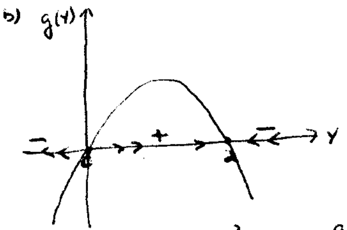
(1) $\dfrac{dY}{dX} = Y(2-Y)$

a) $g(Y) = 0$ if $\boxed{Y=0}$ or $\boxed{Y=2}$

b)



$Y=0$ is $\boxed{\text{UNSTABLE}}$

$Y=2$ is $\boxed{\text{STABLE}}$

c) $g(Y) = 2Y - Y^2$ so $g'(Y) = 2 - 2Y$

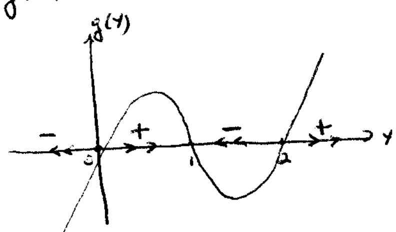
$g'(0) = 2 > 0$, so $Y=0$ is $\boxed{\text{UNSTABLE}}$

$g'(2) = -2 < 0$, so $Y=2$ is $\boxed{\text{STABLE}}$

(3) $\dfrac{dY}{dX} = Y(Y-1)(Y-2)$

a) $g(Y) = 0$ if $\boxed{Y=0}$ or $\boxed{Y=1}$ or $\boxed{Y=2}$

b)



$Y=0$ is $\boxed{\text{UNSTABLE}}$

$Y=1$ is $\boxed{\text{STABLE}}$

$Y=2$ is $\boxed{\text{UNSTABLE}}$

c) $g(Y) = Y^3 - 3Y^2 + 2Y$ so $g'(Y) = 3Y^2 - 6Y + 2$

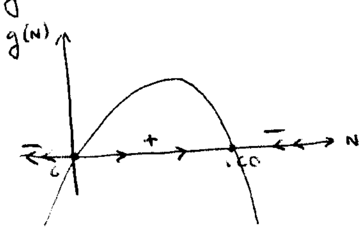
$g'(0) = 2 > 0$, so $Y=0$ is $\boxed{\text{UNSTABLE}}$

$g'(1) = -1 < 0$, so $Y=1$ is $\boxed{\text{STABLE}}$

$g'(2) = 2 > 0$, so $Y=2$ is $\boxed{\text{UNSTABLE}}$

(5) a) $\dfrac{dN}{dT} = rN\left(1 - \dfrac{N}{K}\right)$, so $\boxed{\dfrac{dN}{dT} = 1.5N\left(1 - \dfrac{N}{100}\right)}$

b) $g(N) = 0$ if $\boxed{N=0}$ or $\boxed{N=100}$



$N=0$ is $\boxed{\text{UNSTABLE}}$

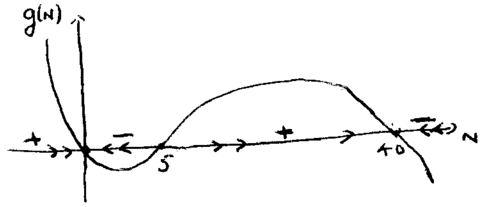
$N=100$ is $\boxed{\text{STABLE}}$

c) $g(N) = \frac{3}{2}N - \frac{3}{200}N^2$ so $g'(N) = \frac{3}{2} - \frac{3}{100}N$

$g'(0) = \frac{3}{2} > 0$, so $N=0$ is $\boxed{\text{UNSTABLE}}$

$g'(100) = -\frac{3}{2} < 0$, so $N=100$ is $\boxed{\text{STABLE}}$

(6) a) $g(N) = N\left(1 - \frac{N}{50}\right) - \frac{9N}{5+N}$



b) $g(N) = N\left[1 - \frac{N}{50} - \frac{9}{5+N}\right] = N\left[\frac{50(5+N) - N(5+N) - 9(50)}{50(5+N)}\right] = \frac{N(-N^2 + 45N - 200)}{50(5+N)}$

$= \frac{N(5-N)(N-40)}{50(5+N)} = 0$ IF $\boxed{N=0}$, $\boxed{N=5}$, OR $\boxed{N=40}$

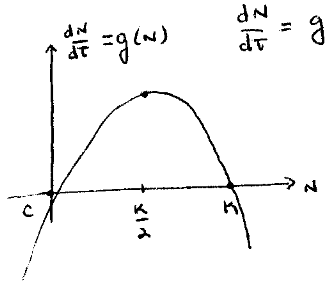
c) $N=0$ IS $\boxed{\text{STABLE}}$

$N=5$ IS $\boxed{\text{UNSTABLE}}$

$N=40$ IS $\boxed{\text{STABLE}}$

(7) a) $\frac{dN}{dt} = g(N) = rN\left(1 - \frac{N}{K}\right) = rN - \frac{r}{K}N^2$ HAS A MAX. WHEN $N = \frac{K}{2}$,

