Scheme Of Valuation

Scoring Indicators

Revision : 2015						Course Code:1002
Course Title : Engineering Mathematics -I						
Qn.No	sub.division	Scoring indicator	Split up Score	Sub Total	Total
I	1.	$\sin\theta = \frac{1}{2}$, $\cos\theta = \sqrt{1-\sin^2\theta} = \sqrt{1-\frac{1}{4}} = \sqrt{\frac{3}{4}} = \frac{\sqrt{3}}{2}$	1+1		
	2.	Area of triangle $\Delta = \frac{1}{2} bc \sin A = \frac{1}{2} \times 3 \times 2 \times \sin 30 = \frac{1}{2} \times 3 \times 2 \times \frac{1}{2} = \frac{3}{2}\ cm^2$	1 1		
	3.	$\underset{x \to 1}{Lt} \frac{2x+3}{4x-1} = \frac{2\times1+3}{4\times1-1} = \frac{5}{3}$	1+1	10	
	4.	$y = 3\cos x - 4\tan x$ $\frac{dy}{dx} = -3\sin x - 4\sec^2 x$	1+1		
	5.	$V = a^3$. $\frac{dV}{da} = 3a^2$.	1 1		

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II.	1.	$\tan 75 = \tan(45+30)$			
		$= \dfrac{\tan 45 + \tan 30}{1-\tan 45 \cdot \tan 30}$	(1)		
		$= \dfrac{1+\frac{1}{\sqrt{3}}}{1-1\cdot\frac{1}{\sqrt{3}}} = \dfrac{1+\frac{1}{\sqrt{3}}}{1-\frac{1}{\sqrt{3}}}$	(1)		
		$= \dfrac{\sqrt{3}+1}{\sqrt{3}-1}$	(1)		
		$\cot 75 = \dfrac{1}{\tan 75} = \dfrac{\sqrt{3}-1}{\sqrt{3}+1}$	(1)		
		$\tan 75 + \cot 75$			
		$= \dfrac{\sqrt{3}+1}{\sqrt{3}-1} + \dfrac{\sqrt{3}-1}{\sqrt{3}+1}$			
		$= \dfrac{(\sqrt{3}+1)^2 + (\sqrt{3}-1)^2}{3-1}$	(1)		
		$= \dfrac{3+1+2\sqrt{3}+3+1-2\sqrt{3}}{2}$			
		$= \dfrac{8}{2} = 4$	(1)		

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	5.	$y = \sin x$. Let x be small increment in x, corresponding increment in y be Δy.			
		$y + \Delta y = \sin(x + \Delta x)$	1		
		$\Delta y = \sin(x+\Delta x) - \sin x$	1		
		$= 2\cos\frac{x+\Delta x+x}{2} \cdot \sin\frac{x+\Delta x - x}{2}$			
		$= 2\cos\left(x + \frac{\Delta x}{2}\right) \cdot \sin\left(\frac{\Delta x}{2}\right)$	1		
		$\frac{\Delta y}{\Delta x} = 2\cos\left(x + \frac{\Delta x}{2}\right) \cdot \frac{\sin\frac{\Delta x}{2}}{\Delta x}$			
		$= 2\cos\left(x + \frac{\Delta x}{2}\right) \cdot \frac{\sin\left(\frac{\Delta x}{2}\right)}{2\times\left(\frac{\Delta x}{2}\right)}$	1		
		$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \lim_{\Delta x \to 0} 2\cos\left(x + \frac{\Delta x}{2}\right) \cdot \frac{\sin\frac{\Delta x}{2}}{2\times\frac{\Delta x}{2}}$	1		
		$= \cos x \cdot 1 = \cos x$	1		
II	6.	$y = a\cos(\log x) + b\sin(\log x)$			
		$\frac{dy}{dx} = a \cdot {}^{-}\sin\log x \cdot \frac{1}{x} + b \cdot \cos\log x \cdot \frac{1}{x}$	(1)		
		$x \cdot \frac{dy}{dx} = -a\sin\log x + b\cos\log x$	1		
		diff. w.r.t x,			
		$x \cdot \frac{d^2y}{dx^2} + \frac{dy}{dx} \cdot 1 = -a\cos\log x \cdot \frac{1}{x} + b\,{}^{-}\sin\log x \cdot \frac{1}{x}$	1		
		$x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} = -[a\cos\log x + b\sin\log x]$	1		
		$= -y$	1		

