KEY

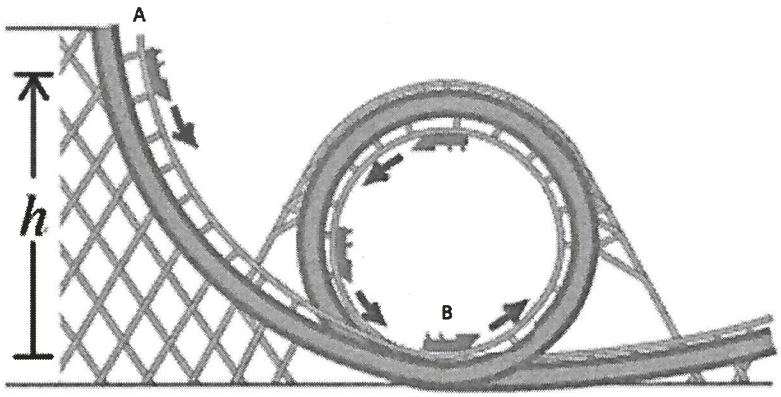
First Name:_____ Last Name:_____

L16 – Worksheet – Unit Review /12 marks

Part 1: Work and Energy

Use the following information to answer Q1-Q2:

A rollercoaster car of mass 2000kg is originally stationary at *Position A*. As the rollercoaster descends to *Position B*, it loses approximately 30% of its mechanical energy due to thermal energy loss, and arrives at *Position B* travelling at 15 m/s.



Q1: At *Position B*, the rollercoaster has ***a.bc*** x 10^{d} Joules of kinetic energy, where ***a, b, c,*** and ***d*** are ___, ___, ___, and ___.

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

2	2	5	5

Top
$E_p = mgh$
$= (2000)(9.81)(h)$

Bottom
$E_K = \frac{1}{2}mv^2$
$= \frac{1}{2}(2000)(15)^2$
$= 225{,}000\ J$
$= 2.25 \times 10^5\ J$

Q2: *(Long Answer)* From what height did the rollercoaster descend? *(2 marks)*

$Eff(\%) = \frac{\text{Useful } E_{out}}{\text{Total } E_{in}} \times 100\%$

$70\% = \frac{225{,}000}{E_{in}} \times 100\%$

$(0.7)(E_{in}) = 225{,}000$

$E_{in} = 321{,}428.571429$

$E_{in} = E_p = mgh$

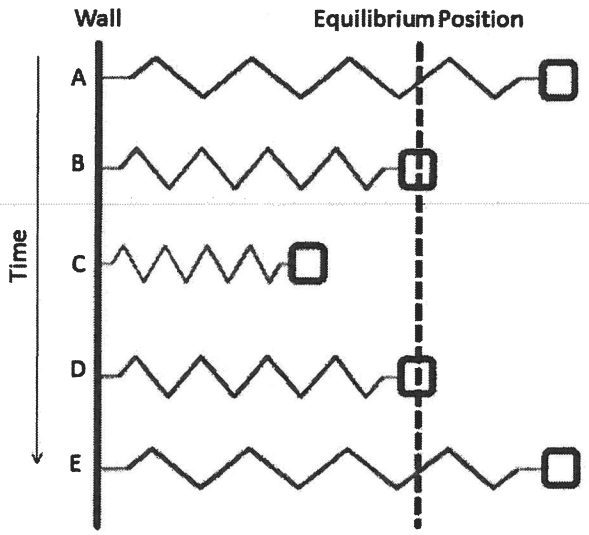
$321{,}428.571429 = (2000)(9.81)\,h$

$h = 16.38\ m$

KEY

Use the following information to answer Q3-Q6

A spring with a 200g mass is attached to a wall, pulled 15cm to the right of its equilibrium position (Position A), released and allowed to complete one full oscillation, as depicted below from a top-view.



$m = 0.2\,kg$

$x_{max} = 0.15m$

Magnitude

1 – Maximum

2 – Minimum

Q3: Use the Numerical Response numbers to identify whether each quantity is a maximum or minimum.

Magnitude:	2	1	1	1
Quantity:	**Speed at Position A**	**Acceleration at Position A**	**Speed at Position B**	**Restoring Force Position C**

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

2	1	1	1

Q4: *(Long Answer)* Draw a Free-Body-Diagram for the object while it is at Position C. Label all relevant forces. *(1 mark)*

KEY

Q5: If there is 2.25J of energy while the spring is in *Position A*, how much force is the person exerting to hold it in place?

a. 1.7×10^{-3} N
b. 1.7×10^{-1} N
c. 3.0×10^{-1} N
(d.) 3.0×10^{1} N

$E_p = \frac{1}{2}kx^2$
$2.25 = \frac{1}{2}k(0.15)^2$
$k = 200\ N/m$

$F = kx$
$= (200)(0.15)$
$= 30N$
$\approx 3.0 \times 10^1 N$

Q6: What is the ~~speed~~ of the 200g mass while it passes through *Position D*?

