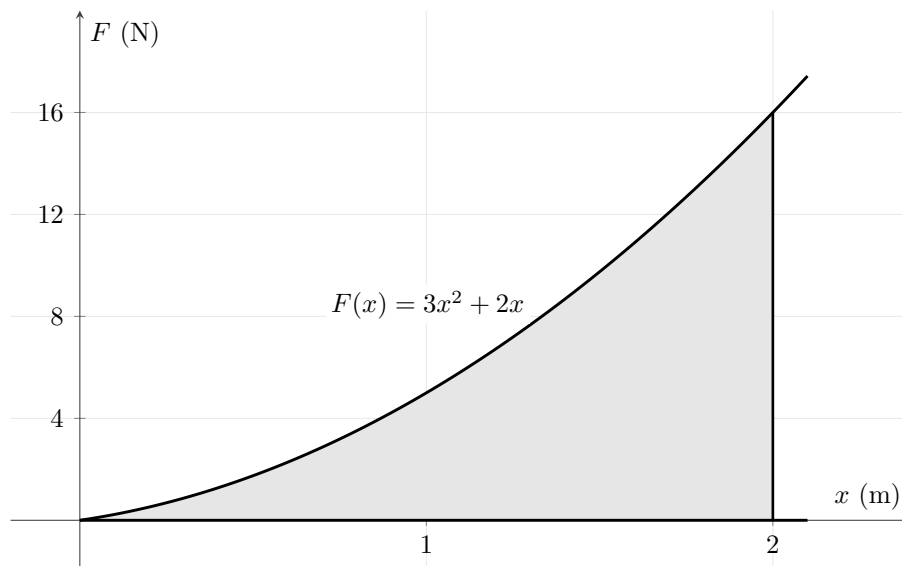


Question 1

A force acting along a straight line is given by

$$F(x) = 3x^2 + 2x \quad (\text{newtons}),$$

where x is the displacement in meters from the origin. Find the work done by the force in moving an object from $x = 0$ to $x = 2$.



The shaded area represents work over the specified interval.

Question 1 – Solution

1. Identify the force and interval.

The force acts along the displacement and is $F(x) = 3x^2 + 2x$ newtons. The object moves from $x = 0$ to $x = 2$ meters.

2. Write the work integral.

Over a small displacement dx , $dW = F(x) dx$. Therefore,

$$W = \int_0^2 F(x) dx = \int_0^2 (3x^2 + 2x) dx.$$

3. Integrate term by term.

By the power rule,

$$\int 3x^2 dx = 3\frac{x^3}{3} = x^3, \quad \int 2x dx = 2\frac{x^2}{2} = x^2.$$

4. Apply the bounds.

$$W = [x^3 + x^2]_0^2 = (2^3 + 2^2) - (0^3 + 0^2) = 8 + 4 = 12.$$

5. State the result with units.

$$\boxed{W = 12 \text{ J}}.$$

A newton times a meter is a joule. Since $F(x) \geq 0$ on $[0, 2]$, the work is the positive shaded area under the force curve.