Answer Template for Lab 1

ENGR 232 – Dynamic Engineering Systems

Lab #1 **Name:** David N Juboor

Question 1: The integral is: $\_\log(x^2+1) - x^2 + \frac{x^4}{2} + C$

Paste code here:

```
syms x C
f = (2*x^5)/(1+x^2);
intf = int(f,x)
intf = intf + C
```

Question 2. The general solution is: $t + C_1 * e^t + 1$

Paste your code here:

```
syms y(t)
DE = diff(y,t) == y - t;
dsolve(DE)
```

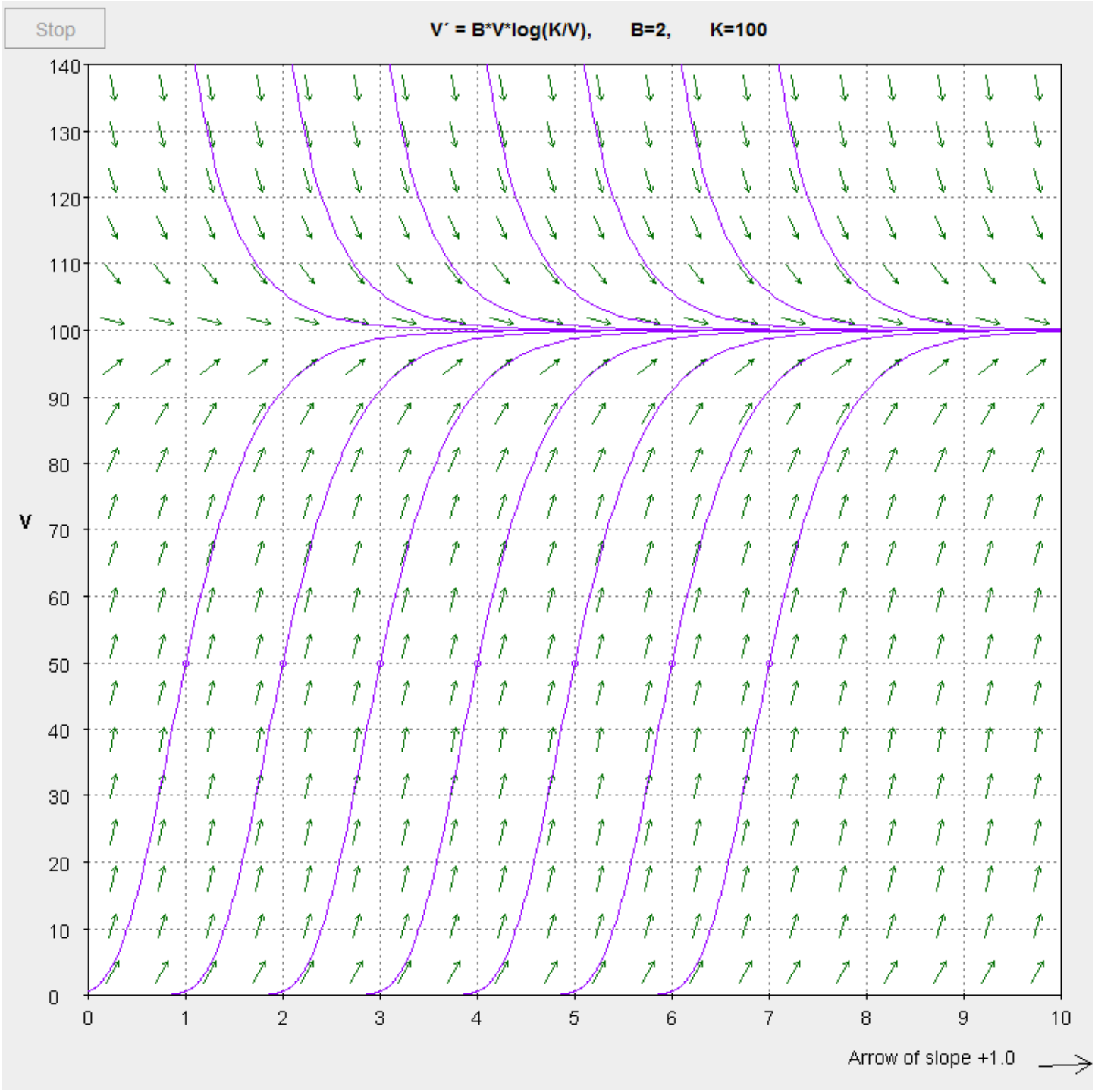
Question 3. The solution satisfying $y(0) = 1$ is: $y(t) =$ t+1

Question 4. The solution satisfying the initial condition $V(0) = 1$ is: $V(t) = 100 * e^{e^{\ln(-2*\ln(10))-2*t}}$

Paste your code here:

```
B = 2;
K = 100;
syms V(t);
DE = diff(V,t) == B*V*log(K/V);
dsolve(DE, V(0)==1)
```

Question 5: Paste your completed image here.