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II.	2.	$\frac{\sin(180+A)\cdot\cos(90-A)\cdot\tan(270+A)}{\sec(540-A)\cdot\cos(360+A)}$			
		$\sin(180+A) = -\sin A$, $\cos(90-A) = \sin A$,	1+1		
		$\tan(270-A) = -\cot A$, $\sec(540-A) = \sec(360+(180-A)) = -\sec A$	1+1		
		$\cos(360+A) = \cos A$	(1)		
		$L.H.S = \frac{-\sin A\cdot\sin A\cdot -\cot A}{-\sec A\cdot\cos A} = \frac{-\sin A\cdot\sin A\cdot\frac{\cos A}{\sin A}}{\frac{1}{\cos A}\cdot\cos A}$			
		$= -\sin A\cos A$	(1)		
	3.	$\cos 20\cdot\cos 40\cdot\cos 60\cdot\cos 80 = [\cos 20\cdot\cos 40]\cdot\frac{1}{2}\cdot\cos 80$	(1)		
		$= \frac{1}{2}\cdot\left[\frac{1}{2}(\cos 60+\cos 20)\right]\cdot\cos 80$	(1)		
		$= \frac{1}{4}\cos 60\cdot\cos 80 + \frac{1}{4}\cos 20\cdot\cos 80$			
		$= \frac{1}{8}\cos 80 + \frac{1}{4}\cdot\frac{1}{2}(\cos 100+\cos 60)$	(1)		
		$= \frac{1}{8}\cos 80 + \frac{1}{8}\cos 100 + \frac{1}{8}\cdot\frac{1}{2}$	(1)		
		$= \frac{1}{8}\cos(180-100) + \frac{1}{8}\cos 100 + \frac{1}{16}$			
		$= -\frac{1}{8}\cos 100 + \frac{1}{8}\cos 100 + \frac{1}{16}$	(1)		
		$= \frac{1}{16}$	(1)		
	4.	$a = 2cm, b = 3cm, c = 4cm$			
		$A = \cos^{-1}\left(\frac{b^2+c^2-a^2}{2bc}\right) = \cos^{-1}\left(\frac{21}{24}\right) = 28^\circ 57' 18''$	2		
		$B = \cos^{-1}\left(\frac{a^2+c^2-b^2}{2ac}\right) = \cos^{-1}\left(\frac{11}{16}\right) = 46^\circ 34' 3''$	2		
		$C = 180-(A+B) = 104^\circ 28' 39''$	2		

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		$x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} = -y$ $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$	(1)		
II	7.	$y = 3x^2 + x - 2$ $\frac{dy}{dx} = 6x+1$	(1)		
		$\left(\frac{dy}{dx}\right)_{(1,2)} = 6\times1+1 = 7.$	(1)		
		Eqn of tangent $(y-y_1) = \frac{dy}{dx}(x-x_1)$ $(y-2) = 7(x-1)$	(1)		
		$7x - y - 5 = 0$	(1)	30	
		Eqn of Normal $(y-y_1) = \frac{-1}{\frac{dy}{dx}}(x-x_1)$ $(y-2) = \frac{-1}{7}(x-1)$	(1)		
		$x + 7y - 15 = 0$	(1)		
III	a.	$\frac{\sin A}{1-\cos A} + \frac{1-\cos A}{\sin A} = 2\operatorname{cosec} A$ $\frac{\sin A}{1-\cos A} + \frac{1-\cos A}{\sin A} = \frac{\sin^2 A + (1-\cos A)^2}{\sin A(1-\cos A)}$	(1)		
		$\frac{\sin^2 A + 1 + \cos^2 A - 2\cos A}{(\sin A)(1-\cos A)} = \frac{2-2\cos A}{\sin A(1-\cos A)}$	1+1		
		$= \frac{2(1-\cos A)}{\sin A(1-\cos A)} = \frac{2}{\sin A} = \operatorname{cosec} A$	1+1		

