20/20

A. 4/4 B a) 5/5 b) 2/2 c) 6/6 d) 3/3

MATH 256 - LAB 4

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L1A

A. [V, Γ] = eig(A) gives..

$\lambda_1 = 4.4888$, $\lambda_2 = -3.6402 + 1.9615i$, $\lambda_3 = -3.6402 - 1.9615i$, $\lambda_4 = -.2085$ ✓

$$V_1 = \begin{bmatrix} .8084 \\ -.0452 \\ .4089 \\ .4210 \end{bmatrix}; \quad V_2 = \begin{bmatrix} .4410 + .2759i \\ .0807 - .5126i \\ -.6234 \\ -.2197 + .1525i \end{bmatrix}; \quad V_3 = \begin{bmatrix} .4410 - .2759i \\ .0807 - .5126i \\ -.6234 \\ -.2197 - .1525i \end{bmatrix}; \quad V_4 = \begin{bmatrix} -.8041 \\ 0.5767 \\ -.1333 \\ 0.0545 \end{bmatrix}$$ ✓

B. (a) $m_1 y_1'' = -k_1 y_1 + k_2 (y_2 - y_1)$ where $Y_1 = Y_{11}$, $Y_1' = Y_{11}' = Y_{12}$, $Y_1'' = Y_{12}'$

$m_2 y_2'' = -k_2 (y_2 - y_1) + f(t)$ $Y_2 = Y_{21}$, $Y_2' = Y_{21}' = Y_{22}$, $Y_2'' = Y_{22}'$

$$\begin{bmatrix} Y_{11}' \\ Y_{12}' \\ Y_{21}' \\ Y_{22}' \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 & 0 \\ \frac{-(k_1+k_2)}{m_1} & 0 & \frac{k_2}{m_1} & 0 \\ 0 & 0 & 0 & 1 \\ \frac{k_2}{m_2} & 0 & \frac{-k_2}{m_2} & 0 \end{bmatrix} \begin{bmatrix} Y_{11} \\ Y_{12} \\ Y_{21} \\ Y_{22} \end{bmatrix} + f(t)$$

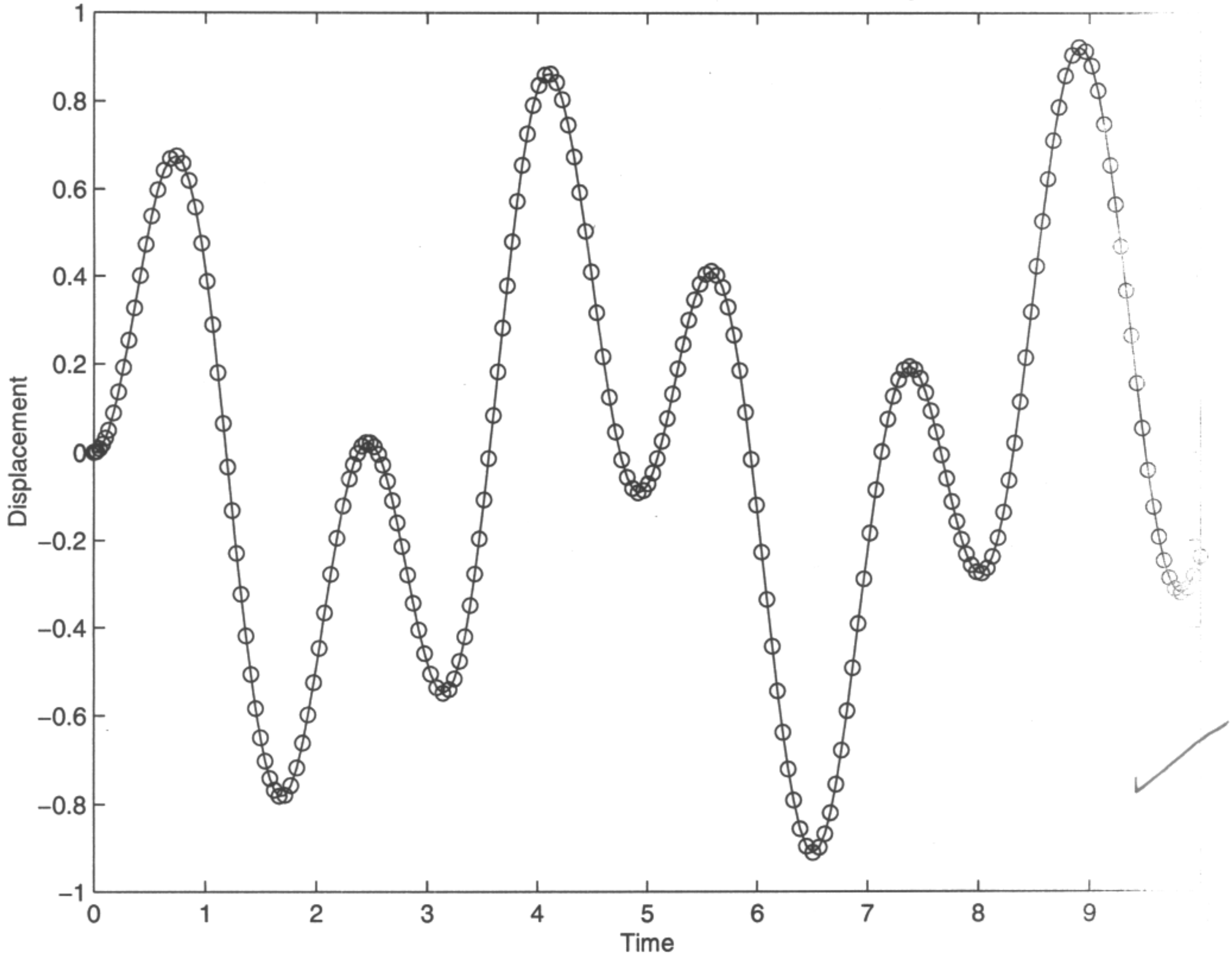
$$\hookrightarrow A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ -11 & 0 & 6 & 0 \\ 0 & 0 & 0 & 1 \\ 6 & 0 & -6 & 0 \end{bmatrix}$$ ✓ → USING MATLAB:

