2.1. 10. (a) When $\frac{dv}{dt} = 0$, $v = 0$, or

$$v^2 - (1+a)v + a = 0$$

$$(v-1)(v-a) = 0$$

$v = 1$ or $v = a$

(b) $\frac{dv}{dt} = -v(v-a)(v-1)$

When $\frac{dv}{dt} > 0$, $v \in (a, 1) \cup (-\infty, 0)$

(c) ~~When $\frac{dv}{dt} \neq 0$~~

When $\frac{dv}{dt} < 0$, $v \in (0, a) \cup (1, \infty)$

9.2. 4. $y' = x(2-y)$

	$(0,0)$	$(-1,-1)$	$(-2,-2)$	$(1,1)$	$(2,2)$	$(-1,1)$
y'	0	-3	-8	1	0	-1

Not IV, because $y' = 0$ at $(0,0)$.

Not II, because $y' < 0$ at $(-2,-2)$.

Not III, because $y' < 0$ at $(-1,1)$

It's I.

9.2, 6. $y' = \sin x \sin y$

	$(0,0)$	$(-\frac{\pi}{2}, \frac{\pi}{2})$	$(-\frac{\pi}{2}, -\frac{\pi}{2})$	$(\frac{\pi}{2}, -\frac{\pi}{2})$	$(\frac{\pi}{2}, \frac{\pi}{2})$
y'	0	-1	1	-1	1

Not IV, because $y' = 0$ at $(0,0)$.

Not I, because I is solution of $y' = x(2-y)$.

Not III, because $y' = 0$ at $(0,0)$

It's II

9.2. 24. (a) $\hat{y}(0.2) = y'(0)(0.2) + y(0)$

$= 0.2$

$\hat{y}(0.4) = y'(0.2)(0.2) + \hat{y}(0.2)$

$= 0.2\cos(0.4) + 0.2 \approx 0.38$

$\hat{y}(0.6) = y'(0.4)(0.2) + \hat{y}(0.4)$

$= \cos(0.6 + 0.2\cos(0.4))(0.2) + 0.2\cos(0.4) + 0.2$

≈ 0.53

(b) $\hat{y}(0.1) = y'(0)(0.1) + y(0)$

$= 0.1$

$\hat{y}(0.2) = y'(0.1)(0.1) + \hat{y}(0.1)$

$= \cos(0.2)(0.1) + 0.1 \approx 0.20$

$\hat{y}(0.3) = y'(0.2)(0.1) + \hat{y}(0.2) =$

$0.1\cos(0.2) + 0.1 + 0.1\cos(0.3 + 0.1\cos(0.2)) \approx 0.29$

$\hat{y}(0.4) = \hat{y}(0.3) + 0.1\, y'(0.3)$

$\approx 0.2909 + 0.1\cos(0.3 + 0.29019)$

$= 0.37327$

$\cancel{\hat{y}(0.4)} =$

$\hat{y}(0.5) = \hat{y}(0.4) + 0.1\, y'(0.4)$

$= 0.37327 + 0.1\cos(0.4 + 0.37327)$

$= 0.44483$

$\hat{y}(0.6) = \hat{y}(0.5) + 0.1\, y'(0.5)$

$= 0.44483 + 0.1\cos(0.5 + 0.44483)$

$= 0.503$

9.3. 4.

$$y' + xe^y = 0$$

$$\frac{dy}{dx} + xe^y = 0$$

$$dy = -xe^y dx$$

$$\int e^{-y} dy = -\int x\, dx$$

$$+e^{-y} = +\frac{1}{2}x^2 + C$$

$$+y = -\ln\left(\frac{1}{2}x^2 + C\right)$$

9.3. 12. $\frac{dy}{dx} = \frac{x \sin x}{y}$, $y(0) = -1$

$$\int y\, dy = \int x \sin x\, dx$$

$$\frac{1}{2}y^2 = \sin x - x\cos x + C$$

$$y = \pm\sqrt{2(\sin x - x\cos x + C)}$$

$$y(0) = -1 = -\sqrt{2(0 - 0 + c)} = -\sqrt{2c}$$

$$c = \frac{1}{2}$$

$$y = -\sqrt{2\left(\sin x - x\cos x + \frac{1}{2}\right)}$$

$\int x \sin x\, dx$

$u = x$ $\quad dv = \sin x\, dx$

$du = dx$ $\quad v = -\cos x$