[2] $y = 3x^2\sin(\ln x) - x^2\cos(\ln x) + \frac{1}{2}x^{-3}$

$$\boxed{y' = 6x\sin(\ln x) + 3\cancel{x^2}\cos(\ln x)\cdot\frac{1}{\cancel{x}} - \frac{3}{2}x^{-4} + \cancel{x^2}\sin(\ln x)\cdot\frac{1}{\cancel{x}} - 2x\cos(\ln x)}$$ 1

$= 7x\sin(\ln x) + x\cos(\ln x) - \frac{3}{2}x^{-4}$

$$\boxed{y'' = 7\sin(\ln x) + 7\cancel{x}\cos(\ln x)\cdot\frac{1}{\cancel{x}} + 6x^{-5} - \cancel{x}\sin(\ln x)\frac{1}{\cancel{x}} + \cos(\ln x)}$$ 1

$= 6\sin(\ln x) + 8\cos(\ln x) + 6x^{-5}$

$$\begin{array}{l} x^2y'' \\ -3xy' \\ +5y \end{array} = \boxed{\begin{array}{l} 6x^2\sin(\ln x) + 8x^2\cos(\ln x) + 6x^{-3} \\ -21x^2\sin(\ln x) - 3x^2\cos(\ln x) + \frac{9}{2}x^{-3} \\ +15x^2\sin(\ln x) - 5x^2\cos(\ln x) + \frac{5}{2}x^{-3} \end{array}} = \boxed{13x^{-3}}$$ $\frac{1}{2}$ 2

$\frac{1}{2}$

$\boxed{\text{YES}}$, THE GIVEN FUNCTION WAS A SOLUTION OF THE GIVEN DE

[3] IF $P > P_S$ (ABOVE THRESHOLD, SO POPULATION GROWS)

THEN $\boxed{P - P_S > 0}$ AND $\boxed{\frac{dP}{dt} > 0}$ ½

AND $\boxed{\sqrt{P - P_S} > 0}$

½ MUST HAVE BOTH

SO $\boxed{\frac{dP}{dt} = k\sqrt{P - P_S} \text{ IF } P > P_S}$, WHERE $k > 0$ 1

IF $P < P_S$ (BELOW THRESHOLD, SO POPULATION DIES)

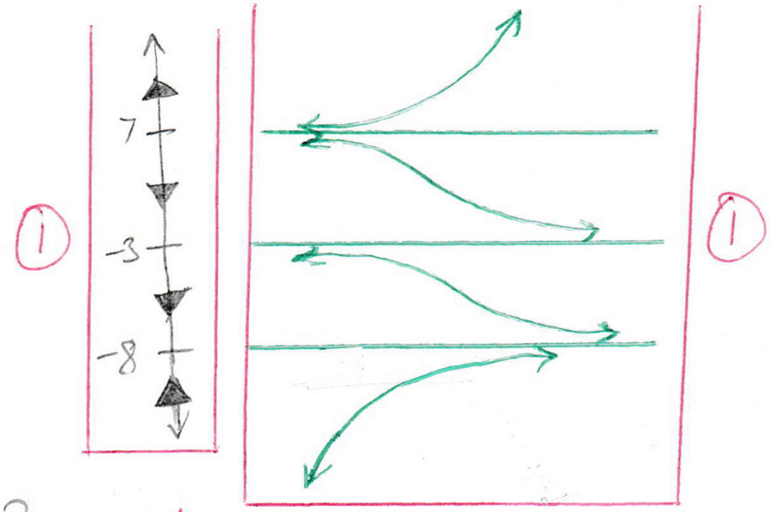
THEN $\boxed{P_S - P > 0}$ AND $\boxed{\frac{dP}{dt} < 0}$ ½

AND $\boxed{\sqrt{P_S - P} > 0}$

½ MUST HAVE BOTH

SO $\boxed{\frac{dP}{dt} = -k\sqrt{P_S - P} \text{ IF } P < P_S}$, WHERE $k > 0$ 1

[4] [a]



