[2] $y = e^{-3x}\cos 2x - 2e^{-3x}\sin 2x + 2e^{-2x}$

$$
\begin{aligned}
y' &= -3e^{-3x}\cos 2x - 2e^{-3x}\sin 2x \\
&\quad -4e^{-3x}\cos 2x + 6e^{-3x}\sin 2x - 4e^{-2x} \\
&= \underline{-7e^{-3x}\cos 2x + 4e^{-3x}\sin 2x - 4e^{-2x}} \quad 1
\end{aligned}
$$

$$
\begin{aligned}
y'' &= 21e^{-3x}\cos 2x + 14e^{-3x}\sin 2x \\
&\quad + 8e^{-3x}\cos 2x - 12e^{-3x}\sin 2x + 8e^{-2x} \\
&= \underline{29e^{-3x}\cos 2x + 2e^{-3x}\sin 2x + 8e^{-2x}} \quad 1\tfrac{1}{2}
\end{aligned}
$$

$$
\begin{aligned}
y'' + 6y' + 13y &= (29 - 42 + 13)e^{-3x}\cos 2x + (2 + 24 - 26)e^{-3x}\sin 2x \\
&\qquad + (8 - 24 + 26)e^{-2x} \quad 1\tfrac{1}{2} \\
&= \underline{10e^{-2x}} \quad \tfrac{1}{2}
\end{aligned}
$$

$\tfrac{1}{2}$ YES, THE GIVEN FUNCTION IS A SOLUTION OF THE GIVEN DE

[3] $\dfrac{dP}{dt} = \boxed{-\dfrac{k_1}{\sqrt[3]{P}}} + \boxed{k_2(P_0 - P)}$

(1) ↓ DYING RATE

$\boxed{\dfrac{dP}{dt} < 0, \; \sqrt[3]{P} > 0}$ (1/2)

SO NEED $-k_1 < 0$

(1) ↓ ADDING RATE

$\boxed{\dfrac{dP}{dt} > 0, \; P_0 - P > 0}$ (1/2)

(SINCE $P < P_0$)

SO NEED $k_2 > 0$

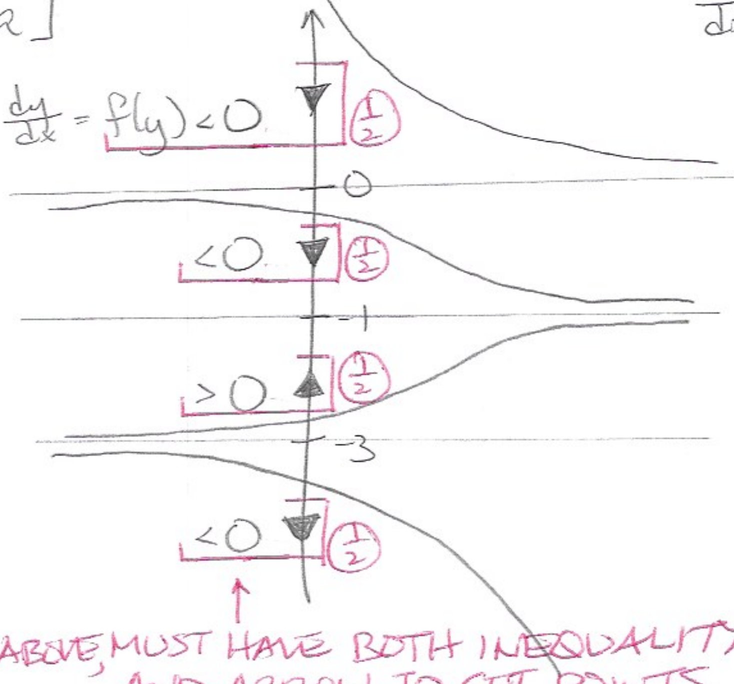
SUBTRACT (1/2) POINT IF YOU FORGOT "$\dfrac{dP}{dt} =$"

SUBTRACT (1/2) POINT IF YOU USED THE SAME CONSTANT FOR BOTH TERMS

(IE. IF YOU ONLY HAVE k, INSTEAD OF k_1, k_2)

[4][a]

$\frac{dy}{dx} = f(y) = 0$ @ $y = \boxed{-3, -1, 0}$ (1)



$y > 0$, $\frac{dy}{dx} = \boxed{f(y) < 0}$ ($\frac{1}{2}$)

$-1 < y < 0$ $\quad \boxed{<0}$ ($\frac{1}{2}$)

$-3 < y < -1$ $\quad \boxed{>0}$ ($\frac{1}{2}$)

$y < -3$ $\quad \boxed{<0}$ ($\frac{1}{2}$)

FOR ALL ABOVE, MUST HAVE BOTH INEQUALITY AND ARROW TO GET POINTS

ADD ($\frac{1}{2}$) POINT IF ALL 4 CURVES HAVE CORRECT SHAPES (NO POINTS IF ONLY 1, 2 OR 3 CURVES CORRECT)

[b] $\boxed{y = 0 \text{ SEMI-STABLE}}$ ($\frac{1}{2}$)

$\boxed{y = -1 \text{ STABLE}}$ ($\frac{1}{2}$)

$\boxed{y = -3 \text{ UNSTABLE}}$ ($\frac{1}{2}$)

SUBTRACT ($\frac{1}{2}$) POINT IF YOU FORGOT "y="

[c][i] $-\sqrt{2} \approx -1.4 \in (-3, -1)$, so $\lim_{x \to -\infty} y(x) = \boxed{-3}$ ($\frac{1}{2}$)

[ii] $\pi > 0$, so $\lim_{x \to \infty} y(x) = \boxed{0}$ ($\frac{1}{2}$)

[5] $\frac{dy}{dx} = x + 2\sqrt{y}$

[a] $y(-1.5) \approx y(-2) + y'(-2)(0.5) = \underline{4 + (-2 + 2\sqrt{4})(0.5)} = 5$ ½

$y(-1) \approx y(-1.5) + y'(-1.5)(0.5) \approx \underline{5 + (-1.5 + 2\sqrt{5})(0.5)}$ 1

$= \underline{4.25 + \sqrt{5}}$ ½

NO POINTS IF YOUR ANSWER WAS SIMPLIFIED INTO A SINGLE DECIMAL, SINCE NO CALCULATORS ALLOWED

[b]

1

$$\boxed{\begin{array}{l} -2 \blacktriangleright X : 4 \blacktriangleright Y : 0.25 \blacktriangleright H \\ Y + (X + 2\sqrt{Y})H \blacktriangleright Y : X + H \blacktriangleright X : Y \end{array}}$$

1

X	Y	X	Y
-1.75	4.5	-.75	7.8317
-1.5	5.1232	-.5	9.0435
-1.25	5.8799	-.25	10.4221
-1	6.7798	0	11.9737

$y(0) \approx 11.9737$