Homework 2

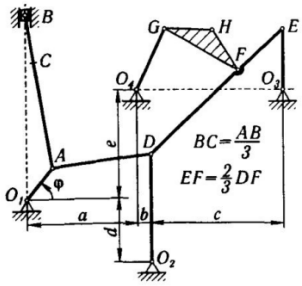
Week HW 2, Task 1 (Coding)

You should find:

1. simulate this mechanism (obtain all positions.)
2. velocities for *A, B, C, E, F, D*. Find angular velocities for all links.
3. acc. for *A* and *B* and ang. vel for *AB*
4. draw plots for previous statements.

Needed variables:

$\omega_{O_1A} = 2\ rad/s$;
$\phi = 52°$; $a = 32$; $b = 4$; $c = 39$; $d = 19$; $e = 32$;
$O_1A = 12$; $O_2D = 32$; $O_3E = 18$; $AB = 46$; $AD = 29$;
$GH = 14$; $DE = 53$; $GF = 25$; $FH = 14$; $O_4G = 20$.



Week HW 2, Task 1 (Yablonskii (rus) K4)

I changed $w_{O_1A} = 1$ rad/s for better and smoother animations
Let us obtain positions of all points:

$$O_1 = (0, 0)$$

$$A = (O_1Acos(\omega_{O_1A}\phi), O_1Asin(\omega_{O_1A}\phi))$$

We can get point B from the following system:

$$\begin{cases} (x_B - x_A)^2 + (y_B - y_A)^2 = AB^2 \\ x_B = 0 \end{cases}$$

We will get 2 solutions for this system, we will take the one with the higher y_B
After solving this system we will find that:

$$y_B = y_A + \sqrt{(AB^2 - x_A^2)}$$

We can obtain C from the following equation:

$$\vec{AC} = \vec{AB}\frac{AC}{AB}$$

$$O_2 = (a + b, -d)$$

We can get point D from the following system:

$$\begin{cases} (x_D - x_A)^2 + (y_D - y_A)^2 = AD^2 \\ (x_D - x_{O_2})^2 + (y_D - y_{O_2})^2 = O_2D^2 \end{cases}$$

We will solve this system and all systems of circle-circle intersection below using the following algorithm: **https://cp-algorithms.com/geometry/circle-circle-intersection.html#solution** (https://cp-algorithms.com/geometry/circle-circle-intersection.html#solution)

$$O_3 = (a + b + c, e)$$

We can get point E from the following system:

$$\begin{cases} (x_D - x_E)^2 + (y_D - y_E)^2 = DE^2 \\ (x_E - x_{O_3})^2 + (y_D - y_{O_3})^2 = O_2D^2 \end{cases}$$

We can obtain F from the following equation:

$$\vec{DF} = \frac{3}{5}\vec{DE}$$

$$O_4 = (a, e)$$

We can get point G from the following system:

$$\begin{cases} (x_G - x_F)^2 + (y_G - y_F)^2 = FG^2 \\ (x_G - x_{O_4})^2 + (y_G - y_{O_4})^2 = O_3G^2 \end{cases}$$

