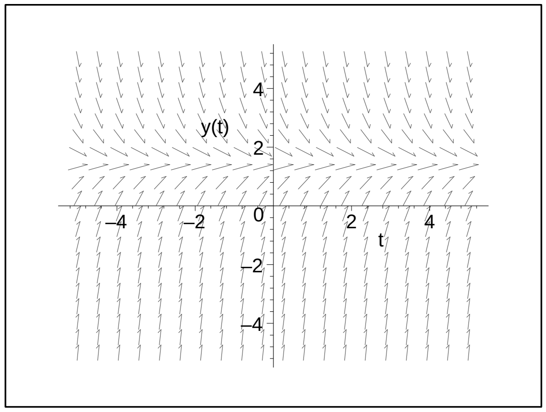
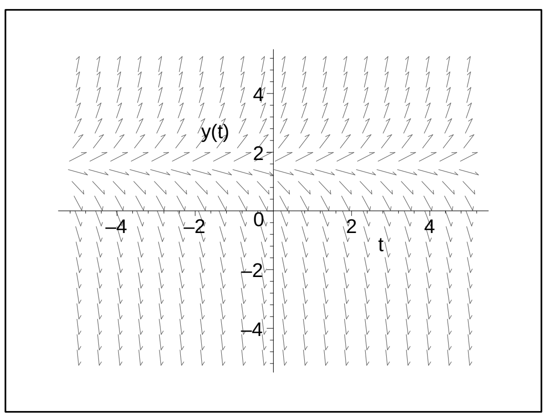
1.



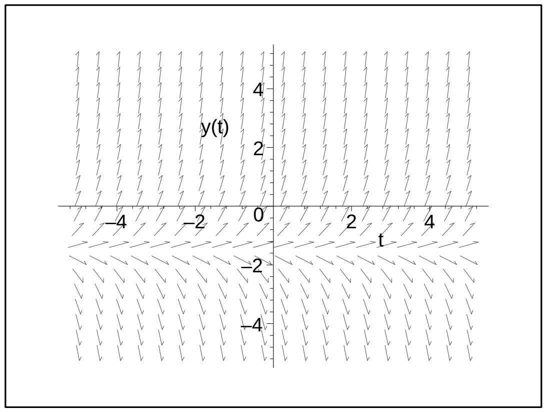
For $y > 3/2$, the slopes are negative, and, therefore the solutions decrease. For $y < 3/2$, the slopes are positive, and, therefore, the solutions increase. As a result, $y \to 3/2$ as $t \to \infty$

2.



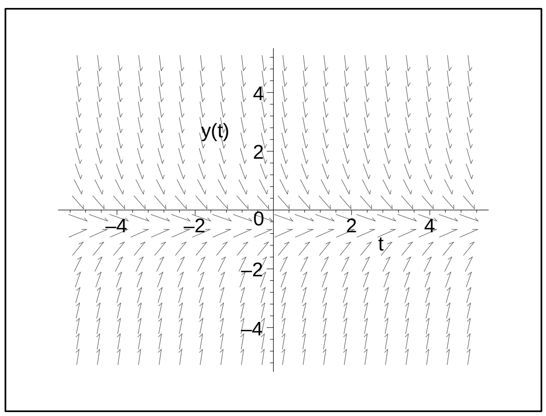
For $y > 3/2$, the slopes are positive, and, therefore the solutions increase. For $y < 3/2$, the slopes are negative, and, therefore, the solutions decrease. As a result, y diverges from $3/2$ as $t \to \infty$

3.



