

Q1)

a) i)

$$y = \frac{x^2}{\sqrt{2x+1}}$$

$$y = x^2 (2x+1)^{-1/2}$$

$$u = 2x+1$$

$$u' = 2$$

$$y = x^2 u^{-1/2} \frac{dy}{dx}$$

$$\frac{du}{2} = dx$$

$$y = x^2 (2x+1)^{-1/2}$$

$$u = x^2$$

$$du = 2x$$

$$v = (2x+1)^{-1/2}$$

$$v' = (-1/2)(2x+1)^{-3/2}$$

$$v' = u^{-1/2}$$

$$2x^{-3/2} - 1/2 (2x+1)^{3/2}$$

$$- (2x+1)^{3/2}$$

$$V \frac{du}{dx} + u \frac{dv}{dx}$$

$$= (2x+1)^{-1/2} \times 2x + x^2 \times (-1/2)(2x+1)^{-3/2}$$

$$2x(2x+1)^{-1/2} - x^2(2x+1)^{3/2}$$

$$\frac{2x}{\sqrt{2x+1}} - \frac{x^2}{3\sqrt{2x+1}}$$

ii)

$$y = \sqrt{x^2+1}$$

$$u = x^2+1$$

$$\frac{dy}{dx} = \frac{1}{2} u^{-1/2} = \frac{du}{2x} \quad \frac{du}{dx} = 2x$$

$$x^2 = u = x^2+1$$

$$x = \sqrt{u-1}$$

$$\frac{dy}{dx} = \frac{1}{2} u^{-1/2} \quad \frac{du}{2x} = dx$$

$$\frac{1}{2} (x^2+1)^{-1/2} \times \frac{1}{2x} dx$$

$$(x^2+1)^{-1/2}$$

$$\frac{1}{4x\sqrt{x^2+1}}$$

$$\text{iii) } y = 3x^{3/2} + 3x^{-2} - 6x$$

$$\frac{dy}{dx} = \frac{9}{2}x^{1/2} - 6x^{-3} - 6$$

$$\text{iv) } y = \sec^3 4x$$

$$u = 4x$$

$$u = \sec \frac{4x}{1}$$

$$y = \sec^2 4x$$

$$\frac{dy}{dx}$$

$$\frac{du}{dx} = 4$$

$$\frac{du}{dx} = \sec x \tan x$$

$$\tan^2 4x$$

$$\sec^2 4x \tan 4x$$

$$\frac{du}{dx}$$

$$\sec^2 \tan x$$

$$\text{v) } y = x + \sin 2x$$

$$\frac{dy}{dx} = 1 + 2\cos 2x$$

$$u = \sec 4x$$

$$du = 4 \sec 4x \tan 4x$$

$$v = \tan 4x$$

$$dv = 4 \sec^2 4x$$

$$4 \sec^2 4x$$

$$\text{vi) } y = \frac{1 - 10x}{(2x-1)^2} \cdot \frac{u}{v}$$

$$\frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$$

$$\frac{[(2x-1)^2 \times -10] - [(1-10x)(2x-1)]}{((2x-1)^2)^2}$$

$$u = 1 - 10x$$

$$du = -10$$

$$v = (2x-1)^2$$

$$\frac{dv}{dx} = 2 \times 2x - 1$$

$$dv = 4x - 1$$

$$da = 2$$

$$-10x \quad |$$

$$2x \quad -20x^2 \quad 2x$$

$$-1 \quad -10x \quad -1$$

$$2(2x-1)' \times 2$$

$$4(2x-1)$$

$$8x - 4$$

$$\frac{1}{2} u^2 \frac{dy}{dx}$$

Maths Test 2 Pg 2

Math Russell

$$\frac{-10(2x-1)^2 - [-20x^2 - 8x - 1]}{(2x-1)^4}$$

$$(2x-1)^4$$

$$2x - 1$$

$$-10(2x-1)^2 + 20x^2 + 8x + 1$$

$$2x \quad 4x^2 \quad -2x$$

$$-10(4x^2 - 4x + 1) + 20x^2 + 8x + 1$$

$$-1 \quad -2x \quad +1$$

$$-40x^2 - 40x - 10 + 20x^2 + 8x + 1$$

$$(2x-1)^4$$

$$\frac{dy}{dx} = \frac{-20x^2 - 32x - 9}{(2x-1)^4}$$

b) $y = \frac{1}{x^2} + \cos 2x \quad \frac{d^5 y}{dx^5}$

$$y = x^{-1} + \cos 2x$$

$$\frac{d^4 y}{dx^4} = +24x^{-5} + 16 \sin 2x$$

$$\frac{dy}{dx} = -x^{-2} - 2 \sin 2x$$

$$\frac{d^5 y}{dx^5} = -120x^{-6} - 32 \sin 2x$$

$$\frac{d^2 y}{dx^2} = +2x^{-3} - 4 \cos 2x$$

$$-8(15x^{-6} - \sin 2x)$$

$$\frac{d^3 y}{dx^3} = -6x^{-4} + 8 \sin 2x$$

$$f'(x) = \operatorname{cosec} x$$

$$c) f(x) = \ln(\operatorname{cosec} x - \cot x)$$

$$u = \operatorname{cosec} x - \cot x$$

$$f(x) \ln u \quad \frac{du}{dx} = \frac{-\operatorname{csc} x}{-\operatorname{cosec} x \cot x - \operatorname{cosec}^2 x}$$

