Name:_________________

Assignment due:

St Patrick's College, Silverstream

PHYSICS

Mechanics Assignment 7

Energy, "Hooke's Law", Power

Level 2

90255 Demonstrate understanding of mechanics

You may find the following formulae useful

$v = \frac{\Delta d}{\Delta t}$	$a = \frac{\Delta v}{\Delta t}$	$v_f = v_i + at$
$d = v_i t + \frac{1}{2}at^2$	$d = \frac{v_i + v_f}{2}t$	$v_f^2 = v_i^2 + 2ad$
$a_c = \frac{v^2}{r}$		
$F = ma$	$\tau = Fd$	$F = -kx$
$F_c = \frac{mv^2}{r}$	$p = mv$	$\Delta p = F\Delta t$
$E_p = \frac{1}{2}kx^2$	$E_k = \frac{1}{2}mv^2$	$\Delta E_p = mg\Delta h$
$W = Fd$	$P = \frac{W}{t}$	

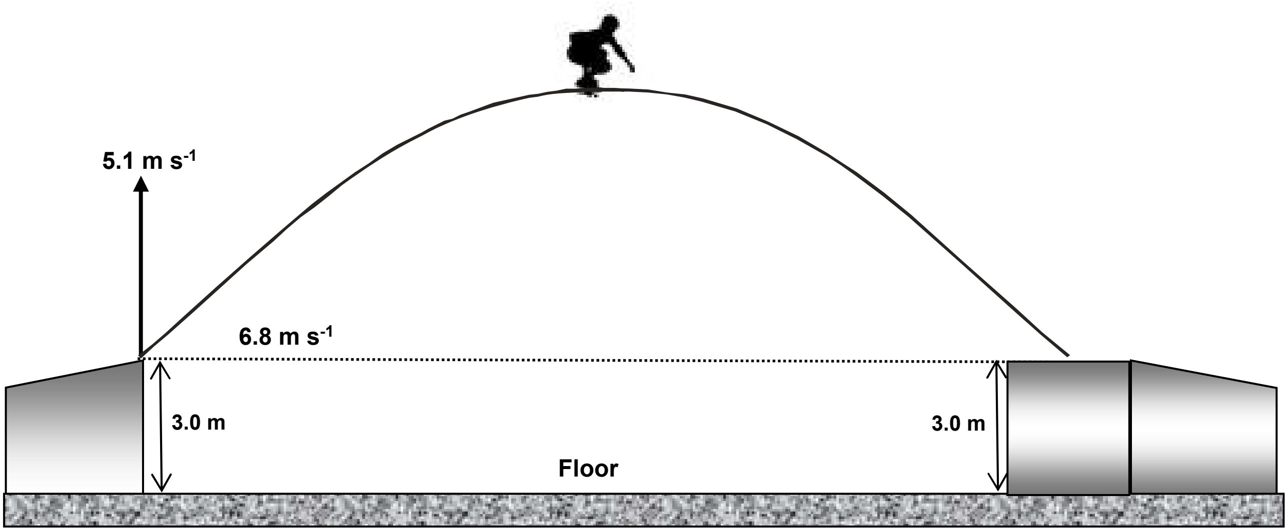
g = 9.8ms^{-2}

Assessor's use only

NZIP 2008

QUESTION TWO: SKATEBOARD SKILLS AND THRILLS

Monica is performing a jump in a skateboarding competition. She jumps across the gap between two ramps as shown in the diagram below. Her initial vertical velocity for the jump is 5.1 ms^{-1} and her horizontal velocity across the gap is 6.8 ms^{-1} and. She lands at the same horizontal level as her take off point.