Stop
V´ = B*V*log(K/V), B=2, K=100
V
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
Arrow of slope +1.0

Question 6. Keep B = 2, and K = 100. It takes a tumor starting at V = 20 about this long to double to V = 40:

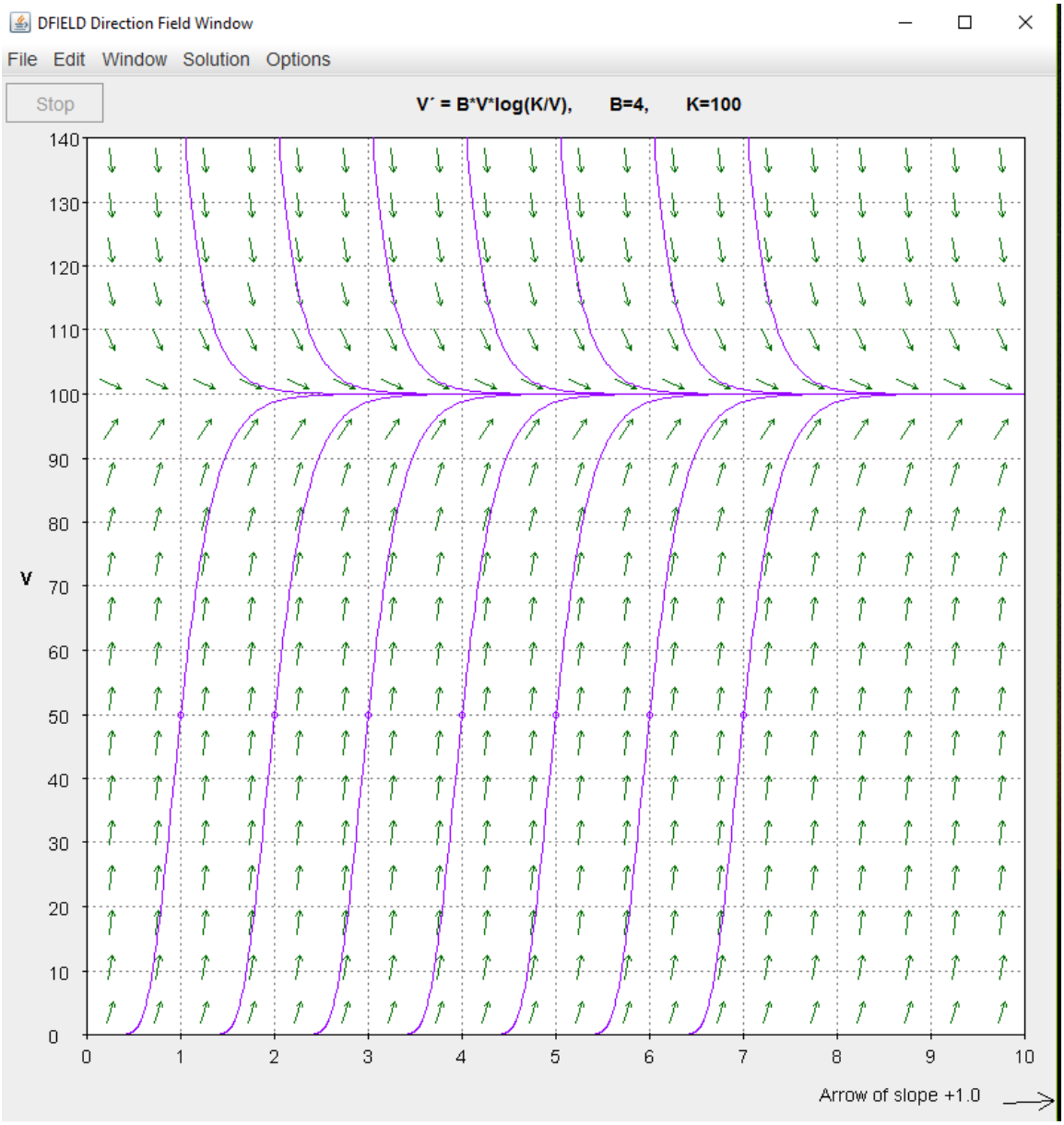
ANS: 0.27 time units

Question 7: Stability

The critical value $V = K = 100$ is: Stable

The critical value $V = 0$ is: Un-Stable

Question 8: A More Aggressive Tumor! Simply change B (beta) from 2 to 4 and leave the carrying capacity as K=100. Obtain a new direction field, and include multiple solutions curves passing through V = 50 and 150 as before. Paste your completed plot below.



Question 9. The tumors are growing fastest when $V =$ _ _ _

Autonomous Property: Enter **horizontal** or **vertical** below.

Question 10. **Horizontal**

Be sure all ten questions are answered, then submit your Answer Template file as a single PDF before the submission window closes. Submission must be a single PDF file!