SO $\frac{K}{2} = 1000$ GIVES $\boxed{K = 2000}$



b) $N(t) = \frac{K}{1 + ae^{-rt}} = \frac{2000}{1 + ae^{-2t}}$ AND $N(0) = 10$, SO $\frac{2000}{1+a} = 10$, $200 = 1 + a$,

$a = 199$ AND $N(t) = \frac{2000}{1 + 199e^{-2t}}$ WHEN $N(t) = 1000$,

$\frac{2000}{1 + 199e^{-2t}} = 1000$, $2 = 1 + 199e^{-2t}$, $1 = 199e^{-2t}$, $e^{-2t} = \frac{1}{199}$,

$-2t = \ln\frac{1}{199} = -\ln 199$, $t = \boxed{\frac{1}{2}\ln 199} \approx 2.65$

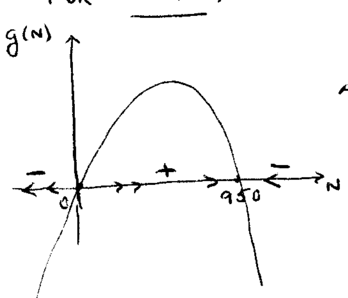
c) $\lim_{t\to\infty} N(t) = K = \boxed{2000}$ SINCE $\lim_{t\to\infty} \frac{2000}{1 + \frac{199}{e^{2t}}} = \frac{2000}{1+0} = 2000$

(10) $\frac{dN}{dt} = rN\left(1 - \frac{N}{K}\right) - hN = 2N\left(1 - \frac{N}{1000}\right) - hN$

a) $g(N) = 0$ IF $2N\left(1 - \frac{N}{1000}\right) - hN = 0$, $N\left[2\left(1 - \frac{N}{1000}\right) - h\right] = 0$,

$N = 0$ OR $2\left(1 - \frac{N}{1000}\right) = h$, $1 - \frac{N}{1000} = \frac{h}{2}$, $1 - \frac{h}{2} = \frac{N}{1000}$, $N = 1000\left(1 - \frac{h}{2}\right) = 500(2-h)$

FOR $h = .1$, WE GET



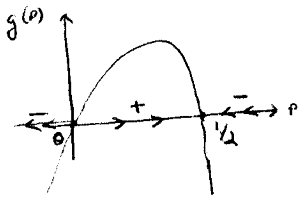
SO $\boxed{N=0 \text{ IS UNSTABLE}}$

AND $\boxed{N=950 \text{ IS STABLE}}$

(10) b) IF $h < r = 2$, THERE IS A STABLE EQUILIBRIUM AT $N = 500(2-h)$ BY PART a);
SO IF $\boxed{h < 2}$ A POSITIVE POPULATION CAN BE MAINTAINED.

(20) $\dfrac{dP}{dT} = 2P(1-P) - P$

a) $g(P) = 2P(1-P) - P = P - 2P^2 = P(1-2P)$



b) $\boxed{\begin{array}{l} P = 0 \text{ IS UNSTABLE} \\ P = 1/2 \text{ IS STABLE} \end{array}}$

(24) $\dfrac{dN}{dT} = 2N(N-10)\left(1 - \dfrac{N}{100}\right)$, $T \geq 0$

a) $g(N) = 2N(N-10)\left(1 - \dfrac{N}{100}\right) = 0$ IF $\boxed{N = 0,\ N = 10,\ \text{OR}\ N = 100}$

b) $g(N) = 2N(N-10)\left(\dfrac{100-N}{100}\right) = .02\left(-N^3 + 110N^2 - 1000N\right)$, SO

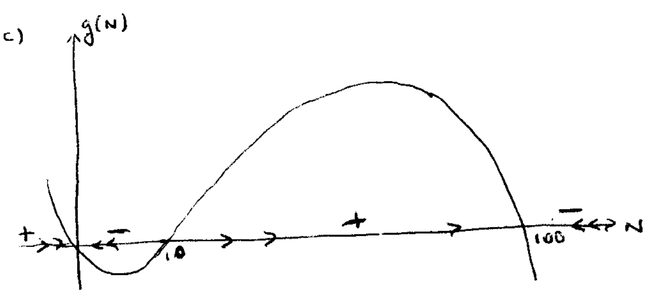
$g'(N) = .02\left(-3N^2 + 220N - 1000\right)$

1) $g'(0) = -20 < 0$, SO $\boxed{N = 0 \text{ IS STABLE}}$

2) $g'(10) = .02(900) = 18 > 0$, SO $\boxed{N = 10 \text{ IS UNSTABLE}}$

3) $g'(100) = .02(-9000) = -180 < 0$, SO $\boxed{N = 100 \text{ IS STABLE}}$

c)



FROM THE GRAPH,

$\boxed{\begin{array}{l} N = 0 \text{ IS STABLE} \\ N = 10 \text{ IS UNSTABLE} \\ N = 100 \text{ IS STABLE} \end{array}}$

THE DERIVATIVES FOUND IN PART b) GIVE THE SLOPES OF THE TANGENT LINES TO THE GRAPH AT THE EQUILIBRIUM POINTS.