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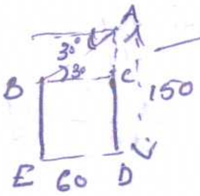
III	b.	Consider ΔABC  figure $\frac{AC}{BC} = \tan 30$ $AC = BC \tan 30$ $= 60 \cdot \frac{1}{\sqrt{3}} = \frac{60}{\sqrt{3}}$ $AD = 150°$ height of 1^{st} tower $BE = CD = AD - AC$ $= 150 - \frac{60}{\sqrt{3}}$ $= 115.36$	(1) (1) (1)+1 (1)		
	c.	$x = 3\sin\theta + 4\cos\theta = R\sin(\theta+\alpha)$ —(1) $3\sin\theta + 4\cos\theta = R\sin\theta\cos\alpha + R\cos\theta\sin\alpha$ Equating coefficient of $\sin\theta$ $3 = R\cos\alpha$ —(2) Equating coefficient of $\cos\theta$ $4 = R\sin\alpha$ —(3) $(2)^2 + (3)^2 \Rightarrow 3^2 + 4^2 = R^2[\sin^2\alpha + \cos^2\alpha]$ $25 = R^2$ $R = \pm 5$ $\frac{(3)}{(2)} \Rightarrow \frac{4}{3} = \frac{R\sin\alpha}{R\cos\alpha} = \tan\alpha$ $\Rightarrow \alpha = \tan^{-1}\left(\frac{4}{3}\right)$ Substituting in (1). $x = 3\sin\theta + 4\cos\theta$ $= \pm 5\sin(\theta + \tan^{-1} 4/3)$	(1) (1) (1) (1) (1)	15	

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IV	a.	$\tan A = \frac{3}{4}$, $\sin B = \frac{5}{13}$			
		$\sec^2 A = 1 + \tan^2 A = 1 + \frac{9}{16} = \frac{25}{16}$			
		$\sec A = -\frac{5}{4} \Rightarrow \cos A = -\frac{4}{5} \Rightarrow \sin A = \sqrt{1-\cos^2 A}$ $= \sqrt{1-\frac{16}{25}} = -\frac{3}{5}$	1+1		
		$\sin B = \frac{5}{13} \Rightarrow \cos B = \sqrt{1-\sin^2 B} = \sqrt{1-\frac{25}{169}}$ $= \sqrt{\frac{144}{169}} = -\frac{12}{13}$	1		
		$\sin(A-B) = \sin A \cos B - \cos A \sin B$ $= -\frac{3}{5} \times -\frac{12}{13} - -\frac{4}{5} \times \frac{5}{13}$ $= \frac{36}{65} + \frac{20}{65} = \frac{56}{65}$	1		
		$\cos(A+B) = \cos A \cos B - \sin A \sin B$ $= -\frac{4}{5} \times -\frac{12}{13} - -\frac{3}{5} \times \frac{5}{13}$ $= \frac{48}{65} + \frac{15}{65} = \frac{63}{65}$	1	15	
	b.	$\sqrt{\frac{1-\sin A}{1+\sin A}} = \sqrt{\frac{(1-\sin A)(1-\sin A)}{(1+\sin A)(1-\sin A)}}$	1		
		$= \frac{(1-\sin A)}{\sqrt{1-\sin^2 A}} = \frac{1-\sin A}{\sqrt{\cos^2 A}} = \frac{1-\sin A}{\cos A}$	1+1+1		
		$= \frac{1}{\cos A} - \frac{\sin A}{\cos A} = \sec A - \tan A$	1		
	c.	$\theta = 30^\circ$, $L.H.S = \tan 2\theta = \tan 2\times 30 = \tan 60 = \sqrt{3}$	1+1		
		$R.H.S = \frac{2\tan\theta}{1-\tan^2\theta} = \frac{2\tan 30}{1-\tan^2 30} = \frac{2\times\frac{1}{\sqrt{3}}}{1-\frac{1}{3}} = \frac{\frac{2}{\sqrt{3}}}{\frac{2}{3}}$	1+1		