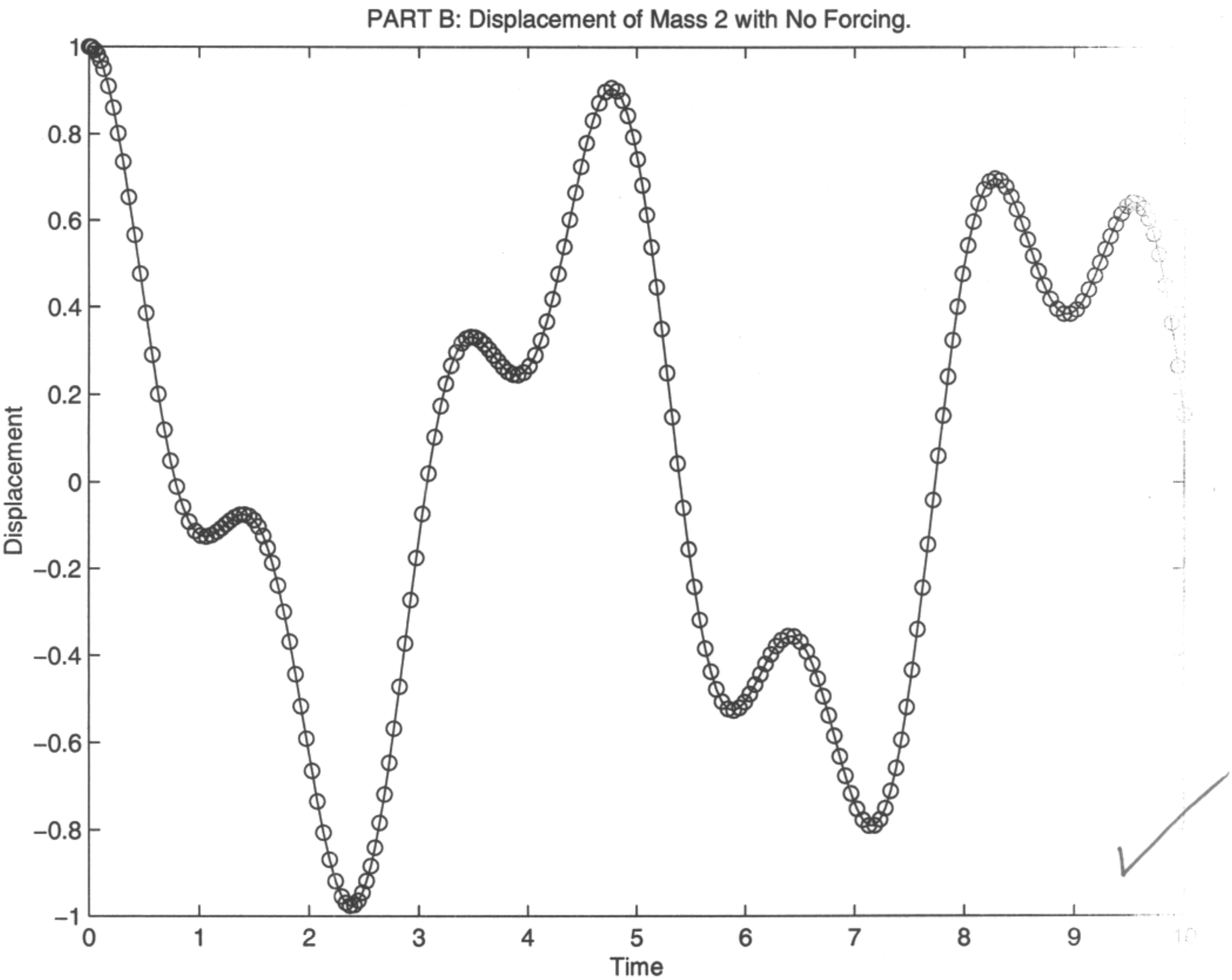
$\lambda_1 = 3.87i$
$\lambda_2 = -3.87i$
$\lambda_3 = 1.41i$
$\lambda_4 = -1.41i$ ✓