a. 0.15 m/s
(b.) 4.74 m/s
c. 15.0 m/s
d. 17.3 m/s

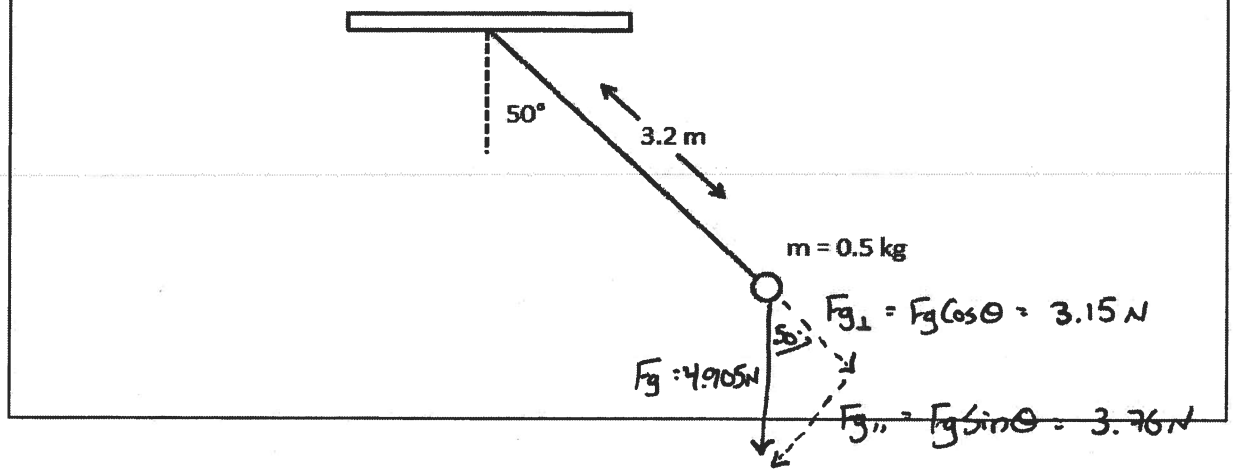
$E_p \rightarrow E_K$
$2.25 = \frac{1}{2}mv^2$
$2.25 = \frac{1}{2}(0.2)v^2$
$22.5 = v^2$
$v = 4.74\ m/s$

KEY

Part 2: Oscillatory Motion

Use the following information to answer Q7-Q8:

A pendulum arm of length 3.2m is pulled 50° to the right of its equilibrium position and released, as shown in *Diagram 1* below.



Q7: What is the tension in the rope when momentarily 50° from equilibrium, a split second after being released?

a. 3.15 N
b. 3.76 N
c. 4.91 N
d. 5.85 N

Q8: How many cycles does the pendulum make in 600 seconds?

a. 5.98×10^{-3}
b. 2.79×10^{-1}
c. 3.59
d. 1.67×10^{2}

$T = 2\pi\sqrt{\frac{L}{g}} = 2\pi\sqrt{\frac{3.2}{9.81}} = 3.589s$

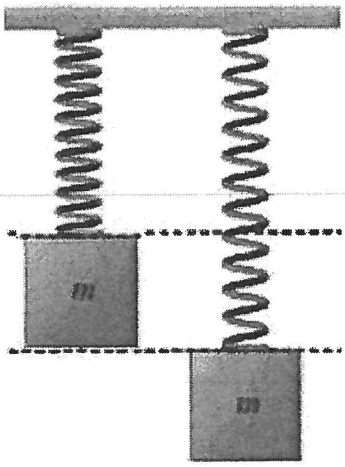
$600 \div 3.589 = 167.2$ cycles

$\approx 1.67 \times 10^2$ cycles

Key

Use the following information to answer Q9-Q10:

A 5.4kg mass suspended from a spring of spring constant 8.6 N/m, and is originally stationary. The spring is then stretched 1.3m [down] and released, causing the mass to oscillate, as seen below in *Diagram 2*.



Q9: *(Long Answer)* What is the maximum speed of the oscillating mass? *(2 marks)*

$E_p \rightarrow E_K$

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

$kx^2 = mv^2$

$(8.6)(1.3)^2 = (5.4)v^2$

$v^2 = 2.69$

$v = 1.64057 \text{ m/s}$

$v \approx 1.64 \text{ m/s}$

Q10: What is the instantaneous acceleration of the mass, in m/s^2, when it is travelling at maximum velocity?

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

0	.	0	0

Max velocity when no stretch (no E_p, all E_K).

$a = \frac{F}{m} = \frac{kx}{m}$ so acceleration $= 0$ when $x = 0$.

$a = 0.00 \text{ m/s}^2$