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1 a) i) $\frac{d}{dx} 4x^2 - \frac{d}{dx} 9xy + \frac{d}{dx} 9y^2 = 0$

$(2)(4x) - \left(9x\frac{dy}{dx} + 9y(1)\right) + (2)\left(9y\frac{dy}{dx}\right) = 0$

$8x - 9x\frac{dy}{dx} - 9y + 18y\frac{dy}{dx} = 0$

$(18y - 9x)\frac{dy}{dx} - 9y + 8x = 0$

$\frac{dy}{dx} = \frac{9y - 8x}{18y - 9x}$

ii) when $\frac{dy}{dx} = 0$, $\frac{9y - 8x}{18y - 9x} = 0$

$9y = 8x$

$y = \frac{8}{9}x$

$4x^2 - 9x\left(\frac{8}{9}x\right) + 9\left(\frac{8}{9}x\right)^2 = 252$

$4x^2 - 8x^2 + \frac{64}{9}x^2 = 252$

$28x^2 = 2268$

$x = \sqrt{\frac{2268}{28}} = \pm 9$

$y = \frac{8}{9}x$ //

$x = 9$, $y = \frac{8}{9}(9) = 8$

$4(9)^2 - 9(9)y + 9y^2 = 252$

$9y^2 - 81y + 72 = 0$

$y^2 - 9y + 8 = 0$

$(y-8)(y-1) = 0$

y

$4(9)^2 - 9(9)y + 9y^2 = 252$

$9y^2 - 81y + 72 = 0$

$y^2 - 9y + 8 = 0$

$(y-8)(y-1) = 0$

$y = 8$ or 1

$x = -9$, $y = \frac{8}{9}(-9) = -8$

b) i)

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2 i) $f(x)' = 3(2x^2) - 2(21x) + 60$
$= 6x^2 - 42x + 60$

a) $f(x)' \geq 0$, $6x^2 - 42x + 60 \geq 0$
$x^2 - 7x + 10 = 0$
$(x-5)(x-2) = 0$

b) $2 < x < 5$

$f(x)'' = 2(6x) - 42$
$= 12x - 42$

$f(2)'' = 24 - 42 = -18$
$f(5)'' = 60 - 42 = 18$

$x > 5$ or $x < 2$

ii) $y = 2(2)^3 - 21(2)^2 + 60(2) + 11$
$= \cancel{52}\ 63$
~~(2, 52)~~ (2, 63) local maximum point
$y = 2(5)^3 - 21(5)^2 + 60(5) + 11$
$= 36$
~~(2,~~ (5, 36) local minimum point

iii) a) $x < 5$
b) $x > 2$

iv)

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3a) i) $(r+2)! - (r+1)! = (r+1)^2 r!$

$$\frac{(r+2)! - (r+1)!}{(r+1)^2 r!} = 1$$

ii) $\sum_{n=1}^{\infty} (n+1)^2 n!$

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4 a) i) $\binom{n}{0}(px)^{n-0}\left(\frac{q}{x}\right)^{0}+\binom{n}{1}(px)^{n-1}\left(\frac{q}{x}\right)^{1}+\cdots$

$= px^{n} + n(px)^{n-1}\left(\frac{q}{x}\right) + \cdots$

$=$

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~~Q5~~ Q5 page 1

5 i) length $= 2x$

$360 = 4\text{ length} + 4\text{ breadth} + 4\text{ height}$

$= 4(2x) + 4x + 4h$

$= \cancel{8}\ 12x + 4h$

$h = \dfrac{360 - 12x}{4} = 90 - 3x$

ii) $V = (2x)(x)(h)$

$= 2x^2(90 - 3x)$

$= 180x^2 - 6x^3$

iii) $\dfrac{dV}{dx} = 360x - 18x^2$

$\dfrac{d}{dx}\dfrac{dV}{dx} = 360 - 36x$

$\dfrac{dV}{dx} = 0, \quad 360x - 18x^2 = 0$

$x = \dfrac{360}{18} = 20$

~~Since second der.~~

~~$f(x)''$~~

$f(20)'' = 360 - 36(20)$

$= -360$

since $f(x)'' > 0$, it is a maximum value

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