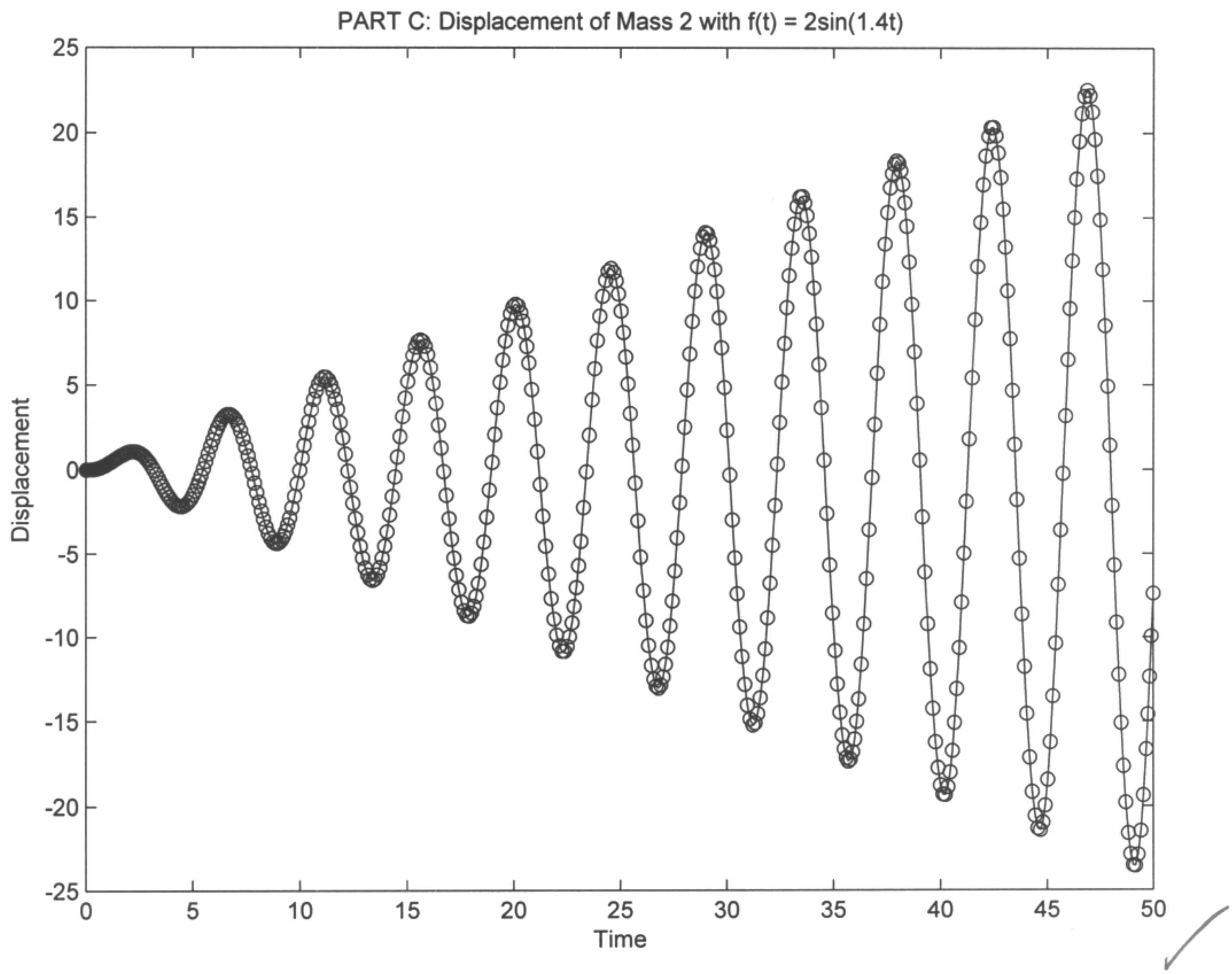
(b) As can be seen in the plots, the masses both oscillate periodically about their ~~their~~ equilibrium positions. There is no damping present, so the oscillations continue indefinitely.

d. Yes, when omega comes near resonance frequency, the amplitude spikes upwards as expected. ✓