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		$= \frac{2}{\sqrt{3}} \times \frac{3}{2} = \sqrt{3}$ L.H.S = R.H.S Hence verified	1		
V.	a.	$\frac{\sin 2A + (\sin 5A + \sin A)}{\cos 2A + (\cos 5A + \cos A)} = \frac{\sin 2A + 2\cos 3A \cdot \sin 2A}{\cos 2A + 2\cos 3A \cdot \cos 2A}$	1+1+1		
		$= \frac{\sin 2A[1+2\cos 3A]}{\cos 2A[1+2\cos 3A]} = \tan 2A$	1+1		
	b.	$R(a^2+b^2+c^2) = abc(\cot A + \cot B + \cot C)$			
		$R.H.S = abc \cdot \frac{\cos A}{\sin A} + abc \cdot \frac{\cos B}{\sin B} + abc \cdot \frac{\cos C}{\sin C}$	1		
		$= \frac{a}{\sin A} bc \cdot \cos A + \frac{b}{\sin B} ac \cos B + \frac{c}{\sin C} ab \cos C$	1		
		$= 2R\left[\frac{b^2+c^2-a^2}{2} + \frac{a^2+c^2-b^2}{2} + \frac{a^2+b^2-c^2}{2}\right]$	1	15	
		$= \frac{2R}{2}[b^2+c^2-a^2+a^2+c^2-b^2+a^2+b^2-c^2]$	1		
		$= R[a^2+b^2+c^2] = L.H.S.$	1		
	c.	$L.H.S = (\sin A + \sin 3A) + (\sin 5A + \sin 7A)$	1		
		$= 2\sin 2A \cdot \cos A + 2\sin 6A \cdot \cos A$	1+1		
		$= 2\cos A[\sin 2A + \sin 6A]$	1		
		$= 2\cos A \cdot 2\sin 4A \cdot \cos 2A$			
		$= 4\cos A \cdot \cos 2A \sin 4A.$	1		

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VI.	a.	$\frac{\sin 3x}{\sin x} - \frac{\cos 3x}{\cos x} = \frac{3\sin x - 4\sin^3 x}{\sin x} - \frac{4\cos^3 x - 3\cos x}{\cos x}$	1+1		
		$= (3 - 4\sin^2 x) - (4\cos^2 x - 3)$	(1)		
		$= 3 - 4\sin^2 x - 4\cos^2 x + 3$	(1)		
		$= 6 - 4[\sin^2 x + \cos^2 x] = 6 - 4 = 2$	(1)		
	b.	$A = 35^\circ, B = 68^\circ, c = 25cm.$			
		$C = 180 - (A+B) = 180 - (35^\circ + 68^\circ)$ $= 77^\circ$	(1)		
		By sine rule $\frac{a}{\sin A} = \frac{c}{\sin C}$	(1)		
		$\frac{a}{\sin 35} = \frac{25}{\sin 77} \Rightarrow a = \frac{25 \times \sin 35}{\sin 77}$			
		$= 14.72\ cm$	(1)	15	
		$\frac{b}{\sin B} = \frac{c}{\sin C} \Rightarrow b = \frac{c \sin B}{\sin C} = \frac{25 \times \sin 68}{\sin 77}$	(1)		
		$= 23.79cm$	(1)		
	c.	$[\sin 50 - \sin 70] + \cos 80$	(1)		
		$= 2\cos\frac{50+70}{2} \cdot \sin\frac{50-70}{2} + \cos 80$	(1)		
		$= 2\cos 60 \cdot \sin^{-}10 + \cos 80$	(1)		
		$= -2 \times \frac{1}{2} \cdot \sin 10 + \cos(90-10)$	(1)		
		$= -\sin 10 + \sin 10 = 0$	(1)		

