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SECTION 2.1 TANGENT & VELOCITY

① a) $t=5$ $m_5 = \frac{250-694}{15-5} = \frac{-444}{10} = \boxed{-44.4 \text{ gal/min}}$

$t=10$ $m_{10} = \frac{250-444}{15-10} = \frac{-194}{5} = \boxed{-38.8 \text{ gal/min}}$

$t=20$ $m_{20} = \frac{250-111}{15-20} = \frac{139}{-5} = \boxed{-27.8 \text{ gal/min}}$

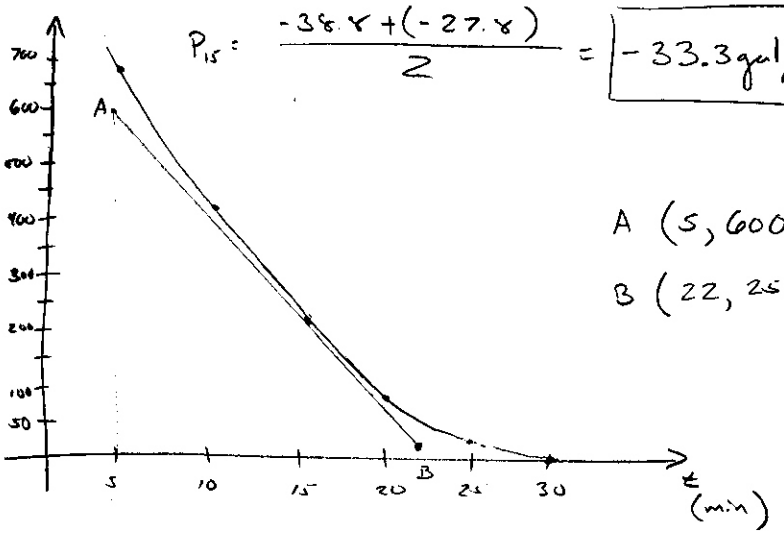
$t=25$ $m_{25} = \frac{250-28}{15-25} = \frac{222}{-10} = \boxed{-22.2 \text{ gal/min}}$

$t=30$ $m_{30} = \frac{250-0}{15-30} = \frac{250}{-15} = \boxed{-16.\overline{6} \text{ gal/min}}$

b) $m_{10} = -38.8$ gal/min $m_{20} = -27.8$ gal/min

$P_{15} = \frac{-38.8+(-27.8)}{2} = \boxed{-33.3 \text{ gal/min}}$

c)



A (5, 600)

B (22, 25)

$m_{AB} = \frac{600-25}{5-22} = \frac{575}{-17} = \boxed{-33.8235 \text{ gal/min}}$

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③ $P(1, \frac{1}{2})$ $y = \frac{x}{(1+x)}$

a) i) $(0.5, 0.333333)$ $m = \frac{0.5 - 0.333333}{1 - 0.5} = \boxed{0.333333}$

ii) $(0.9, 0.473684)$ $m = \frac{0.5 - 0.473684}{1 - 0.9} = \boxed{0.263158}$

iii) $(0.99, 0.497487)$ $m = \frac{0.5 - 0.497487}{1 - 0.99} = \boxed{0.251256}$

iv) $(0.999, 0.49975)$ $m = \frac{0.5 - 0.49975}{1 - 0.999} = \boxed{0.250125}$

v) $(1.5, 0.6)$ $m = \frac{0.5 - 0.6}{1 - 1.5} = \boxed{0.2}$

vi) $(1.1, 0.52381)$ $m = \frac{0.5 - 0.52381}{1 - 1.1} = \boxed{0.238095}$

vii) $(1.01, 0.502488)$ $m = \frac{0.5 - 0.502488}{1 - 1.01} = \boxed{0.248756}$

viii) $(1.001, 0.50025)$ $m = \frac{0.5 - 0.50025}{1 - 1.001} = \boxed{0.249875}$

b) SLOPE OF TANGENT LINE AT $P(1, \frac{1}{2})$ IS $\boxed{\frac{1}{4}}$

c) $y - y_1 = m(x - x_1)$

$y - \frac{1}{2} = \frac{1}{4}(x - 1)$

$y - \frac{1}{2} = \frac{1}{4}x - \frac{1}{4}$

$\boxed{y = \frac{1}{4}x + \frac{1}{4}}$

(5) $f(t) = 40t - 16t^2$

$f(2) = 40(2) - 16(2)^2$

$f(2) = 16$

$f(2.5) = 40(2.5) - 16(2.5)^2 = 0$

$f(2.1) = 40(2.1) - 16(2.1)^2 = 13.44$

$f(2.05) = 40(2.05) - 16(2.05)^2 = 14.76$

$f(2.01) = 40(2.01) - 16(2.01)^2 = 15.7584$

$m_{2-2.5} = \dfrac{16-0}{2-2.5} = \boxed{-32 \text{ ft/s}}$ (i)

