1. Divide both sides by 2t: $$y' + \frac{1}{2t}y = 3t^{-1/2} + \frac{1}{2}t - \frac{1}{2}$$

   Find the Integrating Factor: $$\mu(t) = \exp \int \frac{1}{2t}\,dt = t^{1/2}$$

   Multiply both sides by the integrating factor: $$t^{1/2}y = 3 + \frac{1}{2}t^{3/2} - \frac{1}{2}t^{1/2}$$

   Integrate both sides: $$t^{1/2}y = \int 3 + \frac{1}{2}t^{3/2} - \frac{1}{2}t^{1/2}\,dt = 3t + \frac{1}{5}t^{5/2} - \frac{1}{3}t^{3/2} + c$$

   Simplify to get the General Solution: $$\boxed{y = 3t^{1/2} + \frac{1}{5}t^2 - \frac{1}{3}t + ct^{-1/2}}$$

   The limit as $t \to \infty$ is ∞ no matter what the constant is, because t^2 grows faster than all the other terms, and it goes to ∞.

2. Factor: $$\frac{dy}{dx} = (2+x)y^2$$

   Separate: $$\frac{dy}{y^2} = (2+x)dx$$

   Integrate: $$-\frac{1}{y} = 2x + \frac{1}{2}x^2 + c$$

   Solve for y: $$y = -\frac{1}{2x + x^2/2 + c}$$

   Use the initial condition: $$1 = -\frac{1}{c}$$

   So, $c = -1$, which gives our solution: $$\boxed{y = -\frac{1}{2x + x^2/2 - 1}}$$

3. Let $Q(t)$ denote the quantity of dye in the tank. The volume of water in the tank increases at a rate of 1 L/min and starts at 150, so the volume of water in the tank is $150+t$ for t from 0 to 250 (at which point the tank overflows).

   Set up our differential equation

$$Q' = \text{rate in} - \text{rate out} = \left(\frac{3}{2}\right)(4) - \left(\frac{Q}{t+150}\right)(3) = 6 - \frac{3Q}{t+150}$$

   The differential equation is linear but not separable, so we write it like this:

$$Q' - \frac{3}{t+150}Q = 6$$

   The integrating factor is $(t+150)^3$, so we have

$$(t+150)^3 Q = \int 6(t+150)^3\, dt = \frac{3}{2}(t+150)^4 + c.$$

   Using our initial condition, we get

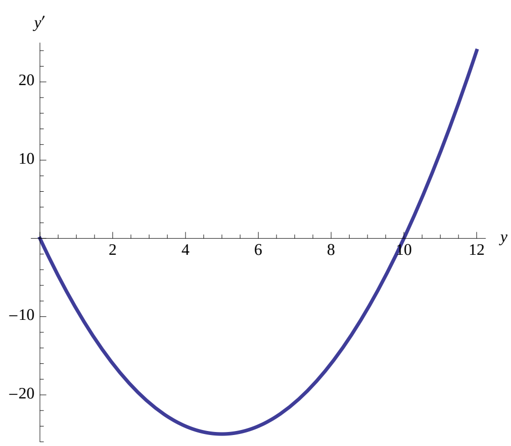
$$(150^3)(75) = \frac{3}{2}(150)^4 + c,$$

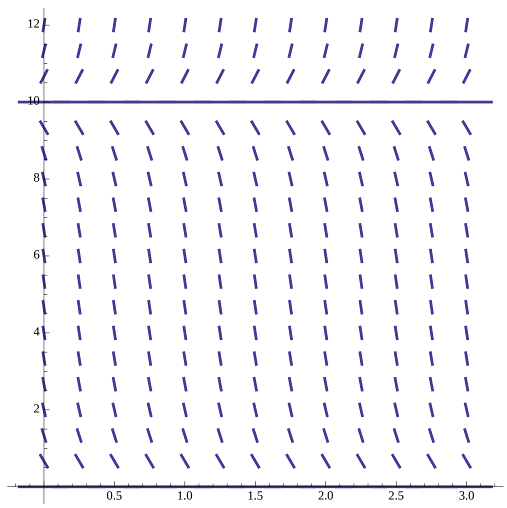
   so $c = -506250000$. Now if we solve for Q, we get

$$\boxed{Q(t) = \frac{3}{2}(t+150) - \frac{5.0625 \times 10^8}{(t+150)^3}}$$

   When it is about to overflow at $t = 250$, we have a quantity of $Q(250) = 592.09g$. But the question asked for concentration, which is quantity over volume, so we should divide by the current volume of the tank, which is 400 liters. So our answer is $\boxed{1.48 \text{ g/L.}}$

4.





   As $t \to \infty$: $y \to \infty$ if $y_0 > 10$, $y \to 10$ if $y_0 = 10$, and $y \to 0$ if $0 \le y < 10$.