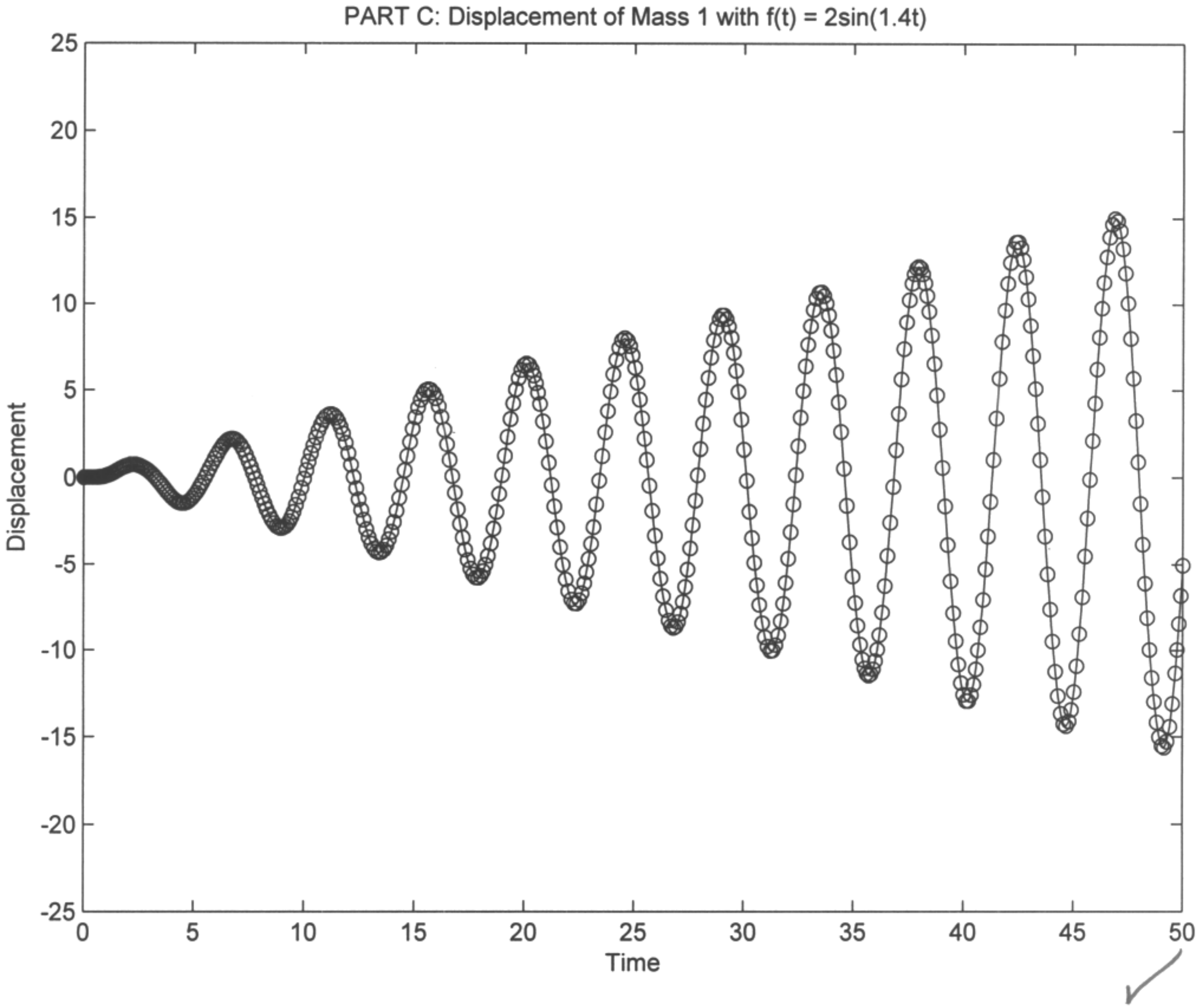
PART B: Displacement of Mass 1 with No Forcing.