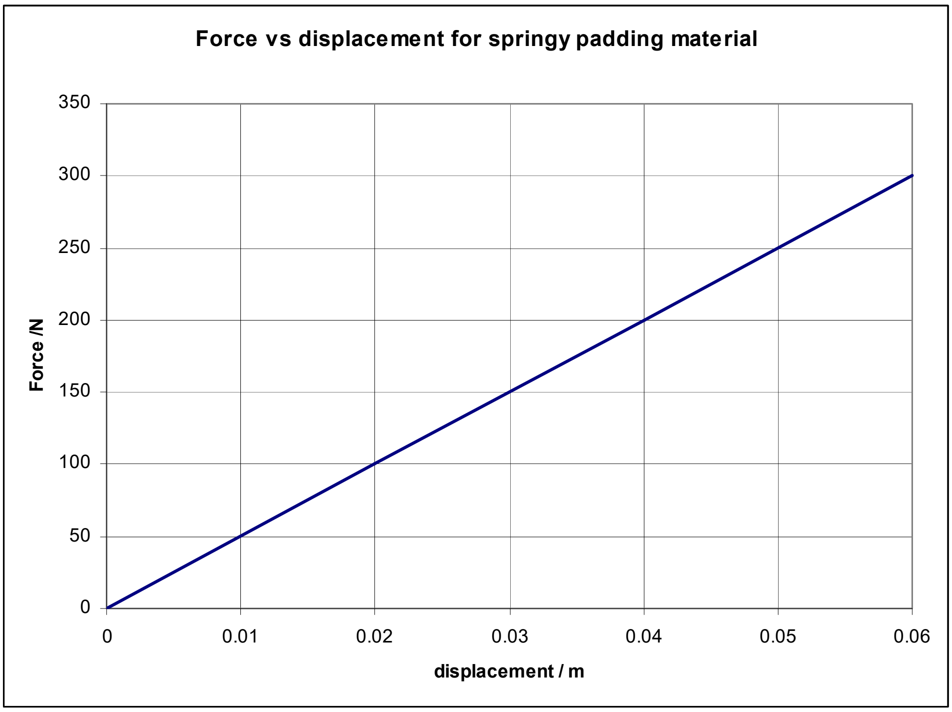
(f) The point where Monica took off from the first ramp is 3.0 m above the floor level. Her mass is 30.0 kg and the diagram shows her position at the maximum height. Calculate **Monica's** gravitational potential energy when she is at the maximum height, with respect to the **floor**.

energy = ____________________

NZIP 2008

QUESTION THREE: CRASH HELMET TESTING

For safety reasons crash helmets are lined with padding materials. The padding material used inside a helmet was tested for its cushioning effect in a laboratory. The result is shown in the graph.



(a) Use the graph to calculate the spring constant of the padding material. Give the appropriate unit for your answer.

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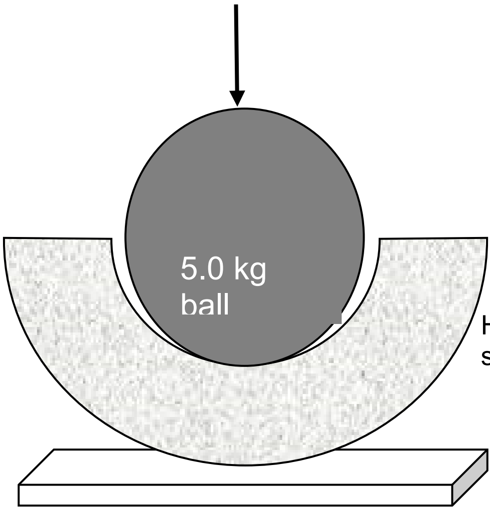
spring constant = ____________

unit = ______________________

A high impact crash helmet is glued onto a floor and a 5.0 kg steel ball is dropped from a certain height into the helmet padding as shown in the diagram. The ball hits the helmet padding at 0.85 ms^{-1}. The spring constant of the padding material is 35 $kN\ m^{-1}$.



(b) Calculate the distance of the padding material compressed by the ball before it comes to a stop. Assume that no energy transferred as heat.

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distance = ________________________

QUESTION ONE: BOATING

Tom and Jill are paddling a canoe across a lake. The **total mass** of Tom, Jill and their boat is 190 kg.

(a) In the photograph they are accelerating from a speed of 0.5 m s^{-1} to a speed of 3.5 m s^{-1} in 9.50 s.

Calculate their **acceleration**.

Write your answer to the correct number of **significant figures**.

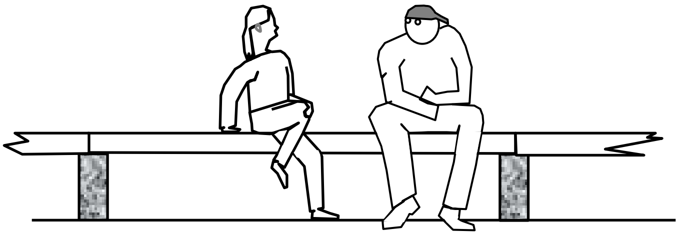
(b) Calculate the **distance** Tom and Jill travels while they are accelerating from a speed of 0.5 m s^{-1} to a speed of 3.5 m s^{-1} in 9.50 s.

