4) a) i) $\because 2\log_2 x - \log_2 (x-1) = 2$

$\therefore \log_2 x^2 - \log_2 (x-1) = 2$

$\therefore \log_2 \left(\frac{x^2}{x-1}\right) = 2 \Rightarrow \frac{x^2}{x-1} = 2^2 \Rightarrow \frac{x^2}{x-1} = 4$

$\therefore x^2 = 4(x-1) \Rightarrow x^2 - 4x + 4 = 0 \Rightarrow (x-2)^2 = 0$

$\therefore x = 2 \Rightarrow S.S = \{2\}$

ii) $\because 3^{|3x-4|} = 9^{|2x-2|}$

$\therefore 3^{|3x-4|} = \left(3^2\right)^{|2x-2|} \Rightarrow 3^{|3x-4|} = 3^{2|2x-2|}$

$\therefore 3^{|3x-4|} = 3^{|4x-4|} \Rightarrow |3x-4| = |4x-4|$

$\therefore 3x-4 = \pm(4x-4)$

•Either $3x-4 = 4x-4 \Rightarrow 4-4 = 4x-3x \Rightarrow \boxed{x=0}$

•Or $3x-4 = -(4x-4) \Rightarrow 3x-4 = -4x+4 \Rightarrow 7x = 8$

$\therefore \boxed{x = \frac{8}{7} = 1\frac{1}{7}} \Rightarrow S.S = \left\{0, 1\frac{1}{7}\right\}$

iii) $\because \log \sqrt[3]{3x-1} + \log \sqrt[3]{3x+1} = \log 20 - 1$

$\therefore \log\left(\sqrt[3]{3x-1} \times \sqrt[3]{3x+1}\right) = \log 20 - \log 10$

$\therefore \log\left(\sqrt[3]{(3x-1)(3x+1)}\right) = \log \frac{20}{10}$

$\therefore \log\left(\sqrt[3]{9x^2-1}\right) = \log 2 \Rightarrow \sqrt[3]{9x^2-1} = 2$

$\therefore \left(9x^2-1\right)^{\frac{1}{3}} = 2 \Rightarrow \left[\left(9x^2-1\right)^{\frac{1}{3}}\right]^3 = (2)^3$

$\therefore 9x^2 - 1 = 8 \Rightarrow 9x^2 = 9 \Rightarrow x^2 = 1 \Rightarrow \boxed{x = \pm 1}$

•Either $\boxed{x=1}$ .Or $x=-1$ .Refused $\Rightarrow S.S = \{1\}$

iv) $\because 7^{3x} + 9 \times 5^{2x} = 5^{2x} + 9 \times 7^{3x}$

$\therefore 9 \times 5^{2x} - 5^{2x} = 9 \times 7^{3x} - 7^{3x}$

$\therefore 5^{2x}(9-1) = 7^{3x}(9-1)$

$\therefore 5^{2x} \times \cancel{8} = 7^{3x} \times \cancel{8} \Rightarrow 5^{2x} = 7^{3x}$

$\therefore \left(5^2\right)^x = \left(7^3\right)^x \Rightarrow 25^x = 343^x$

$\therefore \boxed{x=0} \Rightarrow S.S = \{0\}$

b) $(Tn) = \left(a, ar, ar^2, ar^3, \ldots\right)$

$\because T_1 + T_2 = 9 \Rightarrow a + ar = 9 \Rightarrow \boxed{a(1+r) = 9}$ ..(1)

$\because T_6 + T_7 = 288 \Rightarrow ar^5 + ar^6 = 288$

$\therefore \boxed{ar^5(1+r) = 288}$ ...(2)

$\therefore (2) \div (1) \Rightarrow \frac{\cancel{a}r^5\cancel{(1+r)}}{\cancel{a}\cancel{(1+r)}} = \frac{288}{9}^{32}_{1}$

$\therefore r^5 = 32 \Rightarrow r^5 = (2)^5 \Rightarrow \boxed{r=2}$ ...(3)

$\therefore$ From (3)in(1) $\Rightarrow a(1+2) = 9 \Rightarrow \boxed{a=3}$

$(Tn) = (3, 6, 12, 24, \ldots)$

$\because S_n = \frac{a\left(r^n - 1\right)}{r-1} \Rightarrow S_8 = \frac{3\left(2^8 - 1\right)}{2-1} = 765$

•$T_n = 384 \Rightarrow 3 \times 2^{n-1} = 384 \Rightarrow 2^{n-1} = 128$

$\therefore 2^{n-1} = 2^7 \Rightarrow n-1 = 7 \Rightarrow n = 8 \Rightarrow T_8 = 384$