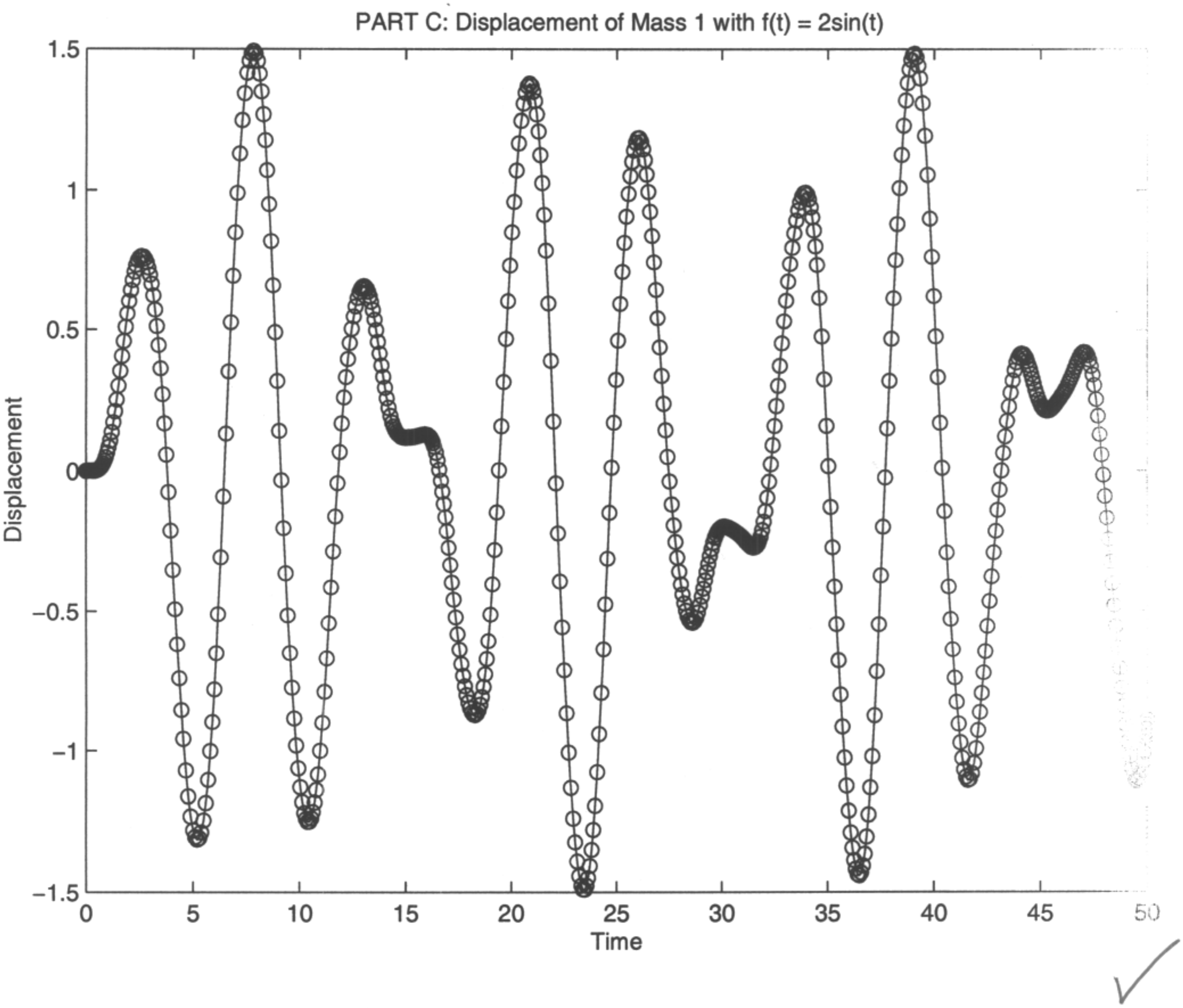

PART B: Displacement of Mass 2 with No Forcing.
Displacement
Time
1
0.8
0.6
0.4
0.2
0
−0.2
−0.4
−0.6
−0.8
−1
0
1
2
3
4
5
6
7
8
9
10