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VII	a(i)	$\lim_{x\to\infty} \frac{x^3-7x^2-2}{4x^3-2x-5} = \lim_{x\to\infty} \frac{\frac{x^3-7x^2-2}{x^3}}{\frac{4x^3-2x-5}{x^3}}$	(1)		
		$= \lim_{x\to\infty} \frac{1-\frac{7}{x}-\frac{2}{x^3}}{4-\frac{2}{x^2}-\frac{5}{x^3}} = \frac{1-0-0}{4-0-0} = \frac{1}{4}$	1+1		
	(ii)	$\lim_{\theta\to 0} \frac{\sin 3\theta \cdot \cos\theta}{\theta} = \lim_{\theta\to 0} \frac{\sin 3\theta}{3\theta} \cdot 3 \cdot \cos\theta$	(1)		
		$= \lim_{\theta\to 0} \left(\frac{\sin 3\theta}{3\theta}\right) \cdot 3 \cdot \lim_{\theta\to 0} \cos\theta$	(1)		
		$= 1 \cdot 3 \cdot 1 = 3$	(1)		
	b.	$x = a\sec\theta$, $y = b\tan\theta$			
		$\frac{dx}{d\theta} = a \cdot \sec\theta\tan\theta$, $\frac{dy}{d\theta} = b \cdot \sec^2\theta$	1+1		
		$\frac{dy}{dx} = \frac{dy/d\theta}{dx/d\theta} = \frac{b\sec^2\theta}{a\sec\theta\tan\theta} = \frac{b\sec\theta}{a\tan\theta}$	1+1	15	
	c.	$y = \frac{e^{2x} \cdot \tan^{-1}3x}{\sqrt{x}}$, $\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v \cdot \frac{du}{dx} - u \cdot \frac{dv}{dx}}{v^2}$	(1)		
		$\frac{\sqrt{x} \cdot \left[e^{2x} \cdot \frac{d}{dx}\tan^{-1}3x + \tan^{-1}3x \cdot \frac{d}{dx}e^{2x}\right] - e^{2x} \cdot \tan^{-1}3x \cdot \frac{1}{2\sqrt{x}}}{(\sqrt{x})^2}$	1+1		
		$\frac{\sqrt{x} \cdot \left[e^{2x} \cdot \frac{1}{1+9x^2} \cdot 3 + \tan^{-1}3x \cdot e^{2x} \cdot 2\right] - e^{2x} \cdot \tan^{-1}3x \cdot \frac{1}{2\sqrt{x}}}{x}$	(1+1)		

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VIII	a.	$y=(1+x^2)^{10}\sin^2 x.$ $\frac{d}{dx}(uv)=u\cdot\frac{dv}{dx}+v\cdot\frac{du}{dx}$ $=(1+x^2)^{10}\frac{d}{dx}\sin^2 x+\sin^2 x\cdot\frac{d}{dx}(1+x^2)^{10}$ $=(1+x^2)^{10}\cdot 2\sin x\cdot\cos x$ $+\sin^2 x\cdot 10\cdot(1+x^2)^9\cdot 2x.$ $=2(1+x^2)^{10}\sin x\cdot\cos x+20x(1+x^2)^9\cdot\sin^2 x$	(1) (1) 1+1 1		
	b.	$ax^2+by^2+2gx+2fy+c=0$ diff. w.r.t. x. $a\cdot 2x+b\cdot 2y\cdot\frac{dy}{dx}+2g\cdot 1+2f\cdot\frac{dy}{dx}+0=0$ $(2by+2f)\frac{dy}{dx}=-2ax-2g$ $\frac{dy}{dx}=\frac{-2[ax+g]}{2(by+f)}$ $=\frac{ax+g}{by+f}$	(3) (1) (1)	15	
	c.	$x=a(\theta-\sin\theta),\ y=a(1-\cos\theta)$ $\frac{dx}{d\theta}=a[1-\cos\theta],\ \frac{dy}{d\theta}=a\cdot{}^{+}\sin\theta$ $\frac{dy}{dx}=\frac{dy/d\theta}{dx/d\theta}=\frac{a\sin\theta}{a(1-\cos\theta)}=\frac{\sin\theta}{1-\cos\theta}$	1+1 1+1+1		