$$f(x) = \frac{1}{u}$$

$$f'(x) = \frac{1}{\operatorname{cosec} x - \cot x}$$

$$\frac{1}{4} \quad \frac{1}{8} \quad \frac{1}{12} \quad \frac{1}{24} \quad \frac{1}{48} \quad \frac{1}{96} \quad \frac{1}{192} \quad \frac{1}{384} \quad \frac{1}{768} \quad \frac{1}{1536} \quad \frac{1}{3072} \quad \frac{1}{6144} \quad \frac{1}{12288} \quad \frac{1}{24576} \quad \frac{1}{49152} \quad \frac{1}{98304} \quad \frac{1}{196608} \quad \frac{1}{393216} \quad \frac{1}{786432} \quad \frac{1}{1572864} \quad \frac{1}{3145728} \quad \frac{1}{6291456} \quad \frac{1}{12582912} \quad \frac{1}{25165824} \quad \frac{1}{50331648} \quad \frac{1}{100663296} \quad \frac{1}{201326592} \quad \frac{1}{402653184} \quad \frac{1}{805306368} \quad \frac{1}{1610612736} \quad \frac{1}{3221225472} \quad \frac{1}{6442450944} \quad \frac{1}{12884901888} \quad \frac{1}{25769803776} \quad \frac{1}{51539607552} \quad \frac{1}{103079215104} \quad \frac{1}{206158430208} \quad \frac{1}{412316860416} \quad \frac{1}{824633720832} \quad \frac{1}{1649267441664} \quad \frac{1}{3298534883328} \quad \frac{1}{6597069766656} \quad \frac{1}{13194139533312} \quad \frac{1}{26388279066624} \quad \frac{1}{52776558133248} \quad \frac{1}{105553116266496} \quad \frac{1}{211106232532992} \quad \frac{1}{422212465065984} \quad \frac{1}{844424930131968} \quad \frac{1}{1688849860263936} \quad \frac{1}{3377699720527872} \quad \frac{1}{6755399441055744} \quad \frac{1}{13510798882111488} \quad \frac{1}{27021597764222976} \quad \frac{1}{54043195528445952} \quad \frac{1}{108086391056891904} \quad \frac{1}{216172782113783808} \quad \frac{1}{432345564227567616} \quad \frac{1}{864691128455135232} \quad \frac{1}{1729382256910270464} \quad \frac{1}{3458764513820540928} \quad \frac{1}{6917529027641081856} \quad \frac{1}{13835058055282163712} \quad \frac{1}{27670116110564327424} \quad \frac{1}{55340232221128654848} \quad \frac{1}{110680464442257309696} \quad \frac{1}{221360928884514619392} \quad \frac{1}{442721857769029238784} \quad \frac{1}{885443715538058477568} \quad \frac{1}{1770887431076116955136} 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Q2)

