Samples **Differentiation SOLUTIONS**

1. Let $u = r^2 + 10r$, then $u' = 2r + 10$.
Let $v = 7r^2 + 2$, then $v' = 14r$.
Quotient rule: $y' = \dfrac{u'v - uv'}{v^2}$, so

$$\begin{aligned} y' &= \frac{(2r+10) \times \left(7r^2+2\right) - \left(r^2+10r\right) \times 14r}{\left(7r^2+2\right)^2} \\ &= \frac{14r^3 + 4r + 70r^2 + 20 - \left(14r^3 + 140r^2\right)}{\left(7r^2+2\right)^2} \\ &= \frac{14r^3 + 4r + 70r^2 + 20 - 14r^3 - 140r^2}{\left(7r^2+2\right)^2} \end{aligned}$$

Hence $y' = \dfrac{-70r^2 + 4r + 20}{\left(7r^2+2\right)^2}$.

2. Let $u = -10h^2 + 10$, then $u' = -20h$.
Let $v = h^2 + 7h$, then $v' = 2h + 7$.
Quotient rule: $y' = \dfrac{u'v - uv'}{v^2}$, so

$$\begin{aligned} y' &= \frac{-20h \times \left(h^2+7h\right) - \left(-10h^2+10\right) \times (2h+7)}{\left(h^2+7h\right)^2} \\ &= \frac{-20h^3 - 140h^2 - \left(-20h^3 - 70h^2 + 20h + 70\right)}{\left(h^2+7h\right)^2} \\ &= \frac{-20h^3 - 140h^2 + 20h^3 + 70h^2 - 20h - 70}{\left(h^2+7h\right)^2} \end{aligned}$$

Hence $y' = \dfrac{-70h^2 - 20h - 70}{\left(h^2+7h\right)^2}$.

3. Let $u = -4x^2 + 4x$, then $u' = -8x + 4$.
Let $v = 4x^2 + 10x$, then $v' = 8x + 10$.
Quotient rule: $y' = \dfrac{u'v - uv'}{v^2}$, so

$$\begin{aligned} y' &= \frac{(-8x+4) \times \left(4x^2+10x\right) - \left(-4x^2+4x\right) \times (8x+10)}{\left(4x^2+10x\right)^2} \\ &= \frac{-32x^3 - 80x^2 + 16x^2 + 40x - \left(-32x^3 - 40x^2 + 32x^2 + 40x\right)}{\left(4x^2+10x\right)^2} \\ &= \frac{-32x^3 - 80x^2 + 16x^2 + 40x + 32x^3 + 40x^2 - 32x^2 - 40x}{\left(4x^2+10x\right)^2} \end{aligned}$$

Hence $y' = \dfrac{-56x^2}{\left(4x^2+10x\right)^2}$.