

1. Let  $u = -6t - t^2$ , then  $u' = -6 - 2t$ .

Let  $v = -10 + 5t - 2t^2$ , then  $v' = 5 - 4t$ .

Quotient rule:  $y' = \frac{u'v - uv'}{v^2}$ , so

$$\begin{aligned} y' &= \frac{(-6 - 2t) \times (-10 + 5t - 2t^2) - (-6t - t^2) \times (5 - 4t)}{(-10 + 5t - 2t^2)^2} \\ &= \frac{60 - 30t + 12t^2 + 20t - 10t^2 + 4t^3 + 30t - 24t^2 + 5t^2 - 4t^3}{(-10 + 5t - 2t^2)^2} \end{aligned}$$

$$\text{Hence } y' = \frac{-17t^2 + 20t + 60}{(-10 + 5t - 2t^2)^2}.$$

2. Let  $u = -3 + 2x^2$ , then  $u' = 4x$ .

Let  $v = -9 + 2x - 4x^2$ , then  $v' = 2 - 8x$ .

Quotient rule:  $y' = \frac{u'v - uv'}{v^2}$ , so

$$\begin{aligned} y' &= \frac{4x \times (-9 + 2x - 4x^2) - (-3 + 2x^2) \times (2 - 8x)}{(-9 + 2x - 4x^2)^2} \\ &= \frac{-36x + 8x^2 - 16x^3 + 6 - 24x - 4x^2 + 16x^3}{(-9 + 2x - 4x^2)^2} \end{aligned}$$

$$\text{Hence } y' = \frac{4x^2 - 60x + 6}{(-9 + 2x - 4x^2)^2}.$$

3. Let  $u = -4 + 5r - 10r^2$ , then  $u' = 5 - 20r$ .

Let  $v = -4r^2 + 2r + 4$ , then  $v' = -8r + 2$ .

Quotient rule:  $y' = \frac{u'v - uv'}{v^2}$ , so

$$\begin{aligned} y' &= \frac{(5 - 20r) \times (-4r^2 + 2r + 4) - (-4 + 5r - 10r^2) \times (-8r + 2)}{(-4r^2 + 2r + 4)^2} \\ &= \frac{-20r^2 + 10r + 20 + 80r^3 - 40r^2 - 80r - 32r + 8 + 40r^2 - 10r - 80r^3 + 20r^2}{(-4r^2 + 2r + 4)^2} \end{aligned}$$

$$\text{Hence } y' = \frac{-112r + 28}{(-4r^2 + 2r + 4)^2}.$$