a) i) $\int \frac{2x}{(4+3x^2)} dx$

$$\int 2x(4+3x^2)^{-1}$$

$$u = 4+3x^2 \quad 4+3x^2$$

$$\frac{du}{dx} = 6x$$

$$\int 2x u^{-1} \quad \frac{du}{6x} = dx$$

$$\frac{2}{6} \int u^{-1} du$$

$$\frac{2}{6} \int \frac{1}{u} du$$

$$\frac{2}{6} [\ln u] + c$$

$$\frac{2}{6} \ln(4+3x^2) + c$$

ii) $\int_0^4 e^{\frac{1}{2}x} dx$

$$\left[2e^{\frac{1}{2}x} \right]_0^4$$

$$2e^{\frac{1}{2}(4)} - 2e^{\frac{1}{2}(0)} = \frac{12.478}{3}$$

$$2e^2 - 2e^0$$

$$2e^2 - 2$$

$$\text{iii)} \int_0^4 \frac{5x+13}{(2x+1)(x+4)} dx$$

$$\begin{array}{r} 2x^2 + 1 \\ \times 2x^2 + x \\ + 4 \quad 8x + 4 \end{array}$$

$$\int_0^4 \frac{5x+13}{2x^2+9x+4} dx$$

$$\int_0^4 (5x+13)(2x^2+9x+4)^{-1} dx$$

$$u = 2x^2 + 9x + 4$$

$$\frac{du}{dx} = 4x + 9$$

$$\int_0^4 (5x+13) u^{-1} dx$$

$$\int_0^4 5x u^{-1} + 13 u^{-1} \frac{du}{4x+9}$$

$$\int uv' = uv - \int u'v$$

$$\int_0^4 (5x+13)(2x^2+9x+4)^{-1} dx$$

$$u' = 5x+13 \quad u =$$

$$v = \frac{5x^2}{2} + 13x$$

$$u = (2x^2+9x+4)^{-1} \quad u = u^{-1}$$

$$du = -1/u$$

$$\frac{4x+9}{2x^2+9x+4} \ln(2x^2+9x+4)$$

$$\int uv' = (2x^2+9x+4)^{-1} \times \left(\frac{5x^2}{2} + 13x\right) - \int (4x+9) \ln(2x^2+9x+4) \times \left(\frac{5x^2}{2} + 13x\right)$$

Maths Test 2

Matt Russell

$$f(x) = \frac{4}{x(1+4\ln x)^2} dx$$

$$(16\ln^2 x + 8\ln x + 1)x$$

$$f(x) = 16\ln^3 x + 8\ln^2 x + 8x$$

$$f(x) = 4(16\ln^3 x + 8\ln^2 x + 8x)^{-1} dx$$

$$\frac{4}{x(1+4\ln x)} dx \quad u = 1 + 4\ln x$$

$$\frac{du}{dx} = \frac{4}{x}$$

$$\int \frac{4}{x} \frac{1}{u} = \frac{1}{u} du$$

$$\int \frac{1}{u}$$

$$\int \ln u$$

$$\ln(1+4\ln x) + C$$

$$c)i) \int_{\ln 2}^{\ln 5} \frac{3e^{2x}}{\sqrt{e^x - 1}} dx$$

$$\int 3e^{2x} (e^x - 1)^{-1}$$

$$\int uv' = uv - \int u'v$$

$$u = -\frac{3e^{2x}}{(e^x - 1)^{-1}} \quad v' = e^x$$

$$u' = e^x \ln e^x - 1 \quad v = \frac{1}{2} e^{2x}$$

$$(e^x - 1) 3e^{2x}$$

$$e^x \quad a = a^{-1} \\ da = \ln a$$

$$\int uv' = (e^x - 1)^{-1} \times \frac{3}{2} e^{2x} - \int e^x \ln e^x - 1 \times \frac{3}{2} e^{2x}$$

$$\int 3e^{2x} (e^x - 1)^{-1} = \frac{3}{2} e^{2x} (e^x - 1)^{-1} - \int 3e^{2x} (e^x \ln e^x - 1)$$

$$\int 3e^{2x} (e^x - 1)^{-1} = \frac{3}{2} e^{2x} (e^x - 1)^{-1} - \int -3e^{2x}$$

$$\left[\frac{\frac{3}{2} e^{2x}}{e^x - 1} + \frac{3}{2} e^{2x} \right]_{\ln 2}^{\ln 5}$$

$$\left[\frac{\frac{3}{2} e^{2 \ln 5}}{e^{\ln 5} - 1} + \frac{3}{2} e^{2 \ln 5} \right] - \left[\frac{\frac{3}{2} e^{2 \ln 2}}{e^{\ln 2} - 1} + \frac{3}{2} e^{2 \ln 2} \right]$$

$$\left[\frac{\frac{3}{2} \times 25}{4} + \frac{3}{2} \times 25 \right] - \left[\frac{\frac{3}{2} \times 4}{1} + \frac{3}{2} \times 4 \right]$$

$$\left[\frac{15}{8} + \frac{15}{4} \right] - [6 + 6]$$

$$\frac{45}{8} - 12 = -\frac{51}{8}$$

$$\frac{-i - 3 + 3i + 1}{-i + 3 - 3i + 1}$$

$$\frac{-i + 3 - 3i + 1}{-i + 3 - 3i + 1}$$

$$\frac{-4i + 4}{-4i + 4}$$

$$\frac{2i - 2}{-4i + 4}$$

$$\underline{\underline{-\frac{1}{2}i - \frac{1}{2}}}$$

$$\underline{\underline{-\frac{1}{2} - \frac{1}{2}i}}$$

$$\text{ii) } \frac{3}{(1+i)(2+i)} = \frac{3}{i^2 + 3i + 2}$$

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

$$\frac{3}{3i + 1}$$

$$\frac{3 - 3i}{3 + i}$$

$$\text{iii) } \frac{1+i}{1-i} = (1+2i)(2+i) + \frac{3-i}{1+i}$$

$$\frac{1+i}{1-i} \times \frac{1+i}{1+i} = \frac{1+i^2}{1-i^2} = \frac{1-1}{1+1} = \frac{0}{2} = 0$$

$$\frac{1+i}{1-i} \times \frac{1+i}{1+i} = \frac{1+i^2}{1-i^2} = \frac{1-1}{1+1} = \frac{0}{2} = 0$$

$$\frac{3-i}{1+i} \times \frac{1-i}{1-i}$$

$$\frac{3-i}{1+i} \times \frac{1-i}{1-i} = \frac{3-i-i^2}{1-i^2} = \frac{3-i+1}{1+1} = \frac{4-i}{2} = 2 - \frac{1}{2}i$$

