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Further Mathematics

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Page 1

Acha 4006

Q1

(i) $y = 5x^4 + 5x^2 + 3x - 19$

$$\frac{dy}{dx} = 20x^3 + 10x + 3$$

(ii) $y = (2x+5)(x-1)$

$$\frac{d}{dx}(y) = \frac{d}{dx}((2x+5)(x-1))$$

$$\frac{dy}{dx} = 4x + 3$$

(iii) $y = \frac{1}{x^6} - \cos(5x)$

$$\frac{d}{dx}(y) = \frac{d}{dx}\left(\frac{1}{x^6} - \cos(5x)\right)$$

$$\frac{dy}{dx} = \frac{6}{x^7} + 5 \sin(5x)$$

(iv) ~~y = e^{2x} \sin 3x~~

$$y = e^{2x} \sin 3x$$

$$\frac{d}{dx}(y) = \frac{d}{dx}(e^{2x} \sin(3x))$$

$$\frac{dy}{dx} = 3e^{2x} \cos(3x) + 2e^{2x} \sin(3x)$$

$$(V) \quad y = \frac{\tan(7x)}{\sin(x)}$$

$$\frac{d}{dx}(y) = \frac{d}{dx} \left(\frac{\tan(7x)}{\sin(x)} \right)$$

$$= \cot(x) \csc(x) \tan(7x) + 7 \sec^2(7x) \csc(x)$$

$$\frac{dy}{dx} = -\cot(x) \csc(x) \tan(7x) + 7 \sec^2(7x) \csc(x)$$

$$(Vi) \quad y = \sqrt{6x^2 - 3x + 5}$$

$$\frac{d}{dx}(y) = \frac{d}{dx} \left((6x^2 - 3x + 5)^{\frac{1}{2}} \right)$$

$$\frac{dy}{dx} = \frac{3(4x-1)}{2(6x^2-3x+5)^{\frac{1}{2}}}$$

Q2

$$(i) \quad \sin(x) = 0.43$$

$$x = \arcsin(0.43)$$

$$x = 25.46$$

$$x = 180 - 25.46$$

$$= 154.53$$

$$x = 25.46 + 360^\circ, 154.53 + 360^\circ$$

$$(ii) \quad 5 \tan(x) = -7$$

$$\tan(x) = -\frac{7}{5}$$

$$x = \arctan\left(-\frac{7}{5}\right)$$

$$x = -54.46^\circ$$

$$x = 125.53$$

$$x = 125.53 + 180^\circ, 125.53 + 180^\circ$$

$$(iii) \quad 5 \cos(x) = 3$$

$$\cos(x) = \frac{3}{5}$$

$$x = \arccos\left(\frac{3}{5}\right)$$

$$x = 53.13^\circ$$

$$x = 360 - 53.13^\circ$$

$$53.13^\circ - 360^\circ$$

$$= x = 306.869$$

$$x = 53.13^\circ + 360^\circ, 306.869 + 360^\circ$$

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Further mathematics

AQA work

5/5/2022

Page 4

$$(Q4) \quad y = \frac{t(x^2 + R)}{0}$$

$$\frac{t(x^2 + R)}{0} = y$$

$$\frac{t(x^2 + R)0}{0} = y_0$$

$$tx^2 + tR = y_0$$

$$\begin{aligned} x &= \sqrt{\frac{t(y_0 - Rt)}{t}} \\ x &= -\sqrt{\frac{t(y_0 - Rt)}{t}} \end{aligned}$$

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Further mathematics

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5/5/2022

Page 5

Q5

$$(i) 3^{x+4} = 7x$$

$$\ln(3^{x+4}) = \ln(7x)$$

$$(x+4) \ln(3) = x \ln(7)$$

$$x = - \frac{4 \ln(3)}{\ln(3) - \ln(7)}$$

$$(P^6) \log(x+5) + \log(x+2) = \log(x+7) + \log(x+6)$$

$$\log(x^2 + 7x + 10) = \log(x+7) + \log(x+6)$$

$$\log(x^2 + 7x + 10) = \log(x^2 + 13x + 42)$$

$$\log x = - \frac{16}{3}$$

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Further Mathematics

5/5/2022

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Acha 4006

Page 6

Q6

$$(i) \int x^8 + 4x^3 + 5x - 1 dx$$

$$\frac{1}{9}x^9 + C + 4\left(\frac{x^4}{4} + C\right) + 5\left(\frac{x^2}{2} + C\right) - x + 5$$

$$\boxed{\frac{x^9}{9} + x^4 + \frac{5x^2}{2} - x + C}$$

$$(ii) \int 5x^2(x^3 + 2x + 1) dx$$

$$5\left(\frac{x^6}{6} + C + 2\left(\frac{x^4}{4} + C\right) + \frac{x^3}{3} + C\right)$$

$$5\left(\frac{x^6}{6} + \frac{x^4}{2} + \frac{x^3}{3}\right) + C$$

$$\boxed{5\left(\frac{1}{6}x^6 + \frac{1}{2}x^4 + \frac{1}{3}x^3\right) + C}$$

$$(iii) \int 5 \sin(3x) dx$$

$$\frac{5}{3}(-\cos(u)) + C$$

$$-\frac{5 \cos(3x)}{3} + C$$

$$\boxed{-\frac{5}{3} \cos(3x) + C}$$

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Further mathematics
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5/5/2022
Page 7

$$(iv) \int_0^5 (x+5)(x+1) dx$$

$$\int_0^5 x^2 + 6x + 5 dx$$

$$\left[\frac{1}{3}x^3 \right]_0^5 + \int_0^5 6x dx + \int_0^5 5 dx$$

$$\boxed{\frac{425}{3}}$$