

First Name: _____

Last Name: _____

L06 - FQ - Elastic Potential Energy

Q1: In preparing to shoot an arrow, an archer pulls a bowstring back 0.51 m by exerting a force that increases uniformly from 0 to 215 N. What is the equivalent spring constant of the bow?

- a. 110 N/m
- b. 211 N/m
- c. 422 N/m
- d. 1653 N/m

$$F = kx$$

$$215 = k(0.51)$$

$$k = 421.569 \text{ N/m}$$

Use the following information to answer Q2-Q3:

An archer pulls their bowstring, which has a spring constant of 350 N/m, back a distance of 0.46 m.

Q2: How much potential energy is stored in that bowstring?

- a. $3.70 \times 10^1 \text{ J}$
- b. $7.41 \times 10^1 \text{ J}$
- c. $8.05 \times 10^1 \text{ J}$
- d. $1.61 \times 10^2 \text{ J}$

$$E_p = \frac{1}{2}kx^2$$

$$= \frac{1}{2}(350)(0.46)^2$$

$$= 37.03 \text{ J}$$

$$= 3.703 \times 10^1 \text{ J}$$

Q3: If the arrow has a mass of 25.0 grams, and all the elastic potential energy of the system was successfully transferred into the arrow, then the arrow is released with an initial speed of $a.bc \times 10^d \text{ m/s}$, where a , b , c , and d are ____, ____, ____, and ____.

(Record your **three-digit** answer in the Numerical Response boxes below)

5	4	4	1
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$$E_p \rightarrow E_k$$

$$37.03 = \frac{1}{2}(0.025)v^2$$

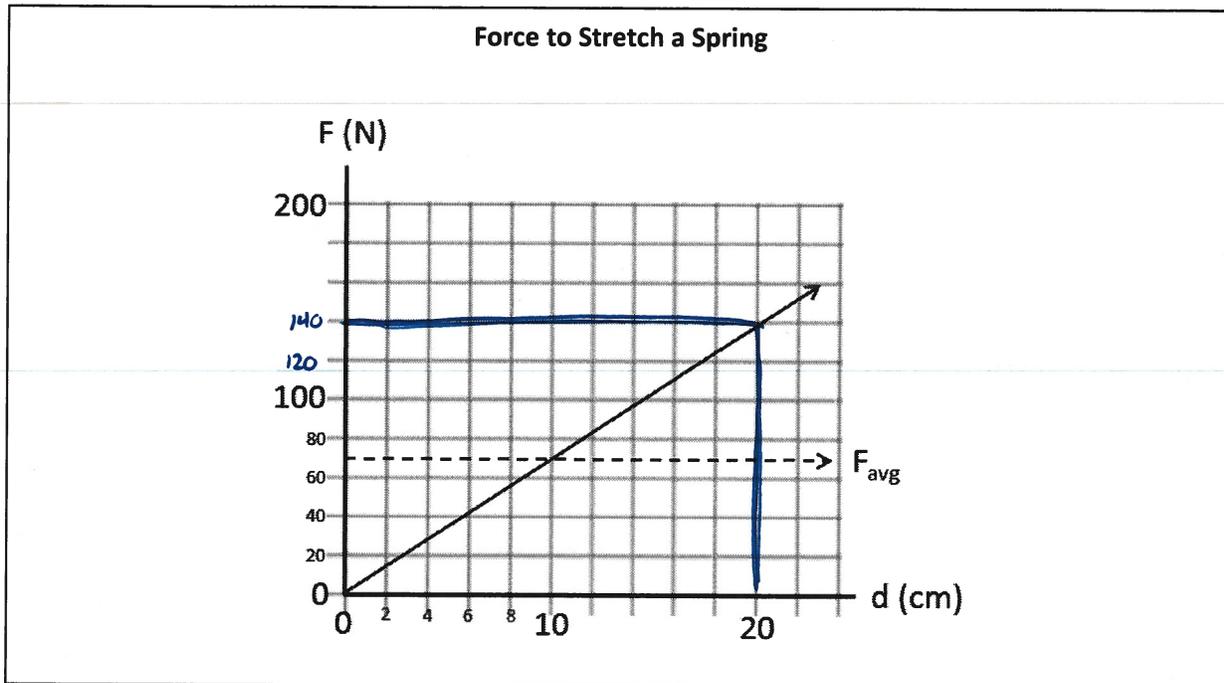
$$v^2 = 2962.4$$

$$v = 54.4 \text{ m/s}$$

$$v = 5.44 \times 10^1 \text{ m/s}$$

KEY

Use the following information to answer Q4-Q5:



Q4: When the spring is stretched 20cm from equilibrium there is $a.bc \times 10^d$ Joules of energy stored in the spring, where a , b , c , and d are __, __, __, and __.

(Record your **four-digit** answer in the Numerical Response boxes below)

1	4	0	1
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$$F = kx$$

$$140 = k(0.2)$$

$$k = 700 \text{ N/m}$$

$$E_k = \frac{1}{2}kx^2$$

$$= \frac{1}{2}(700)(0.2)^2$$

$$= 14 \text{ J}$$

$$\approx 1.40 \times 10^1 \text{ J}$$

Alternate

Work = ΔE = Area under graph

$$\Delta E = \frac{1}{2}bh = \frac{1}{2}(0.2)(140)$$

$$\Delta E = 14 \text{ J}$$

$$= 1.40 \times 10^1 \text{ J}$$

Q5: How much force is required to stretch the spring to a distance of 45 cm? (2 marks)

$$F = kx$$

$$= (700)(0.45)$$

$$\boxed{F = 315 \text{ N}}$$

MARKING:

Beginning	0	-	2.5
Progressing	3	-	4
Competent	4.5	-	5
Exemplary	5.5	-	6