

First Name: _____

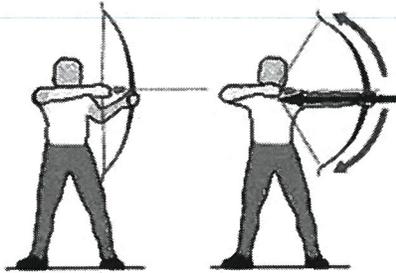
Last Name: _____

1.09 – Worksheet – Practice Summative Quiz

/12 marks

Use the following information to answer Q1-Q2:

An archer is using a recurve bow of spring constant 480 N/m, and pulls the bow back 0.85m.



Q1: The archer is applying a force of $a.bc \times 10^d$ Newtons to the bow, where a , b , c , and d are ____, ____, ____, and ____.

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

4	0	8	2
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$$\begin{aligned}
 F &= kx \\
 &= (480 \text{ N/m})(0.85) \\
 &= 408 \text{ N} \\
 &= 4.08 \times 10^2 \text{ N}
 \end{aligned}$$

Q2: If the archer pulls back an additional 0.15m, how much additional work does this take?

- (a) 66.6 J
- b. 72.0 J
- c. 173.4 J
- d. 240.0 J

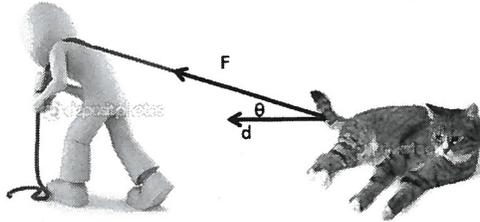
$$\begin{aligned}
 E_{P_i} &= \frac{1}{2} k x_i^2 \\
 &= \frac{1}{2} (480)(0.85)^2 \\
 &= 173.4 \text{ J}
 \end{aligned}$$

$$\begin{aligned}
 E_{P_f} &= \frac{1}{2} k x_f^2 \\
 &= \frac{1}{2} (480)(1)^2 \\
 &= 240.0 \text{ J}
 \end{aligned}$$

$$\text{Work} = \Delta E = 66.6 \text{ J}$$

Use the following information to answer Q3:

A person applying a force of 8.00 N moves a cat a distance of 30.0 meters. The person does 200J of work.



Q3: At what angle above the horizontal was the force applied?

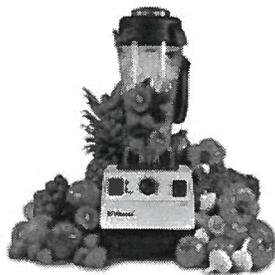
(Record your **three digit** answer in the Numerical Response boxes below)

33.6

$$\begin{aligned}
 W &= |F||d| \cos \theta \\
 200 &= (8)(30) \cos \theta \\
 200 &= 240 \cos \theta \\
 0.8\bar{3} &= \cos \theta \\
 \theta &= \cos^{-1}(0.8\bar{3}) \\
 \theta &\approx 33.6^\circ
 \end{aligned}$$

Use the following information to answer Q4:

The Vitamix © 5200 Blender, depicted below, is rated at 1380W. It has a blade of radial length 3.8cm (0.038m), where the tip of the blade can spin up to 240mph (107m/s).



Q4: If it takes 30 seconds to crush ice, how much energy is being used?

- a. 4.60×10^1 J
- b. 1.73×10^2 J
- c. 4.14×10^4 J
- d. 1.56×10^5 J

$$\begin{aligned}
 P &= \frac{\Delta E}{\Delta t} \quad \Rightarrow \quad \Delta E = P \Delta t \\
 &= (1380)(30) \\
 &= 41,400 \text{ J} \\
 &= 4.14 \times 10^4 \text{ J}
 \end{aligned}$$

Use the following information to answer Q5-Q6:

Depicted below is the "Kingda Ka" rollercoaster, located in Jackson, New Jersey. The cars are initially accelerated up to 206 km/h (57.2 m/s) while at the base of the rollercoaster, then travel vertically up a 139m tall track.



Q5: How fast are the cars going at the top of the track?

- a. 11.7 m/s
- (b.) 23.3 m/s**
- c. 43.7 m/s
- d. 57.2 m/s

$$\begin{aligned}
 E_{ki} &\rightarrow E_{pf} + E_{kf} \\
 \frac{1}{2}mv_i^2 &= mgh_f + \frac{1}{2}mv_f^2 \\
 \frac{1}{2}(57.2)^2 &= (9.81)(139) + \frac{1}{2}v_f^2 \\
 1635.92 &= 1363.59 + \frac{1}{2}v_f^2 \\
 272.33 &= \frac{1}{2}v_f^2 \\
 v_f &= 23.3 \text{ m/s}
 \end{aligned}$$

