

Extra Revision Questions

Quadratics

1. A rectangular school courtyard is surrounded by a concrete walkway.
The length is 15 m less than three times its width (w).
Walkway width = 3 m.
Walkway Depth = 0.12m.
Courtyard area = 1575 m^2 .
 - a. Show that $w=25\text{m}$.
 - b. Calculate the length of the courtyard. **60m**
 - c. What volume of concrete is needed for the walkway? **52.52m^3**
 - d. If the concrete is poured at a rate of $0.015\text{m}^3/\text{s}$, how long does it take to pour the whole slab? **3768s / 62.8mins / 1.05hours**
 - e. What is the length of the fence to go around the whole area? **194m**

2. A village green is rectangular and surrounded by an asphalt road.
The length of the green is 25 m more than its width (w).
The road has a uniform width of 6 m.
The area of the yard is 3000 m^2 .
 - a. Show that $w=40\text{m}$.
 - b. Calculate the length of the green. **65m**
 - c. The whole road needs resurfacing with 0.05m of asphalt. What volume is needed? **50.2m^3**
 - d. The cost of resurfacing is £30 per square metre, what is the total cost?
£30,120
 - e. To protect the users of the green, a safety barrier is to be erected around the perimeter, what length of barrier is required? **210m**

Calculus

3. A drone delivers a medical package by ascending vertically.
Its height is given by:
$$h = 22t - 2t^2 \quad 0 \leq t \leq 6$$
 - a. Find the expressions for Velocity and Acceleration. **$v=22-4t$, $a=-4\text{m/s}^2$**
 - b. Determine the maximum height of the drone. **60.5m**

4. A hydraulic hammer is lifted vertically before driving a pile.

The height of the hammer is:

$$h = 14t - 1.4t^2 \quad 0 \leq t \leq 10$$

- a. Find expressions for Velocity and Acceleration. $v=14-2.8t$ $a=-2.8\text{m/s}^2$
b. Determine the maximum height of the hammer. 35m

5. A cantilever beam of length 5 m carries a uniformly varying distributed load along its length.

The load intensity in N/m is given by:

$$w(x) = 500 + x^2$$

where x is the distance from the fixed end in metres.

The total load on the beam is given by:

$$P = \int_0^5 w(x) dx$$

and the moment at the fixed end is given by:

$$M = \int_0^5 w(x) x dx$$

- a. Determine the total load. $P= 2541.7\text{N}$
b. Determine the bending moment at the fixed end, M . 6406.25Nm

Matrices

6. A **triangular steel frame** is being designed. Three support beams carry vertical loads L_1, L_2, L_3 (in kN). The following equilibrium equations must be satisfied:

$$\begin{aligned} L_1 + L_2 + L_3 &= 120 \\ 2L_1 + L_2 + 3L_3 &= 250 \\ L_1 + 2L_2 + 2L_3 &= 220 \end{aligned}$$

Determine the load on each beam. $L_1=20\text{kN}$, $L_2=45\text{kN}$, $L_3=55\text{kN}$

7. A water treatment plant needs to mix Chemicals A, B, and C to meet water quality requirements. The amounts in kilograms satisfy:

$$\begin{aligned} A + B + C &= 300 \\ 2A + 3B + C &= 520 \\ 3A + B + 2C &= 500 \end{aligned}$$

Determine the quantities of each chemical. $A=6.7\text{kg}$, $B=106.7\text{kg}$, $C=186.7\text{kg}$