(c) Calculate the minimum average power Tom and Jill must produce together to cause this acceleration. Write your answer with the correct **unit**.

(d) Explain clearly why the average power Tom and Jill must actually produce together will be **greater** than that which you calculated in (c).

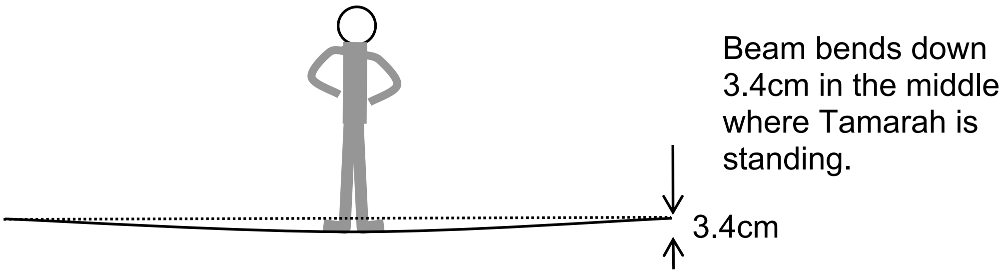
NZIP 2006
QUESTION FOUR: SITTING IN THE STAND

Aaron and Tamarah sat on a wooden seat in the stand to watch the cricket.



The wooden seat consisted of a **3.2m** long beam which had a weight of **130N**. When Tamarah, whose weight was **520N**, stood on the beam at the mid point the beam bent **3.4cm**.

(a) Draw and label arrows onto the diagram below to show the forces acting in this situation.



(b) Calculate the spring constant of the beam.

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(c) Calculate the Elastic potential energy stored in the beam when it is bent **3.4cm**.

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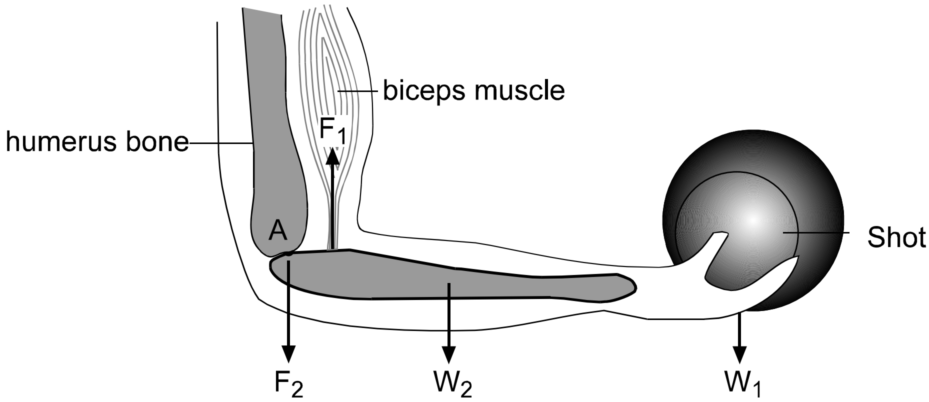
______________________ Elastic Potential Energy = ____________________

NZIP 2005

QUESTION ONE: FORCES AND EQUILIBRIUM. The shot putter

A shot putter holds a shot of mass 7.0kg in the palm of her hand. Her upper arm is vertical and her forearm (mass 1.5kg) is horizontal. The diagram shows the forces exerted on the forearm. F_1 is the upward force exerted by the biceps muscle. F_2 is the downward force exerted by the humerus bone.



W_1, the weight of the shot, is 69N and W_2, the weight of the forearm, is 15N.

Next the athlete raises the shot 0.35 m, to above shoulder height so that her forearm is vertical.

(d) Calculate the increase in gravitational potential energy of the shot.

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______________________ ΔE_{PG} = ______________

(e) Is the actual work done by the athlete greater or less than the energy calculated in (d)? Explain your answer.