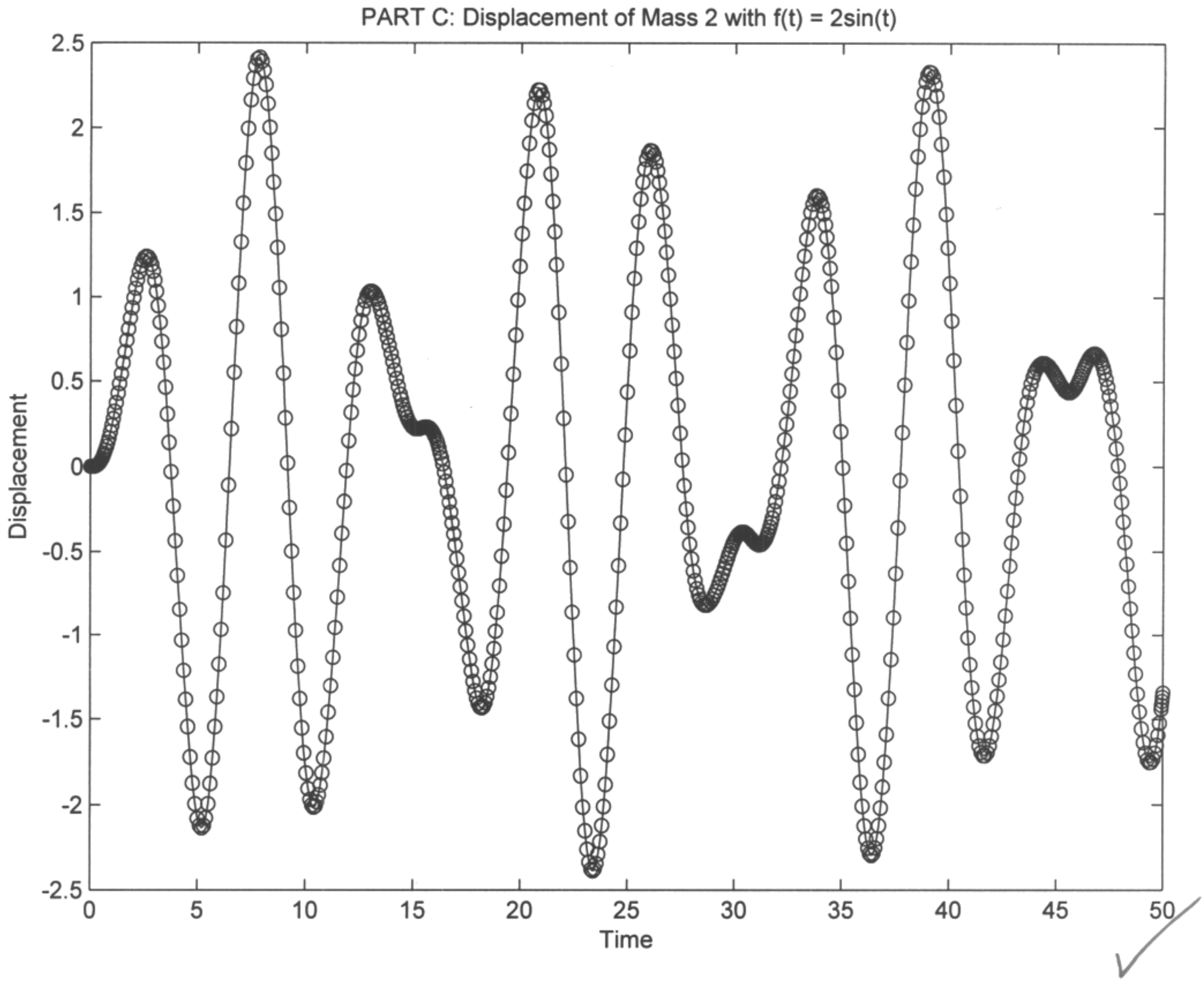


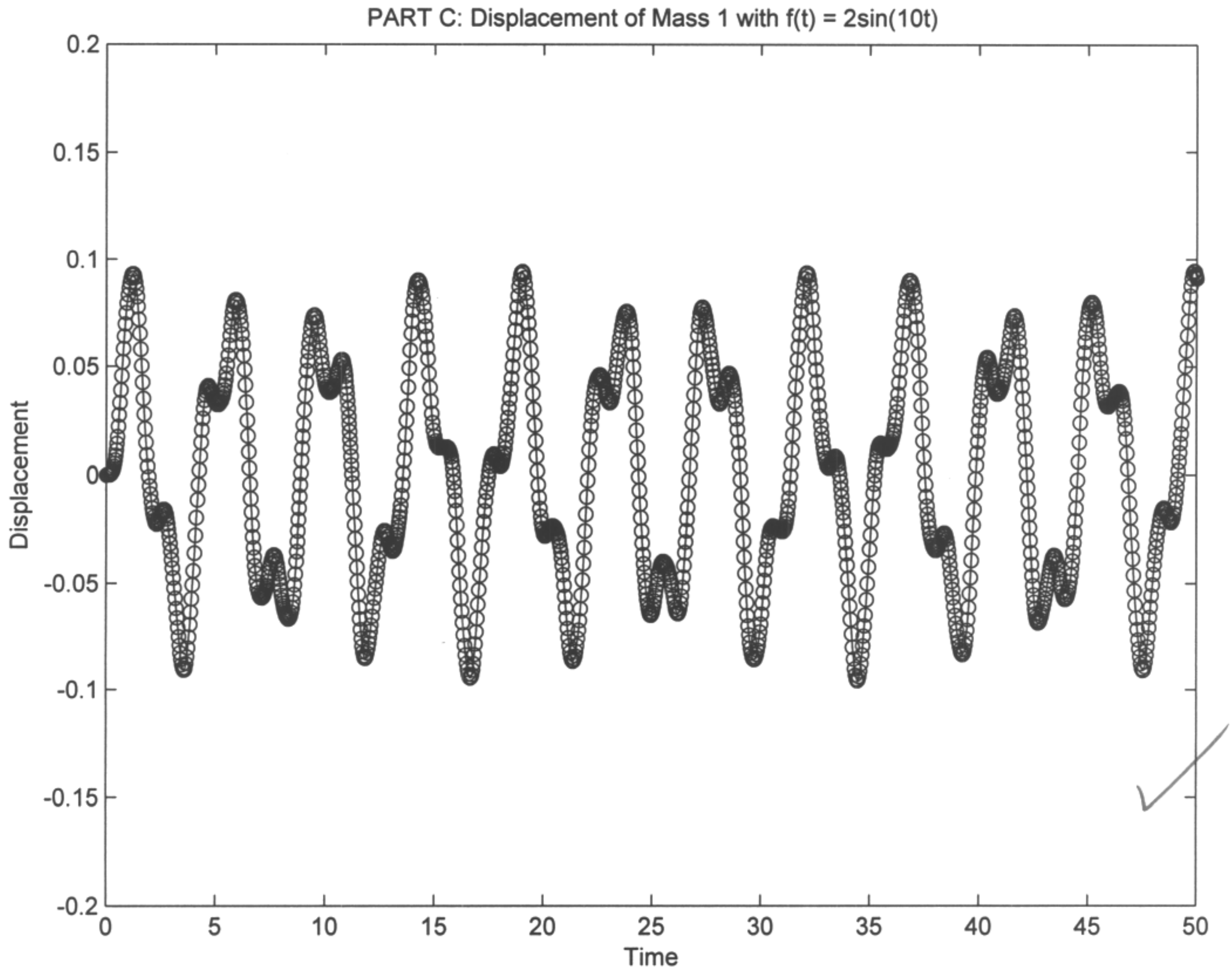
PART C: Displacement of Mass 2 with f(t) = 2sin(1.4t)
Displacement
Time
25
20
15
10
5
0
-5
-10
-15
-20
-25
0
5
10
15
20
25
30
35
40
45
50

