SOLUTION

☑ 1. Displacement from Velocity

Given:

$$v(t) = 2t^2 + 4t \text{ m/s}$$

Displacement is the integral of velocity:

$$\text{Displacement} = \int_0^3 (¿\, 2t^2 + 4t)\, dt\, ¿$$

$$¿ \left[\frac{2t^3}{3} + 2t^2 \right]_0^3 = \left(\frac{2(27)}{3} + 2(9) \right) = (18 + 18) = 36 \text{ meters}$$

☑ 2. Work Done by Variable Force

Given:

$$F(x) = 4x^3 \text{ N}$$

Work done:

$$W = \int_1^2 4x^3\, dx = \left[x^4 \right]_1^2 = 2^4 - 1^4 = 16 - 1 = 15 \text{ J}$$

☑ 3. Pressure on a Dam Wall

Force due to water pressure:

$$F = \rho g \int_0^8 h\, dh = 1000 \cdot 9.8 \cdot \left[\frac{h^2}{2} \right]_0^8 = 9800 \cdot \left(\frac{64}{2} \right) = 9800 \cdot 32 = 313,600 \text{ N/m (total force per meter width)}$$

☑ 4. Rate of Heat Transfer

Given:

$$T(t)=80e^{-0.1t}, \frac{dT}{dt}=-8e^{-0.1t}$$

At $t=5$:

$$\frac{dT}{dt}=-8e^{-0.5}\approx -8\cdot 0.6065=-4.852\,°\text{C/min}$$

☑ 5. Changing Magnetic Flux (Faraday's Law)

$$\Phi_B(t)=0.4t^2-3t, \text{EMF}=-\frac{d\Phi_B}{dt}$$

$$\frac{d\Phi_B}{dt}=0.8t-3, \text{At } t=2: 0.8(2)-3=1.6-3=-1.4$$

$$\text{Induced EMF}=-(-1.4)=1.4\,\text{V}$$

☑ 6. Fluid Flow Gradient

$$v(y)=5y-y^3, \frac{dv}{dy}=5-3y^2$$

At $y=2$:

$$\frac{dv}{dy}=5-3(4)=5-12=-7$$

☑ 7. Complex Division: $\frac{5+3i}{2+i}$

Multiply numerator and denominator by conjugate of denominator:

$$\frac{5+3i}{2+i}\cdot\frac{2-i}{2-i}=\frac{(5+3i)(2-i)}{(2+i)(2-i)}$$

Numerator:

$$¿10-5i+6i-3i^2=10+i+3=13+i$$

Denominator:

$$¿4+1=5$$

$$\frac{13+i}{5}=2.6+0.2i$$

☑ 8. Express $\frac{2+5i}{1+3i}$ in $a+bi$ form

Multiply by conjugate:

$$\frac{2+5i}{1+3i}\cdot\frac{1-3i}{1-3i}$$

Numerator:

$$(2+5i)(1-3i)=2-6i+5i-15i^2=2-i+15=17-i$$

Denominator:

$$1+9=10$$

$$\frac{17-i}{10}=1.7-0.1i$$

☑ 9. Focus of a Parabola (Parabolic Dish)

Given: Width = 6 m, Depth = 1.5 m The formula:

$$4f=\frac{w^2}{d}\Rightarrow f=\frac{w^2}{4d}=\frac{6^2}{4\cdot 1.5}=\frac{36}{6}=6\,\text{m}$$

☑ 10. Binomial Expansion of ¿ (3 terms)

Use binomial expansion:

¿

Here, $a=-0.2, n=4$

$$¿1+4(-0.2x)+\frac{4\cdot 3}{2}¿$$

Answer:

¿