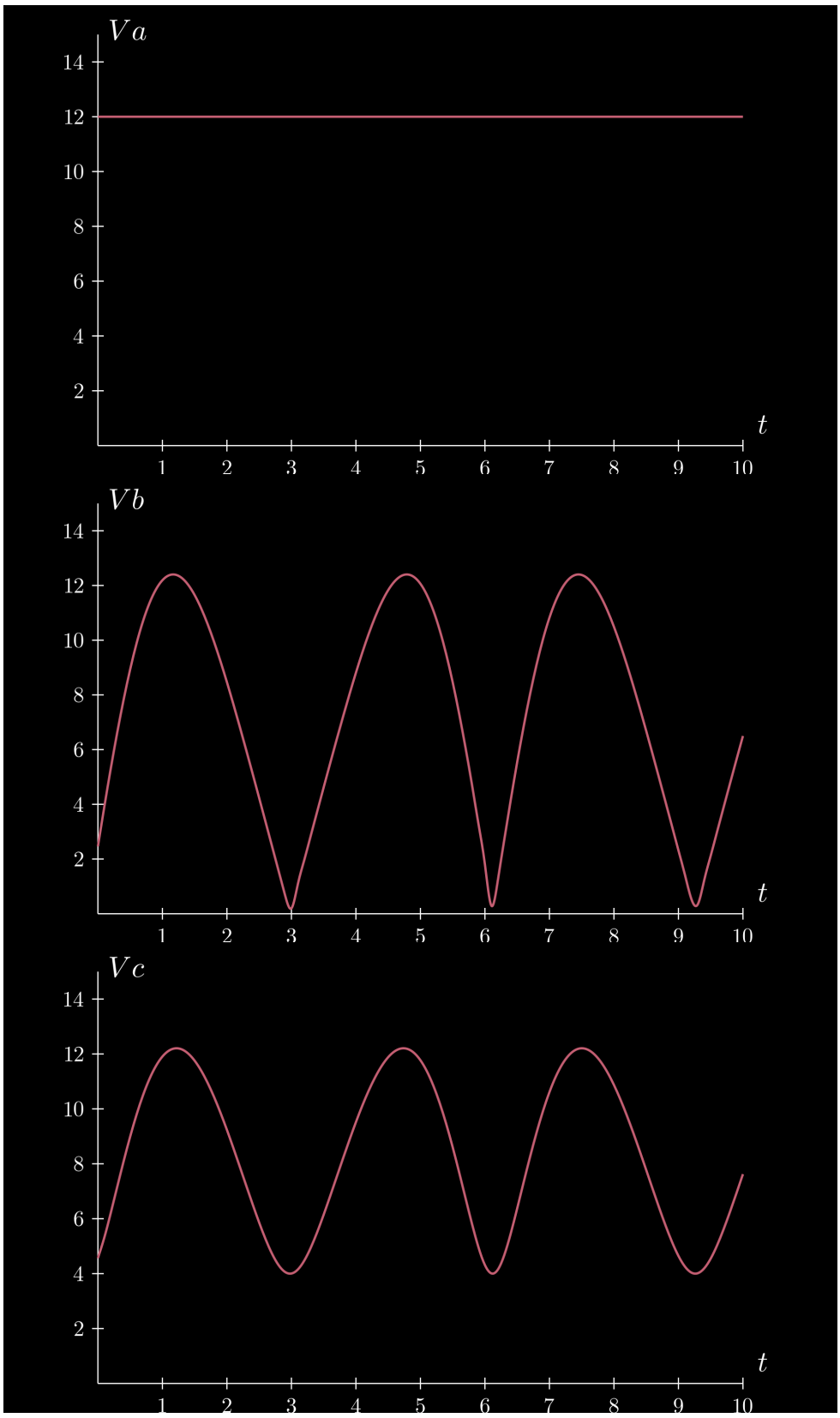
Finally,
We can get point H from the following system:

$$\begin{cases} (x_H - x_F)^2 + (y_H - y_F)^2 = FH^2 \\ (x_G - x_H)^2 + (y_G - y_H)^2 = HG^2 \end{cases}$$