Q6: If the cars were actually only going 18.0 m/s at the top, what is the energy efficiency? (2 marks)

$$\begin{aligned}
 E_{ki} &= \frac{1}{2}mv_i^2 \\
 &= \frac{1}{2}m(57.2)^2 \\
 &= (1635.92)m
 \end{aligned}$$

$$\begin{aligned}
 E_{kf} &= \frac{1}{2}mv_f^2 \\
 &= \frac{1}{2}m(18)^2 \\
 &= (162)m
 \end{aligned}$$

$$\begin{aligned}
 E_{pf} &= mgh \\
 &= m(9.81)(139) \\
 &= (1363.59)m
 \end{aligned}$$

$$\begin{aligned}
 \text{Eff}(\%) &= \frac{\text{Useful } E_{out}}{\text{Total } E_{in}} \times 100\% = \frac{162m + 1363.59m}{1635.92m} \times 100\% \\
 &= \frac{(1525.59)m}{(1635.92)m} \times 100\% = \boxed{93.3\%}
 \end{aligned}$$

Use the following information to answer Q7-Q8:

An archer does 117 Joules of work to stretch a bow backward 0.85m, then releases a 28 gram arrow, shooting it vertically. Assume that the bow & arrow is 100% energy efficient.



Q7: What is the initial speed of the arrow after it is release, in the form $a.bc \times 10^d$ m/s?

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

9	1	4	1
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$$E_p \rightarrow E_k$$

$$117 \text{ J} = \frac{1}{2} (0.028) v^2$$

$$v = 91.4 \text{ m/s}$$

$$v = 9.14 \times 10^1 \text{ m/s}$$

Q8: What is the spring constant of the bow?

a. 81.0 N/m

b. 137.6 N/m

c. 169.1 N/m

d. 323.9 N/m

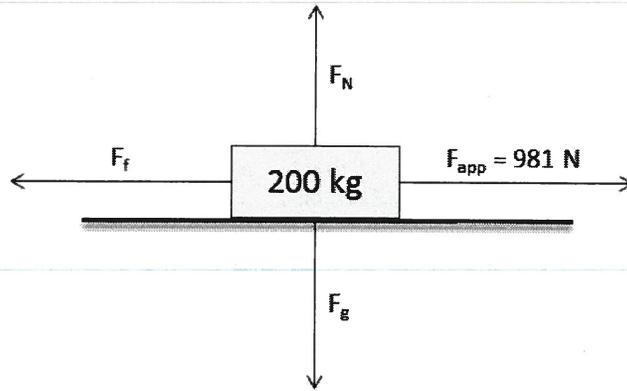
$$E_p = \frac{1}{2} k x^2$$

$$117 = \frac{1}{2} (k) (0.85)^2$$

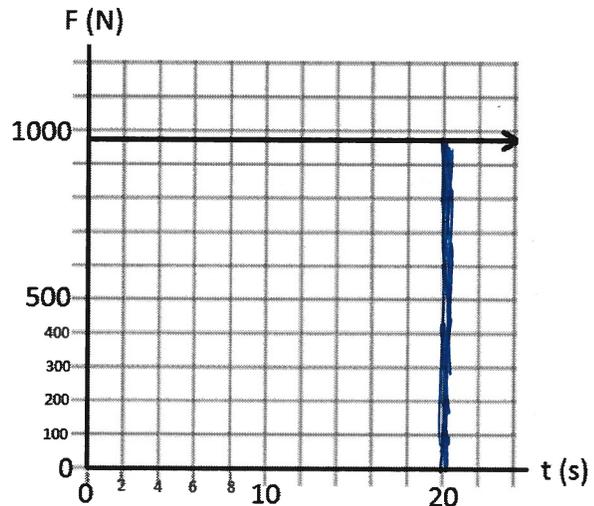
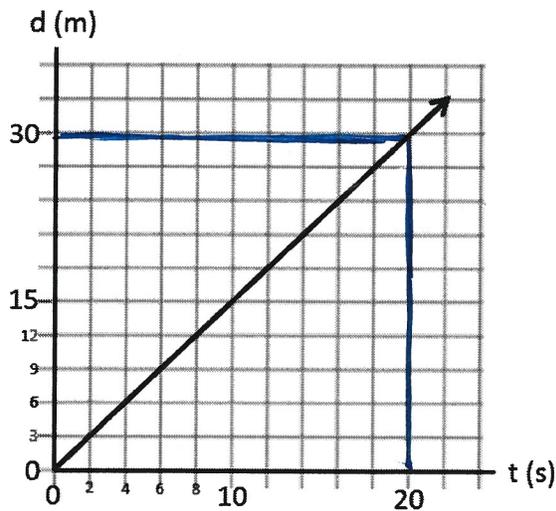
$$k = 323.9 \text{ N/m}$$

Use the following information to answer Q9:

A 200kg block sitting on a rough surface has a 981 N force applied to it.



The position of the block and the force acting on the block are both graphed as a function of time.