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IX.	a.	tangent $\parallel^{le}$ to x-axis if $\frac{dy}{dx}=0$	(1)		
		$\frac{d}{dx}\left(\frac{x}{x^2+1}\right) = \frac{(x^2+1)\frac{d}{dx}x - x\cdot\frac{d}{dx}(x^2+1)}{(x^2+1)^2}$			
		$= \frac{(x^2+1)\cdot 1 - x\cdot 2x}{(x^2+1)^2} = \frac{x^2+1-2x^2}{(x^2+1)^2}$			
		$= \frac{1-x^2}{(x^2+1)^2}$	(1)		
		tangent $\parallel^{le}$ to x-axis if $\frac{dy}{dx}=0$			
		$\Rightarrow \frac{1-x^2}{(x^2+1)^2} = 0$	(1)		
		$\Rightarrow 1-x^2=0 \Rightarrow x^2=1 \Rightarrow x=\pm 1$	(1)		
		$\therefore$ tangent $\parallel^{le}$ to x-axis if $x=\pm 1$	(1)		
	b.	$S = a\cos nt + b\sin nt$			
		Velocity $= v = \frac{ds}{dt} = a(-\sin nt)n + b(\cos nt)n$			
		$= -an\sin nt + bn\cos nt$			
		acceleration $= a = \frac{d^2s}{dt^2} = -an\cdot\cos nt\cdot n + bn\cdot -\sin nt\, n$			
		$= -n^2 a\cos nt - n^2 b\sin nt$			
		$= -n^2[a\cos nt + b\sin nt]$			
		$a = -n^2 S$			
		$\therefore$ acceleration varies as displacement			

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IX.	c.	$y = 2x^3 - 9x^2 + 12x$			
		$\frac{dy}{dx} = 6x^2 - 18x + 12$	1		
		$\frac{d^2y}{dx^2} = 12x - 18$	1		
		St. pts are given by			
		$\frac{dy}{dx} = 0 \Rightarrow 6x^2 - 18x + 12 = 0$			
		$\Rightarrow x^2 - 3x + 2 = 0$			
		$\Rightarrow x = 2$ & $x = 1$	1		
		at $x = 1$		15	
		$\frac{d^2y}{dx^2} = 12 \times 1 - 18 = -6 < 0$			
		$\therefore$ deflection is max. at $x = 1$	1		
		Max. deflection is			
		$y = 2 \times 1^3 - 9 \times 1^2 + 12 \times 1 = 5$	1		
X	a.	$\frac{dv}{dt} = -20$ cc/sec			
		$V = \frac{4}{3}\pi r^3$	1		
		$\frac{dV}{dt} = \frac{4}{3} \times 3\pi r^2 \cdot \frac{dr}{dt} = 4\pi r^2 \cdot \frac{dr}{dt}$	1		
		$\frac{dr}{dt} = \frac{-20}{4\pi r^2}$	1		
		$A = 4\pi r^2$	1		
		$\frac{dA}{dt} = 4\pi \cdot 2r \cdot \frac{dr}{dt} = 4\pi \cdot 2r \cdot \frac{-20}{4\pi r^2} = \frac{-40}{15}$ $= \frac{-8}{3}$ cm²/sec			
		$\therefore$ Surface area shrinking at the rate of 8/3 cm²/sec	1		

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	b.	$S = 2t^3 - 9t^2 + 12t + 6$			
		$v = \frac{ds}{dt} = 6t^2 - 18t + 12$	(1)		
		$a = \frac{d^2s}{dt^2} = 12t - 18$	(1)		
		$a = 0 \Rightarrow 12t - 18 = 0 \Rightarrow t = \frac{18}{12} = \frac{3}{2}$ sec.	1		
		Velocity when $t = \frac{3}{2}$ sec			
		$V = 6\left(\frac{3}{2}\right)^2 - 18 \times \frac{3}{2} + 12$			
		$= 6 \times \frac{9}{4} - 9 \times 3 + 12 = \frac{27}{2} - 27 + 12$			
		$= \frac{-3}{2}$ units	2		
	c.	Let x be side of the square 		15	
		then sides of the box are $8-2x$, $8-2x$ and x			100
		$\therefore V = (8-2x)^2 x = (64 + 4x^2 - 32x)x$			
		$= 4x^3 - 32x^2 + 64x$	(1)		
		$\frac{dV}{dx} = 12x^2 - 64x + 64$	(1)		
		$\frac{d^2V}{dx^2} = 24x - 64$	(1)		
		St. pts are given by $\frac{dV}{dx} = 0 \Rightarrow 12x^2 - 64x + 64 = 0$ $\Rightarrow x = 4/3$ & $x = 4$	(1)		
		x cannot be 4. $\therefore x = 4/3$.			
		at $x = 4/3$ $\frac{d^2V}{dx^2} = 24 \times \frac{4}{3} - 64 = -32 < 0$			
		$\therefore$ Volume is max when $x = 4/3$ cm.	(1)		