MECHANICS

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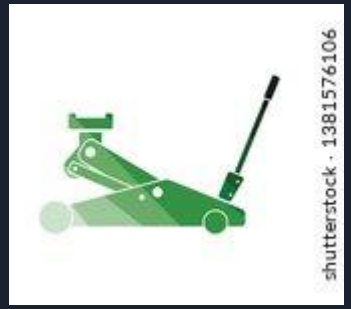
ABSTRACT

- The history of mechanics is a great part of mechanical engineering.
- This started around the time of Aristotle and many of his concepts have been proven wrong.
- Later, in the third century BC it was Archimedes who contributed so much to the world of mechanics and invented many machines as well.
- Many breakthroughs followed during the times of Galileo. His principles as well as Newtons have been used profoundly in the world of mechanical engineers.

REAL WORLD APPLICATION

Hydraulic jack, this is used to be able to lift and lower a car off a floor. Under the floor of the shop is a chamber of fluid, and with either end with two large cylinders each with a piston and a valves. When one applies force by pressing down the piston in one cylinder this causes an output in the other cylinder that pushes up and raises the car.



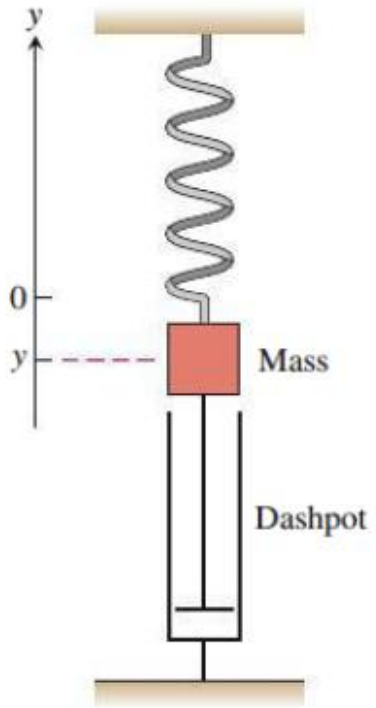
A Dashpot is a mechanical device, a damper which resists motion via viscous friction. The resulting force is proportional to the velocity and acts in the opposite direction

QUESTION

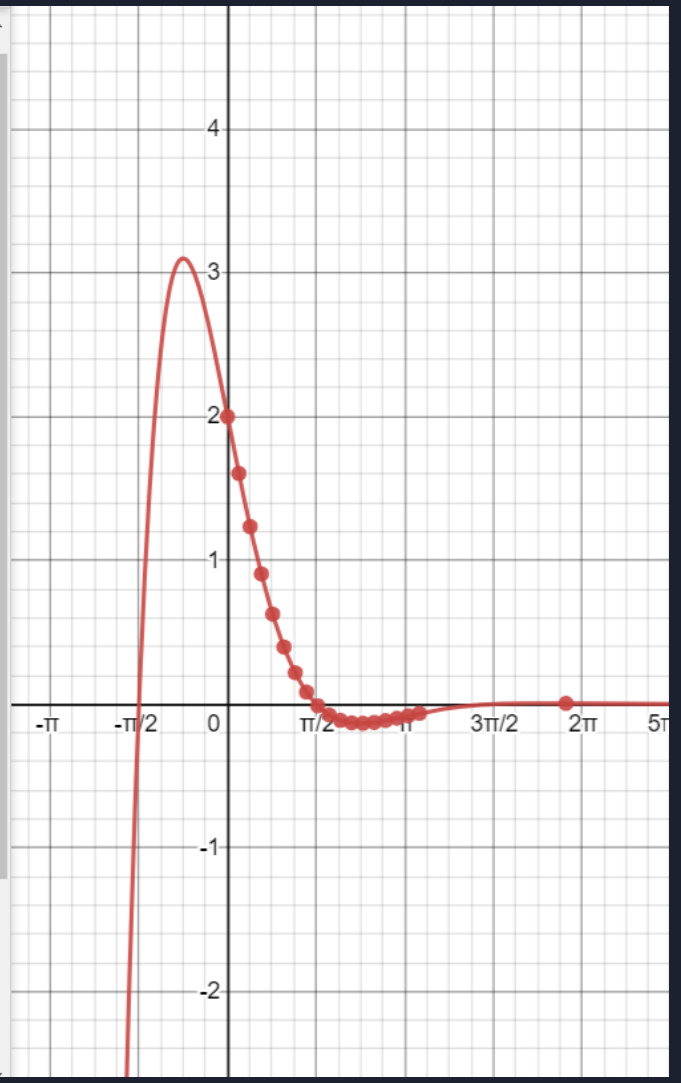
65. Average value A retarding force, symbolized by the dashpot in the accompanying figure, slows the motion of the weighted spring so that the mass's position at time t is

$$y = 2e^{-t}\cos t, \qquad t \geq 0.$$

Find the average value of y over the interval $0 \leq t \leq 2\pi$.



t	$2e^{-t}\cos t$
0	2
.2	1.6048213
.4	1.2348113
.6	0.90590758
.8	0.62610101
1	0.39753222
1.2	0.21828012
1.4	0.083826763
1.6	−0.011790564
1.8	−0.075112507
2.0	−0.1126387
2.2	−0.13041556
2.4	−0.1337897
2.6	−0.12728839
2.8	−0.1145932
3	−0.098577648
3.2	−0.081385391
3.4	−0.064530434
6	0.0047600484



$$y = \frac{1}{b-a}\int_a^b f(t)\,dt$$

$$f(t) = e^{-t}\cos(t)\,, a = 0, b = 2\pi$$

$$= \frac{1}{2\pi - 0}\int_0^{2\pi} 2e^{-t}\cos(t)\,dt$$

$$= \frac{1}{2\pi}\int_0^{2\pi} 2e^{-t}\cos(t)\,dt$$

$$= \int e^{at}\cos(bt)(dt) = \frac{e^{at}}{a^2 + b^2}[\mathrm{acos}(bt) + bsin(bt)] + c$$

$$= \frac{2}{2\pi}\left(\frac{e^{-t}}{(t)^2 + (1)^2}(-\cos(t) + \sin(t))\right.$$

$$= \frac{1}{\pi}\left(\frac{e^{-t}}{2}(\sin(\mathrm{t}) - \cos(\mathrm{t}))\right|_0^{2\pi}$$

$$= \frac{1}{2\pi}(e^{-2\pi}(0 - 1) - (0 - 1))$$

$$= \frac{1}{2\pi}(1 - e^{-2\pi}) \approx 0.15886$$

REFERENCES

https://www.isotechinc.com/product-category/air-cylinders-actuators/dashpots/

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- "Fluid Mechanics - Real-Life Applications." *Science Clarified*, www.scienceclarified.com/everyday/Real-Life-Chemistry-Vol-3-Physics-Vol-1/Fluid-Mechanics-Real-life-applications.html.

L0021979 Galileo Galilei (1564-1642). Oil painting after JustusCredit: Wellcome Library, London. Wellcome Images images@wellcome.ac.uk http://wellcomeimages.org Galileo Galilei (1564-1642). Oil painting after Justus Sustermans, 1635. Oil By: Justus SustermansPublished: - Copyrighted work available under Creative Commons Attribution only licence CC BY 4.0 http://creativecommons.org/licenses/by/4.0/

https://en.wikipedia.org/wiki/Dashpot#:~:text=A%20dashpot%20is%20a%20mechanical,which%20acts%20to%20resist%20displacement).