Since we have functions of coordinates for all points, we will find the velocities of these points by derivating these functions numerically.
The simulation of this mechanism and the velocities of each point can be found in the file simulation.mp4 generated using the code in **Task1.py** (http://Task1.py)
To find the value of the angular velocity for each point we will use the following formula:

$$w = \frac{|\vec{r}.\vec{v}|}{|\vec{r}|^2}$$

Such that $\vec{r}$ is the coordinate vector of the point and $\vec{v}$ is the velocity vector
Accelerations of points A and B will be computed numerically as you can just derivate the velocities of these points.
Below you can find all plots, they were generated by the file **Task1plots.py** (http://Task1plots.py)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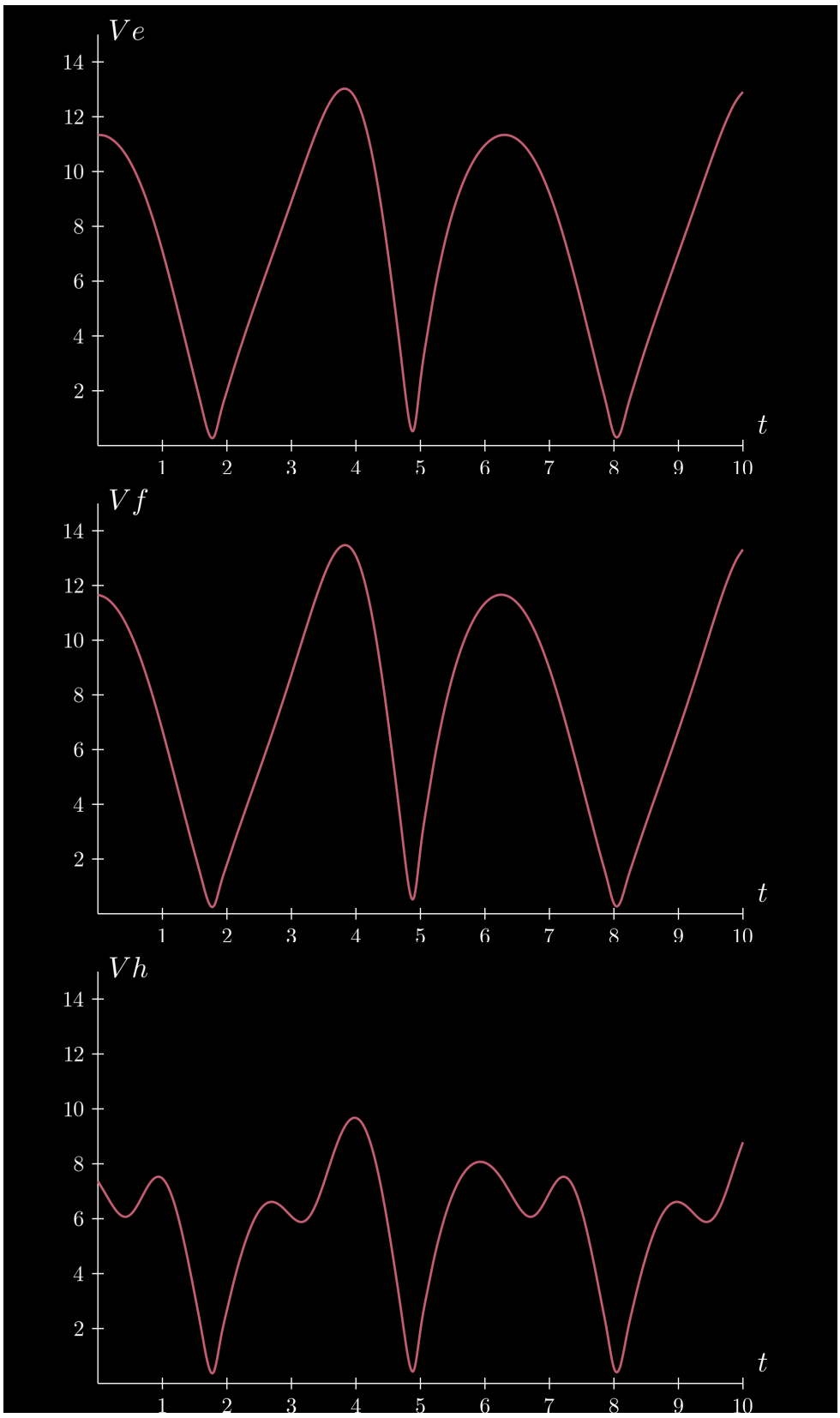