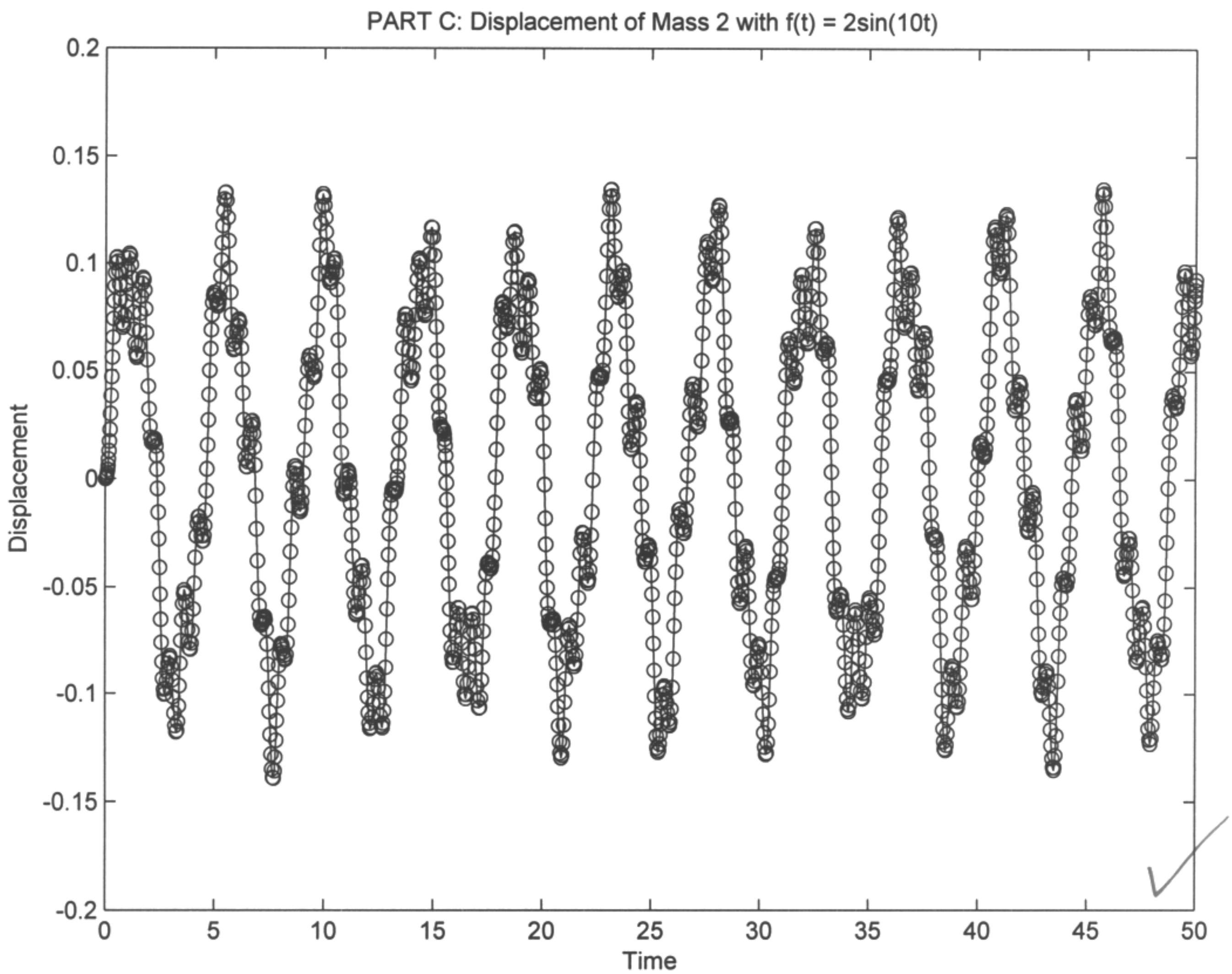


PART C: Displacement of Mass 1 with f(t) = 2sin(1.4t)
Displacement
Time
25
20
15
10
5
0
-5
-10
-15
-20
-25
0
5
10
15
20
25
30
35
40
45
50