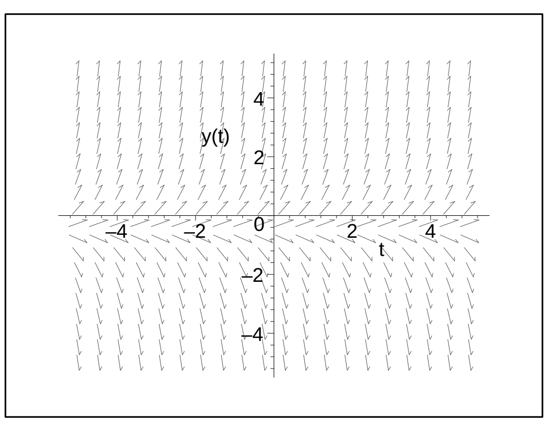
For $y > -3/2$, the slopes are positive, and, therefore the solutions increase. For $y < -3/2$, the slopes are negative, and, therefore, the solutions decrease. As a result, y diverges from $-3/2$ as $t \to \infty$

4.



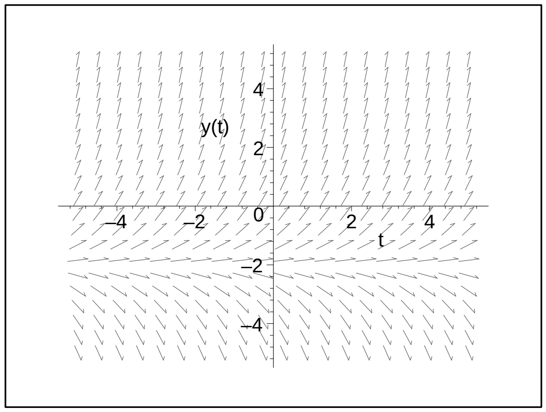
For $y > -1/2$, the slopes are negative, and, therefore the solutions decrease. For $y < -1/2$, the slopes are positive, and, therefore, the solutions increase. As a result, $y \to -1/2$ as $t \to \infty$

5.



For $y > -1/2$, the slopes are positive, and, therefore the solutions increase. For $y < -1/2$, the slopes are negative, and, therefore, the solutions decrease. As a result, y diverges from $-1/2$ as $t \to \infty$

6.



For $y > -2$, the slopes are positive, and, therefore the solutions increase. For $y < -2$, the slopes are negative, and, therefore, the solutions decrease. As a result, y diverges from -2 as $t \to \infty$

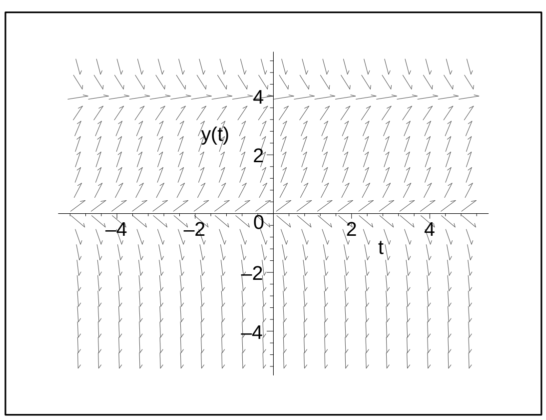
7. For the solutions to satisfy $y \to 3$ as $t \to \infty$, we need $y' < 0$ for $y > 3$ and $y' > 0$ for $y < 3$. The equation $y' = 3 - y$ satisfies these conditions.

8. For the solutions to satisfy $y \to 2/3$ as $t \to \infty$, we need $y' < 0$ for $y > 2/3$ and $y' > 0$ for $y < 2/3$. The equation $y' = 2 - 3y$ satisfies these conditions.

9. For the solutions to satisfy y diverges from 2, we need $y' > 0$ for $y > 2$ and $y' < 0$ for $y < 2$. The equation $y' = y - 2$ satisfies these conditions.

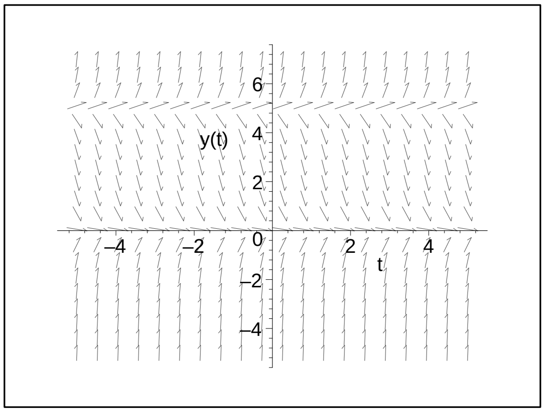
10. For the solutions to satisfy y diverges from $1/3$, we need $y' > 0$ for $y > 1/3$ and $y' < 0$ for $y < 1/3$. The equation $y' = 3y - 1$ satisfies these conditions.

