT A*/A

(1) A solid ice shaped cylinder with height $10cm$ and base radius r is melting at a constant rate of $1cm^3s^{-1}$

Show that an expression for the rate at which the surface area of the ice shaped cylinder is decreasing can be written as $\frac{5+r}{5r}$

(2) A solid cube has volume V and surface area A. After t seconds the volume of a solid cube is increasing at the rate of $8cm^3s^{-1}$.

Show the rate at which the area increases satisfies the differential equation $A^{0.5}\left(\frac{dA}{dt}\right) = 32\sqrt{6}$