Q9: How many watts of power were required to push the object for 20 seconds? (2 marks)

@ 20 sec

$$d = 30 \text{ m}$$

$$t = 20 \text{ s}$$

$$F = 981 \text{ N}$$

Option #1

$$\begin{aligned} W_{\text{work}} &= Fd \\ &= (981)(30) \\ &= 29,430 \text{ J} \end{aligned}$$

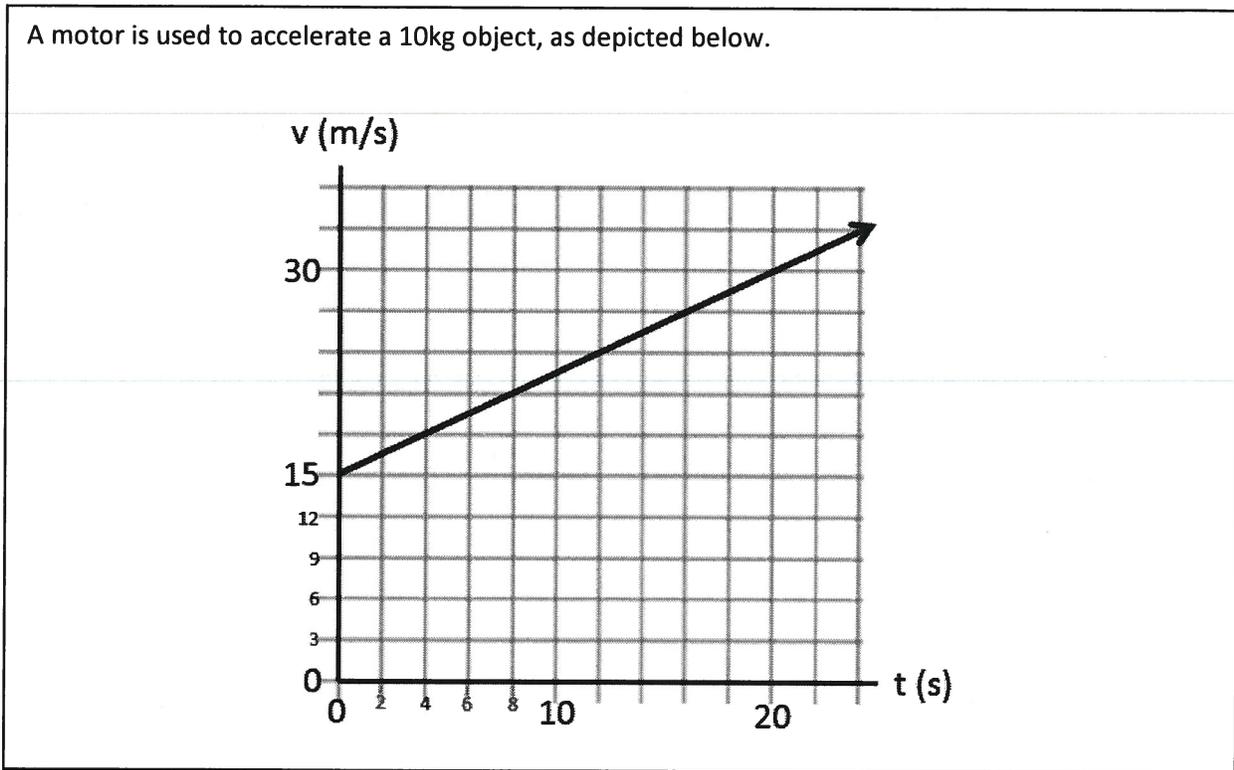
$$P = \frac{W_{\text{work}}}{t} = \frac{29,430}{20 \text{ s}}$$

$$P = 1471.5 \text{ W}$$

Option #2

$$\begin{aligned} W_{\text{work}} &= Fv_{\text{avg}} \\ &= (981) \frac{d}{t} \\ &= \frac{(981)(30)}{(20)} \\ &= 1471.5 \text{ W} \end{aligned}$$

Use the following information to answer Q10:



Q10: How much work was done to accelerate the object over the first 20 seconds?

- a. 450 J
- b. 1125 J
- c. 3375 J**
- d. 4500 J

Initial

$$E_{ki} = \frac{1}{2}mv_i^2$$

$$= \frac{1}{2}(10)(15)^2$$

$$= 1125 \text{ J}$$

Final

$$E_{kf} = \frac{1}{2}mv_f^2$$

$$= \frac{1}{2}(10)(30)^2$$

$$= 4500 \text{ J}$$

$$\text{Work} = \Delta E = 3375 \text{ J}$$

OPTION #2

$$v_f^2 = v_i^2 + 2ad$$

↓

$$30^2 = 15^2 + 2(0.75)d$$

$$d = 450 \text{ m}$$

$$a = \frac{v_f - v_i}{t} \Rightarrow a = \frac{30 - 15}{20} = 0.75 \text{ m/s}^2$$

↓

$$F = ma$$

$$= (10)(0.75)$$

$$= 7.5 \text{ N}$$

$$\text{Work} = Fd$$

$$= (7.5)(450)$$

$$= 3375 \text{ J}$$