11.



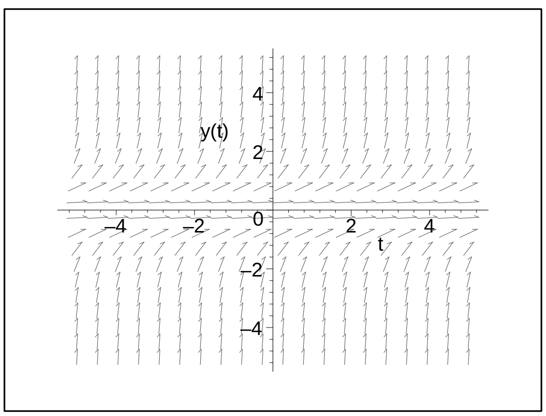
$y = 0$ and $y = 4$ are equilibrium solutions; $y \to 4$ if initial value is positive; y diverges from 0 if initial value is negative.

12.



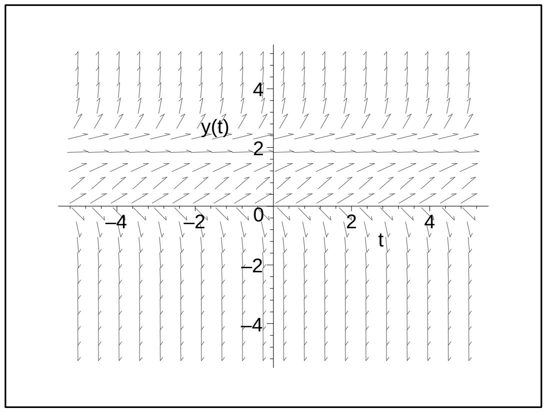
$y = 0$ and $y = 5$ are equilibrium solutions; y diverges from 5 if initial value is greater than 5; $y \to 0$ if initial value is less than 5.

13.



$y = 0$ is equilibrium solution; $y \to 0$ if initial value is negative; y diverges from 0 if initial value is positive.

14.



$y = 0$ and $y = 2$ are equilibrium solutions; y diverges from 0 if initial value is negative; $y \to 2$ if initial value is between 0 and 2; y diverges from 2 if initial value is greater than 2.

15. (j)

16. (c)

17. (g)

18. (b)

19. (h)

20. (e)

21.

(a) Let $q(t)$ denote the amount of chemical in the pond at time t. The chemical q will be measured in grams and the time t will be measured in hours. The rate at which the chemical is entering the pond is given by 300 gallons/hour $\cdot .01$ grams/gal $= 300 \cdot 10^{-2}$. The rate at which the chemical leaves the pond is given by 300 gallons/hour $\cdot q/1,000,000$ grams/gal $= 300 \cdot q10^{-6}$. Therefore, the differential equation is given by $dq/dt = 300(10^{-2} - q10^{-6})$.

(b) As $t \to \infty$, $10^{-2} - q10^{-6} \to 0$. Therefore, $q \to 10^4$ g. The limiting amount does not depend on the amount that was present initially.

22. The surface area of a spherical raindrop of radius r is given by $S = 4\pi r^2$. The volume of a spherical raindrop is given by $V = 4\pi r^3/3$. Therefore, we see that the surface area $S = cV^{2/3}$ for some constant c. If the raindrop evaporates at a rate proportional to its surface area, then $dV/dt = -kV^{2/3}$ for some $k > 0$.