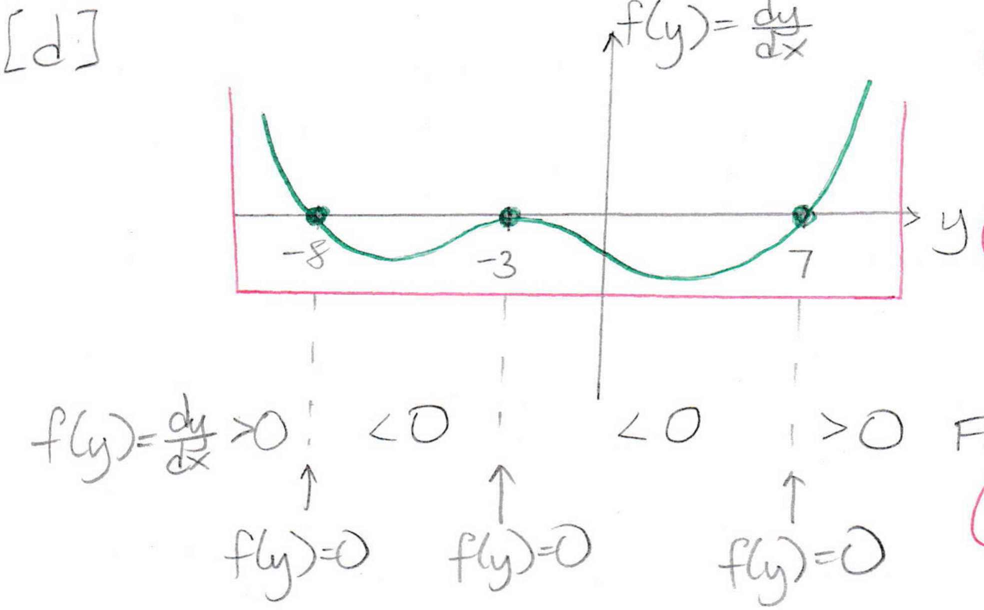
[b] $y = -3$ IS A $\boxed{\text{SEMI-STABLE}}$ EQ SOL'N $\frac{1}{2}$

IF $y(x_0) \approx -3$ AND $y(x_0) > -3$, THEN $\lim_{x \to \infty} y(x) = -3$

BUT IF $y(x_0) \approx -3$ AND $y(x_0) < -3$, THEN $\lim_{x \to \infty} y(x) = -8 \neq -3$

[c] [i] $\boxed{-3}$ $\frac{1}{2}$ [ii] $\boxed{7}$ $\frac{1}{2}$, BOTH FROM [a]

[d]



$\frac{1}{2}$ CORRECT INTERCEPTS ON HORIZONTAL AXIS

$\frac{1}{2}$ GRAPH BELOW HORIZONTAL AXIS ON $(-8, -3)$ AND $(-3, 7)$

$\frac{1}{2}$ GRAPH ABOVE HORIZONTAL AXIS ON $(-\infty, -8)$ AND $(7, \infty)$

[5] $\boxed{\dfrac{dy}{dx} = \dfrac{x+2}{y}}$ $\frac{1}{2}$, $y(-6) = -2$

[a] $y(-5.5) \approx y(-6) + y'(-6)(-5.5 - -6)$

$= -2 + \left(\dfrac{-6+2}{-2}\right)(0.5)$

$= \boxed{-2 + (2)(0.5)}$ $\frac{1}{2}$

$= -1$

$y(-5) \approx y(-5.5) + y'(-5.5)(-5 - -5.5)$

$\approx -1 + \left(\dfrac{-5.5+2}{-1}\right)(0.5)$

$= \boxed{-1 + (3.5)(0.5)}$ $\frac{1}{2}$

$= 0.75$

[b] -6 ▶ X : -2 ▶ Y : 0.2 ▶ H
Y + (X+2)/Y * H ▶ Y : X+H ▶ X : Y

1

x	$y(x) \approx$
-5.8	-1.6
-5.6	-1.125
-5.4	-0.485
-5.2	0.9171
-5	0.2192

$\frac{1}{2}$ 1 → SUBTRACT $\frac{1}{2}$ POINT FOR EACH ERROR
MINIMUM SCORE = 0
(IF 2 OR MORE ERRORS)