Accumulated change

6 questions | 18 marks

Equivalent correct methods earn the corresponding marks.

1. A tank starts with 20 L and fills at $4+2t$ L/min for 0 to 3 min. Find the final volume. [3 marks]

Change $=[4t+t^2]_0^3=21$ L.

Final volume $20+21=41$ L.

Answer: 41 L

2. A machine uses power $P(t)=3t^2$ kW for 0 to 2 hours. Find the energy used. [3 marks]

Energy $=\int_0^2 3t^2\,dt=8.$

Answer: 8 kWh

3. A stock starts at 100 units and changes at $6-2t$ units/day for 0 to 4 days. Find its net change and final size. [3 marks]

Change $=[6t-t^2]_0^4=24-16=8.$

Add 100.

Answer: Net change 8 units; final 108 units.

4. An inflow is 10 L/min and an outflow is t L/min for 0 to 5 min. Find the total inflow and net change. [3 marks]

Inflow $= 10(5) = 50$.

Net change $= \int_0^5 (10 - t)\,dt = 50 - 12.5 = 37.5$.

Answer: 50 L inflow;37.5 L net gain.

5. A population model has $N'(t) = 2e^t$ and $N(0) = 30$. Find $N(\ln 3)$. [3 marks]

Change $= [2e^t]_0^{\ln 3} = 6 - 2 = 4$.

Add 30.

Answer: 34

6. A rate model predicts that a 200 L tank contains 230 L after 10 minutes. What needs checking before accepting that result? [3 marks]

The capacity is exceeded; overflow or a changed flow rule must be modelled.

Answer: Whether the model remains valid after the tank fills.