23. The difference between the temperature of the object and the ambient temperature is $u - 70$. Since the difference is decreasing if $u > 70$ (and increasing if $u < 70$) and the rate constant is 0.05, the corresponding differential equation is given by $du/dt = -0.05(u - 70)$ where u is measured in degrees Fahrenheit and t is measured in minutes.

24.

(a) Let $q(t)$ be the total amount of the drug (in milligrams) in the body at a given time t (measured in hours). The drug enters the body at the rate of 5 mg/cm^3 $\cdot 100$ cm^3/hr

= 500 mg/hr, and the drug leaves the body at the rate of $0.4q$ mg/hr. Therefore, the governing differential equation si given by $dq/dt = 500 - 0.4q$.

(b) If $q > 1250$, then $q' > 0$. If $q < 1250$, then $q' > 0$. Therefore, $q \to 1250$.

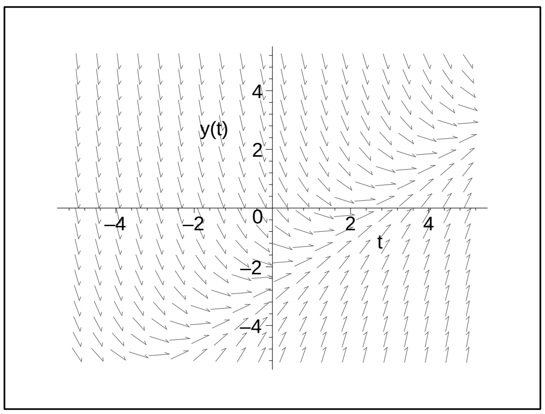
25.

(a) Following the discussion in the text, the equation is given by $mv' = mg - kv^2$.

(b) After a long time, $v' \to 0$. Therefore, $mg - kv^2 \to 0$, or $v \to \sqrt{mg/k}$

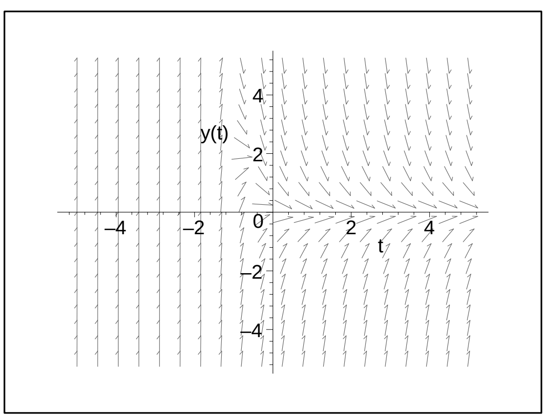
(c) We need to solve the equation $\sqrt{.025 \cdot 9.8/k} = 35$. Solving this equation, we see that $k = 0.0002$ kg/m

26.



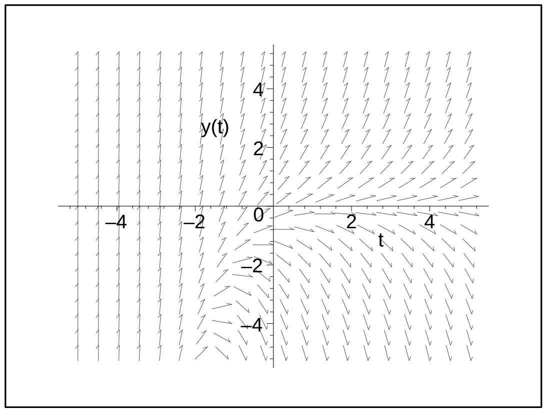
y is asymptotic to $t - 3$ as $t \to \infty$

27.



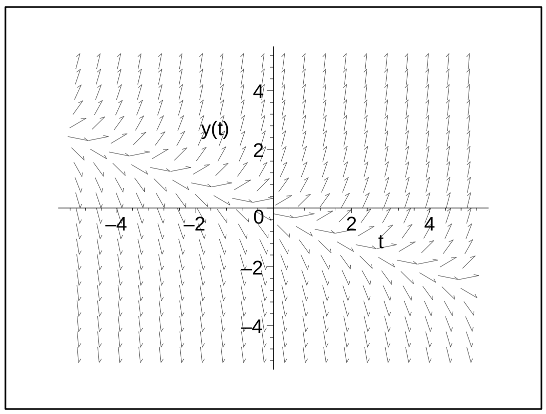
$y \to 0$ as $t \to \infty$

28.