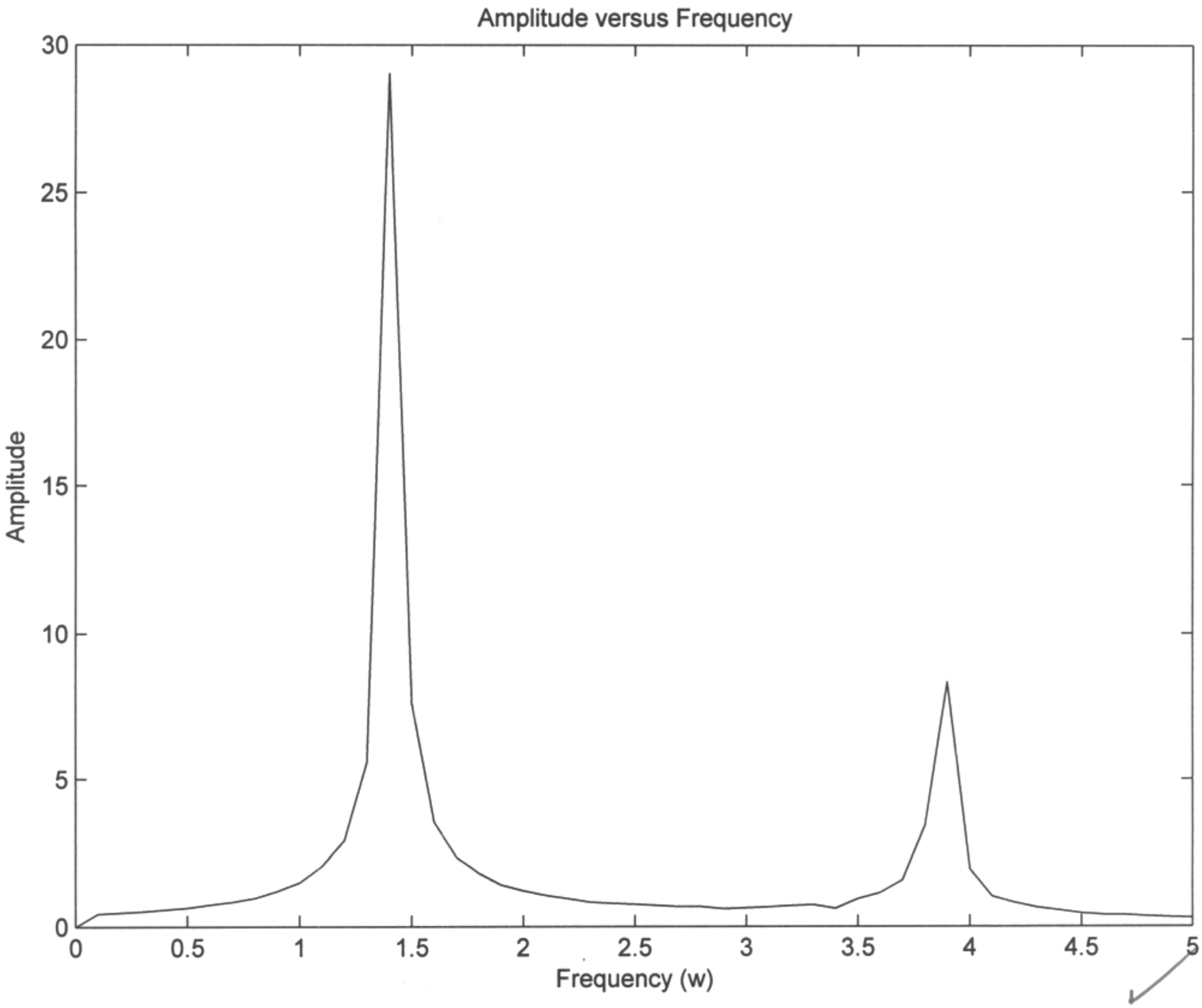

PART C: Displacement of Mass 1 with f(t) = 2sin(t)
Displacement
Time
1.5
1
0.5
0
−0.5
−1
−1.5
0
5
10
15
20
25
30
35
40
45
50


PART C: Displacement of Mass 2 with f(t) = 2sin(t)
Displacement
Time
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
5
10
15
20
25
30
35
40
45
50


PART C: Displacement of Mass 1 with f(t) = 2sin(10t)
Displacement
Time
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
5
10
15
20
25
30
35
40
45
50



PART C: Displacement of Mass 2 with f(t) = 2sin(10t)
Displacement
Time
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
-0.2
0
5
10
15
20
25
30
35
40
45
50


Amplitude versus Frequency
30
25
20
15
10
5
0
Amplitude
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
Frequency (w)