$m_{2-2.1} \quad \dfrac{16-13.44}{2-2.1} = \boxed{-25.6 \text{ ft/s}}$ (ii)

$m_{2-2.05} \quad \dfrac{16-14.76}{2-2.05} = \boxed{-24.8 \text{ ft/s}}$ (iii)

$m_{2-2.01} \quad \dfrac{16-15.7584}{2-2.01} = \boxed{-24.16 \text{ ft/s}}$ (iv)

b) INSTANTANEOUS VELOCITY WHEN $t=2$ IS $\boxed{-24 \text{ ft/s}}$

6 a) $f(t) = 10t - 1.86t^2$

$f(1) = 10(1) - 1.86(1)^2 = 8.14$

$f(2) = 10(2) - 1.86(2)^2 = 12.56$

$f(1.5) = 10(1.5) - 1.86(1.5)^2 = 10.815$

$f(1.1) = 10(1.1) - 1.86(1.1)^2 = 8.7494$

$f(1.01) = 10(1.01) - 1.86(1.01)^2 = 8.20261$

$f(1.001) = 10(1.001) - 1.86(1.001) = 8.14628$

$m_{1-2} = \dfrac{8.14 - 12.56}{1 - 2} = \boxed{4.42 \text{ ft/s}}$ (i)

$m_{1-1.5} = \dfrac{8.14 - 10.815}{1 - 1.5} = \boxed{5.35 \text{ ft/s}}$ (ii)

$m_{1-1.1} = \dfrac{8.14 - 8.7494}{1 - 1.1} = \boxed{6.094 \text{ ft/s}}$ (iii)

$m_{1-1.01} = \dfrac{8.14 - 8.20261}{1 - 1.01} = \boxed{6.261 \text{ ft/s}}$ (iv)

$m_{1-1.001} = \dfrac{8.14 - 8.14628}{1 - 1.001} = \boxed{6.28 \text{ ft/s}}$ (v)

b) INSTANTANEOUS VELOCITY WHEN $t = 1$ IS $\boxed{6.28 \text{ ft/s}}$

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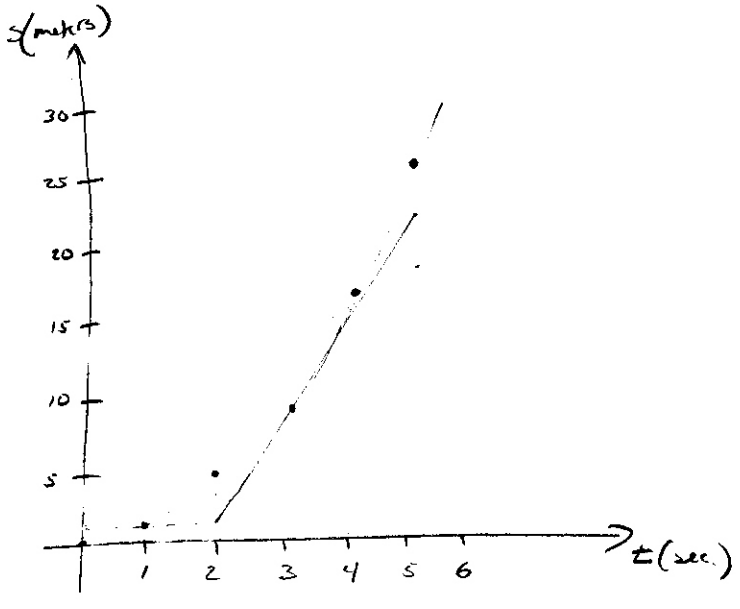
(7) a) $\frac{s(3)-s(1)}{3-1} = \frac{10.7-1.4}{3-1} = \frac{9.3}{2} = \boxed{4.65\ m/s}$ (i)

$\frac{s(3)-s(2)}{3-2} = \frac{10.7-5.1}{3-2} = \frac{5.6}{1} = \boxed{5.6\ m/s}$ (ii)

$\frac{s(5)-s(3)}{5-3} = \frac{25.8-10.7}{5-3} = \frac{15.1}{2} = \boxed{7.55\ m/s}$ (iii)

$\frac{s(4)-s(3)}{4-3} = \frac{17.7-10.7}{4-3} = \frac{7}{1} = \boxed{7\ m/s}$

b)



A(2, 1)

B(5, 23)

$\frac{23-1}{5-2} = \frac{22}{3} = \boxed{7.\bar{3}\ m/s}$