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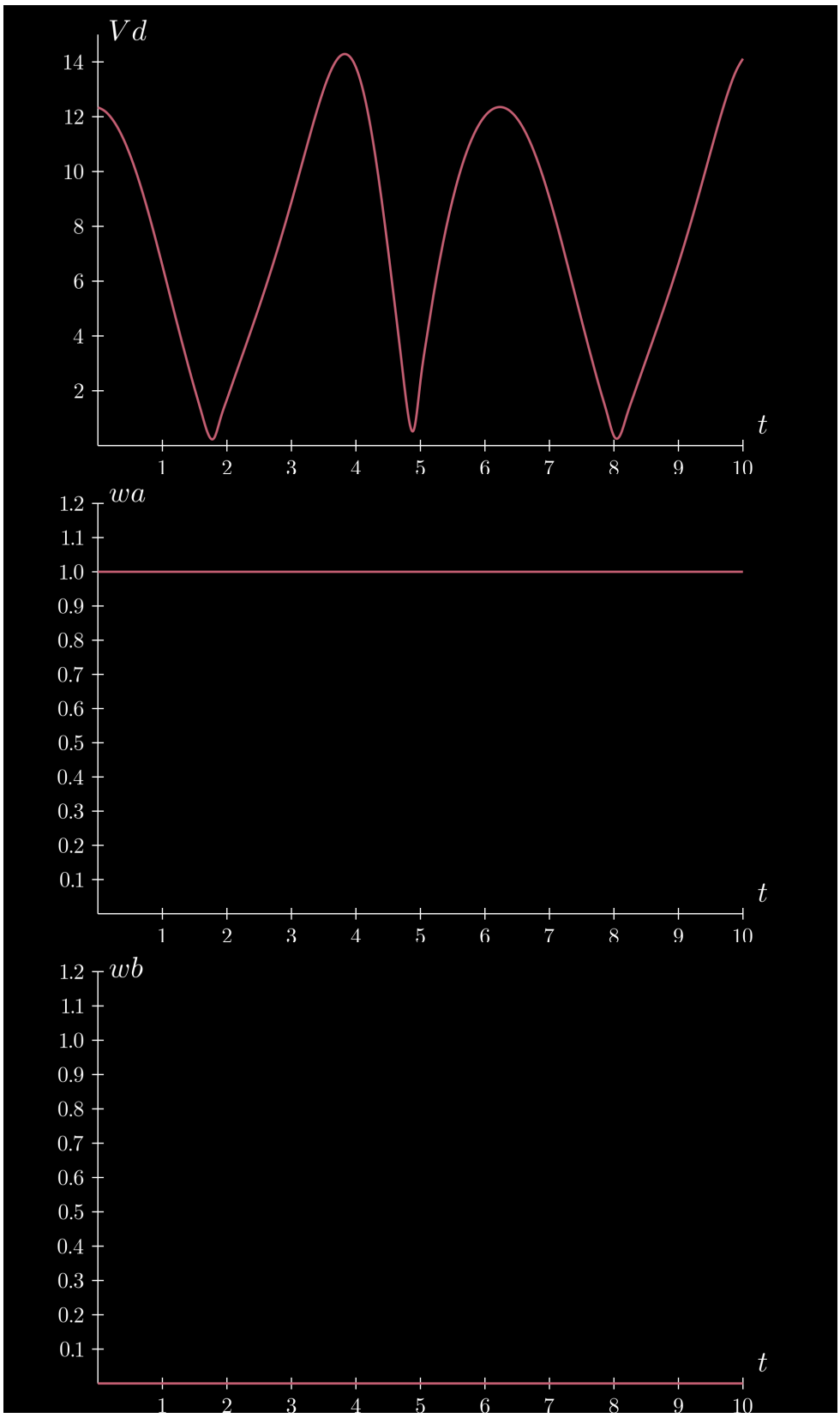
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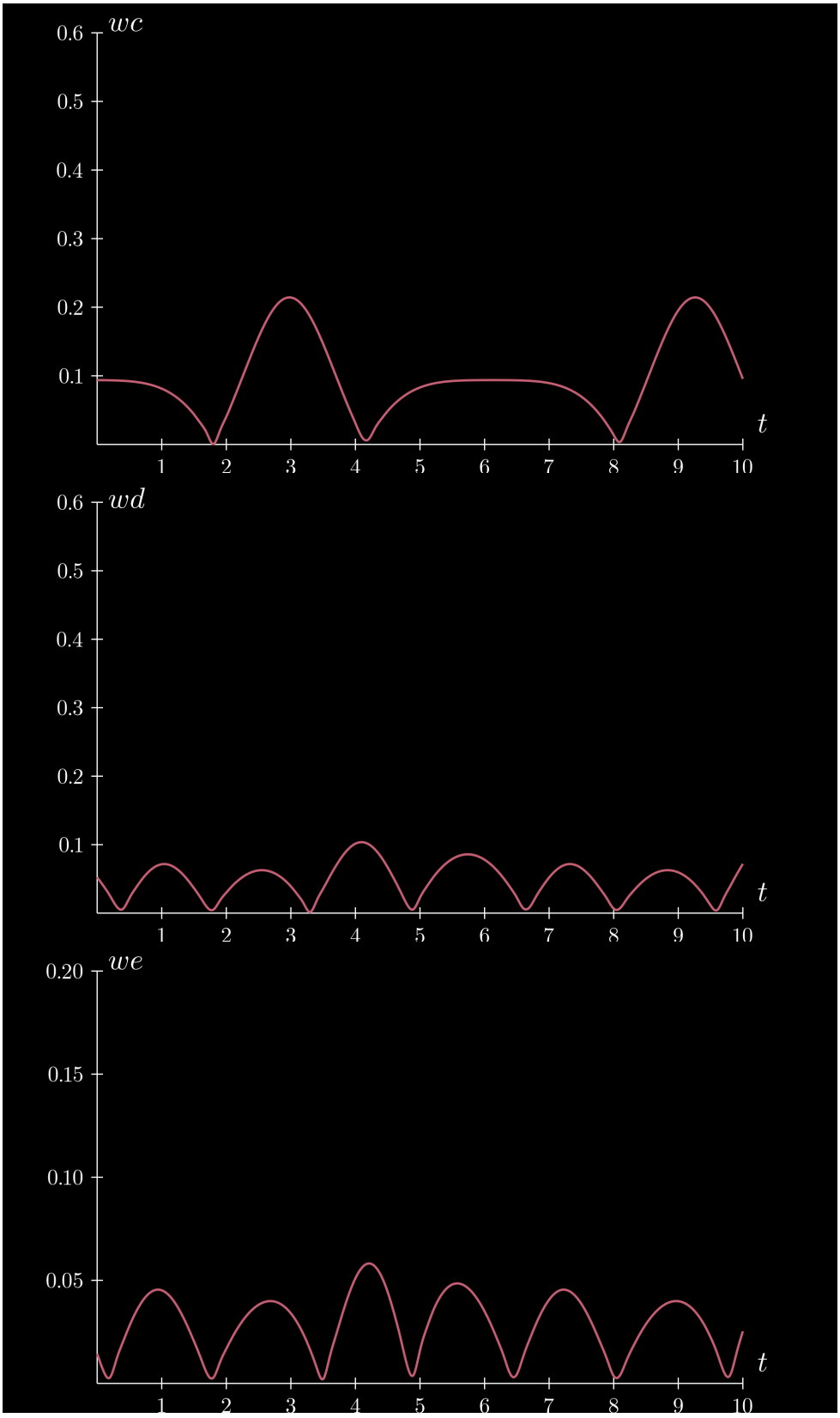
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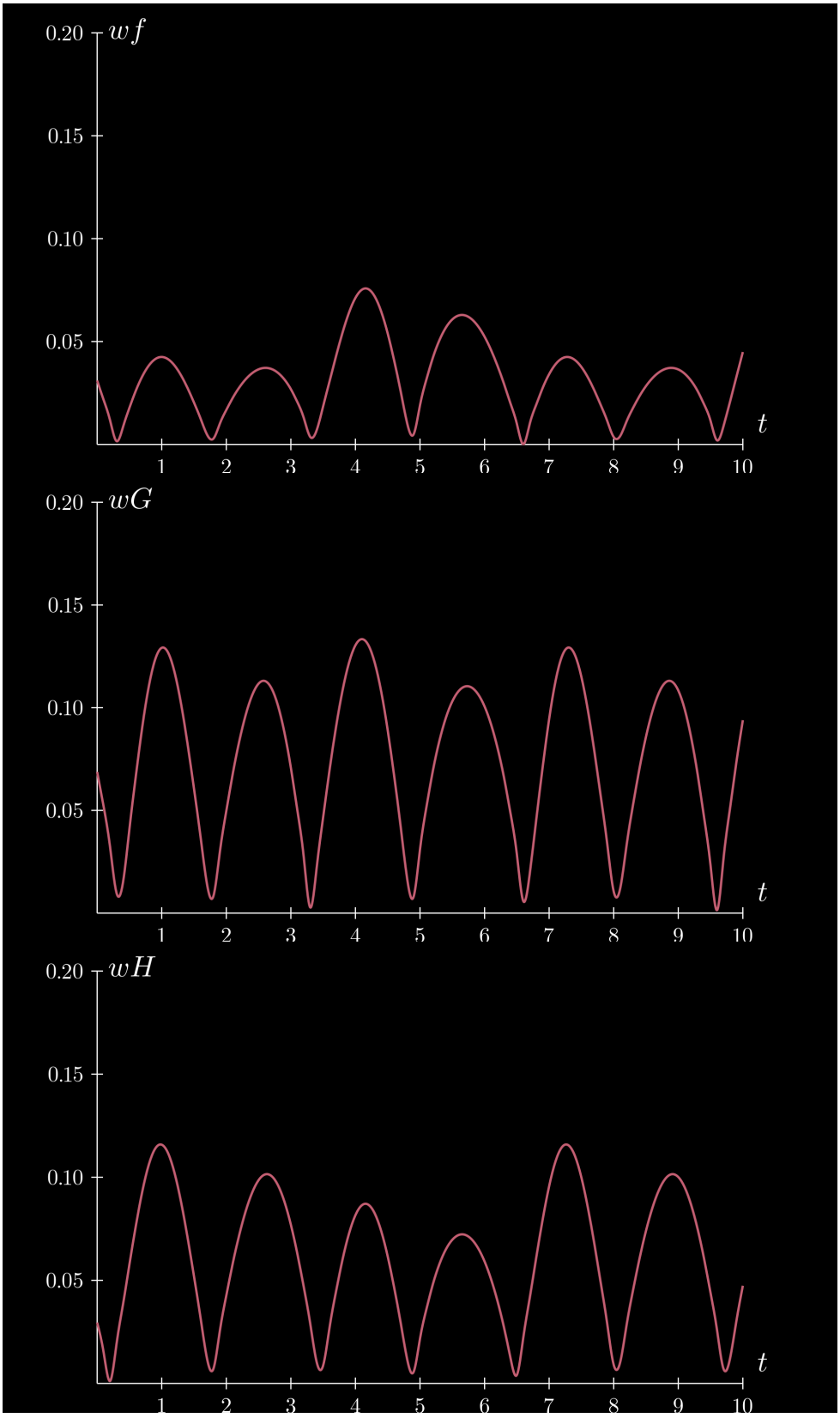
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