17 March (Shift 2) – Single Correct

A block of mass 1 kg attached to a spring is made to oscillate with an initial amplitude of 12 cm. After 2 minutes the amplitude decreases to 6 cm. Determine the value of the damping constant for this motion (take ln2 = 0.693)

(1) $0.69 \times 10^2\ kg\ s^{-1}$

(2) $3.3 \times 10^2\ kg\ s^{-1}$

(3) $1.16 \times 10^{-2}\ kg\ s^{-1}$

(4) $5.7 \times 10^{-2}\ kg\ s^{-1}$

SOLUTION:

from the lecture notes / lectures,

the amplitude for damped oscillation

$A = A_0 e^{\frac{-bt}{2m}}$ where b is damping constant

Given at $t = 2$ minutes

$$A = \frac{A_0}{2} \left(\frac{12}{2} = 6 \right)$$

so, $\frac{A_0}{2} = A_0 e^{\frac{-bt}{2m}} \Rightarrow \ln 2 = \frac{bt}{2m}$

so, $b = \frac{2m \ln 2}{t}$

$$= \frac{2 \times 1 \times 0.693}{2 \times 60}$$

$$= 0.01155$$

$$\approx 1.16 \times 10^{-2} \, kgs^{-1}$$