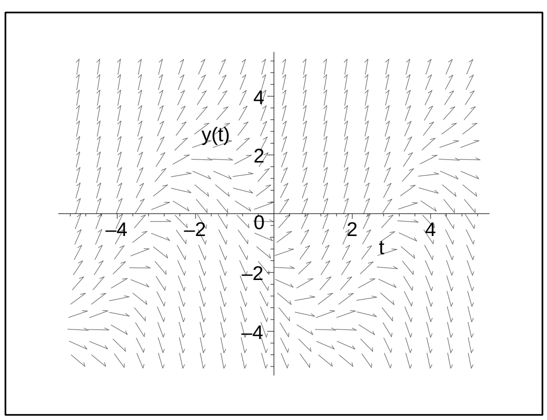
$y \to \infty, 0$, or $-\infty$ depending on the initial value of y

29.



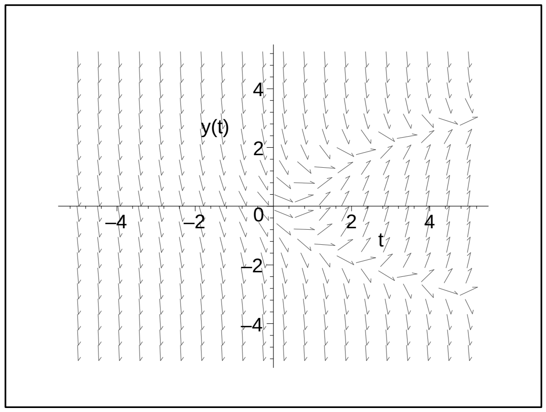
$y \to \infty$ or $-\infty$ depending whether the initial value lies above or below the line $y = -t/2$.

30.



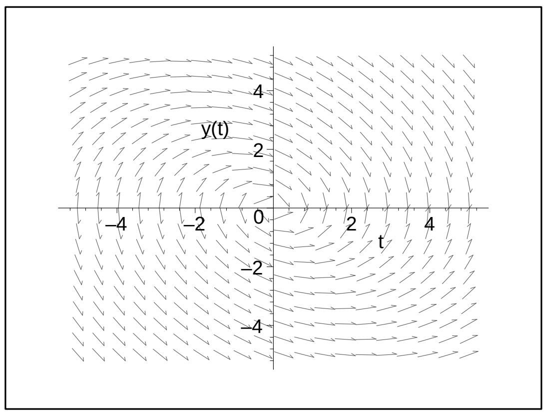
$y \to \infty$ or $-\infty$ or y oscillates depending whether the initial value of y lies above or below the sinusoidal curve.

31.



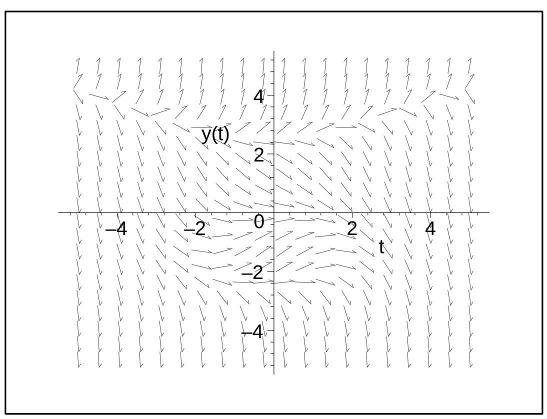
$y \to -\infty$ or is asymptotic to $\sqrt{2t-1}$ depending on the initial value of y

32.



$y \to 0$ and then fails to exist after some $t_f \geq 0$

33.



$y \to \infty$ or $-\infty$ depending on the initial value of y