$$\frac{dy}{dt} = 3\frac{Q}{A}\sin^2(t) - Q/A$$

a) ODE
first order
Linear
non homogenous

b) $t=0$, $y=0$ $A=1250$ $Q=450$
for $t=0$ to $t=1$ $h=0.25$

$\frac{dy}{dt} = 3\frac{450}{1250}\sin^2(0) - \frac{450}{1250} = -0.36$

$y_{.25} = 0 - .36(.25) = -0.09$

$\frac{dy}{dt} = 3\frac{450}{1250}\sin^2(.25) - \frac{450}{1250} = -.29389$

$y_{.5} = -.09 - .29389(.25) = -.16347$

$\frac{dy}{dt} = 3\frac{450}{1250}\sin^2(.5) - \frac{450}{1250} = -0.11176$

$y_{.75} = -.16347 - 0.11172(.25) = -0.19141$

$\frac{dy}{dt} = 3\frac{450}{1250}\sin^2(.75) - \frac{450}{1250} = 0.1418$

$y_1 = -0.19141 + 0.1418(.25) = \boxed{-0.15596}$

c) $t=0$, $y=0$ $A=1250$ $Q=450$
$t=0 \to 1$ $h=.5$

$\frac{dy}{dt} = 3\frac{450}{1250}\sin^2(0) - \frac{450}{1250} = -0.36$

$y_5 = 0 - .36(.5) = -0.18$

$\frac{dy}{dt} = 3\frac{450}{1250}\sin^2(.5) - \frac{450}{1250} = -0.11176$

$y_1 = -.18 - .1176(.5) = \boxed{-.12412}$

Q2

$$\frac{d^3y}{dx^3} - 4\frac{d^2y}{dx^2} + 6\frac{dy}{dx} - 4y = e^{2x}$$

a)

$$z = \frac{dy}{dx}$$

$$\frac{d^2z}{dx^2} - 4\frac{dz}{dx} + 6z - 4y = e^{2x}$$

$$\alpha = \frac{dz}{dx}$$

$$\frac{d\alpha}{dx} - 4\alpha + 6z - 4y = e^{2x}$$

$$\frac{d\alpha}{dx} - 4\alpha + 6z - 4y = e^{2x}$$

$$\alpha = \frac{dz}{dx} \quad z = \frac{dy}{dx}$$

b)

$$\frac{d^5y}{dx^5} + y = \cos(3x)$$

$z = \frac{dy}{dx}$ $\quad \frac{d^4z}{dx^4} + y = \cos(3x)$

$a = \frac{dz}{dx}$ $\quad \frac{d^3a}{dx^3} + y = \cos(3x)$

$b = \frac{da}{dx}$ $\quad \frac{d^2b}{dx^2} + y = \cos(3x)$

$c = \frac{db}{dx}$ $\quad \frac{dc}{dx} + y = \cos(3x)$

$$\begin{cases} \frac{dc}{dx} + y = \cos(3x) \\ c = \frac{db}{dx} \quad b = \frac{da}{dx} \\ a = \frac{dz}{dx} \quad z = \frac{dy}{dx} \end{cases}$$