Maths Test 2 6

Matt Russell

$$\begin{array}{r} 1 - i \\ 1 - i \\ \hline +i - i - i^2 \end{array}$$

$$\cancel{1+1}$$

$$\begin{array}{r} 3 - i \\ 1 - 3 - i \\ \hline -i - i + i^2 \end{array}$$

$$3 - 2i - 1$$

$$2 - 2i$$

$$2i - [2 + 6i] + 2 - 2i$$

$$\cancel{2i} - 2 - 6i + 2 - \cancel{2i}$$

$$\underline{\underline{-6i}}$$

iv) $\frac{2i(i-1)}{2i^2 - 2i} + \frac{(\sqrt{3} - i)}{\sqrt{3} - i} + \frac{(1+i)(1+i)}{2i}$

$$-2$$

$$\begin{array}{r} 1 + i \\ 1 - 1 - i \\ \hline +i - i - i^2 \end{array}$$

$$2i$$

$$-2 - \cancel{2i} + \sqrt{3} - i + \cancel{2i}$$

$$\underline{\underline{-2 + \sqrt{3} - i}}$$

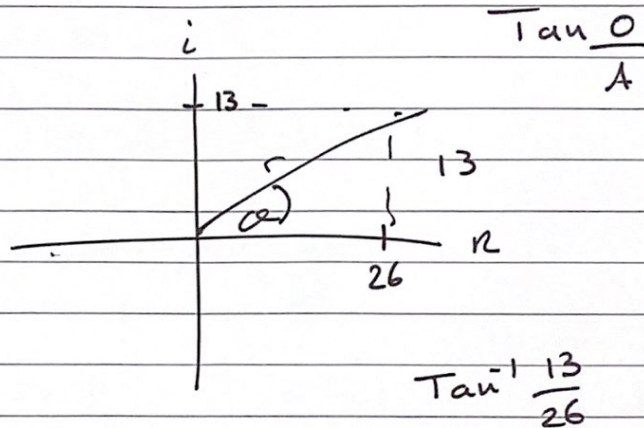
$$\frac{-2 + \sqrt{3}}{-2 + \sqrt{3}} \times \frac{-2 - \sqrt{3}}{-2 - \sqrt{3}}$$

$$\begin{array}{r} -2 + \sqrt{3} \\ -2 - \sqrt{3} \\ \hline 4 - 2\sqrt{3} \\ -\sqrt{3} - 2\sqrt{3} - 3 \end{array}$$

$$b) (4+7i)(3-2i)$$

$$\begin{array}{rcl} 4 & 7i & \\ 3 & 12 & 21i \end{array} \quad 26 + 13i$$

$$\begin{array}{rcl} -2i & -8i & -14i^2 \\ & & 14 \end{array}$$



$$\angle 26.6^\circ$$

$$r = \sqrt{13^2 + 26^2}$$

$$r = \underline{\underline{13\sqrt{5}}}$$

$$c) 1+3i \quad 1+i$$

1) a) $y = \frac{x^2}{(2x+1)^{1/2}} \frac{u}{v}$

$\frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$

$u = x^2 \quad v = (2x+1)^{1/2}$

$du = 2x \quad dv =$

$\frac{(2x+1)^{1/2} \times 2x - x^2 \times \frac{1}{4} (2x+1)^{-1/2}}{(2x+1)}$

$\frac{2x(2x+1)^{1/2} - \frac{x^2}{4} (2x+1)^{-1/2}}{2x+1}$

$2x+1$

$\frac{1}{2} a^{1/2} \quad \frac{1}{2} a^{-1/2} \quad \frac{dx}{2}$
 $\frac{1}{4} a^{-1/2}$
 $\frac{1}{4} (2x+1)^{-1/2}$

1) iv) $y = \sec^3 4x$

$u = \sec 4x$

$du = 4 \sec 4x \tan 4x$

$y = \sec^2 4x \frac{du}{4 \sec 4x \tan 4x}$

$y = \frac{\sec 4x}{16 \tan 4x}$

$\frac{dy}{dx} = \frac{\sec 4x}{16 \tan 4x} \frac{u}{v}$

$du = 4 \sec 4x \tan 4x$

$dv = 32 \sec^2 4x$