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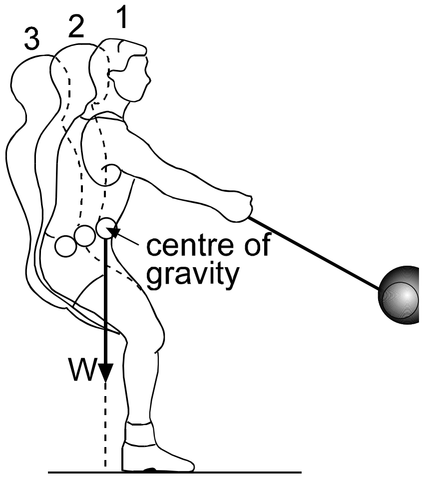
Assessor's use only

NZIP 2005

QUESTION TWO: The hammer throw

A 'hammer' is a ball of mass 7.26kg on the end of a wire and handle.



In a hammer throw event, an athlete spins three times on the spot, and in each spin, the hammer is made to move faster in a circular path. The illustration above shows three positions of the athlete. Position 1 is during the first spin and position 3 is in the last. It can be seen that the athlete must lean further back during each spin.

(i) The kinetic energy of the hammer at the instant it is released is 2270 J. The athlete takes 2.4 s to get it up to maximum speed. What is the power supplied by the athlete to give the hammer this amount of kinetic energy?

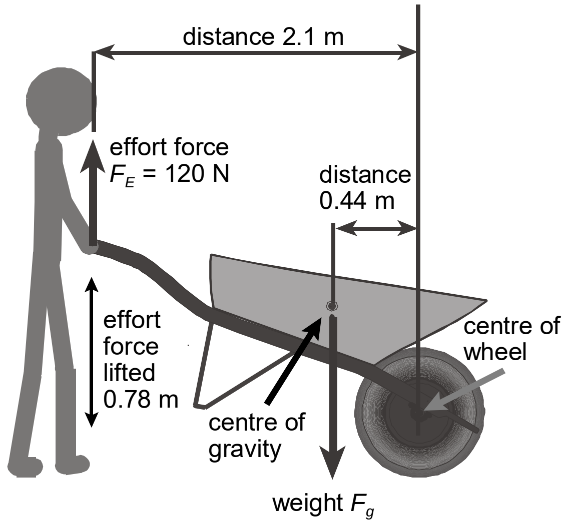
Power =

Assessor's use only

NZIP 2004

QUESTION TWO: FORCES ON A WHEELBARROW

The diagram shows a person lifting the handles of a wheelbarrow by exerting an effort force (***F_E***) of **120 N** through a vertical height of **0.78 m**. The weight of the load (including the wheel barrow) is ***F_g***.



(a) Show that the **work** done by the person in lifting the wheelbarrow is **93.6 J**.

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(b) The person takes **0.95 s** to lift the wheelbarrow through a height of **0.78m.** Calculate the power required to lift the wheelbarrow. Give your answer to the correct number of significant figures.

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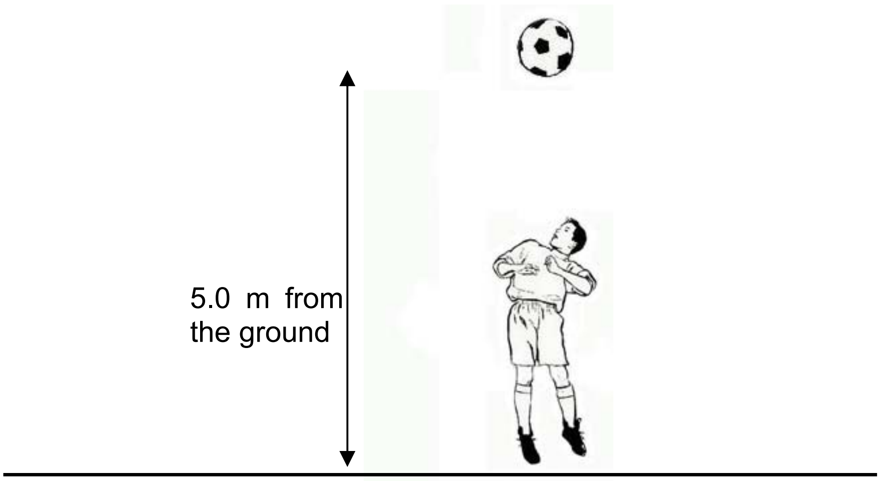
Power = ____________________

NZIP 2004

QUESTION THREE: SOCCER GAME

During a soccer game, the ball is headed straight up in the air. It reaches a height of **5.0 m** as shown in the diagram and it then falls to the ground. The mass of the ball is **0.41 kg.**



(a) Show that the **gravitational potential energy** of the soccer ball when it is at **5.0 m** from the ground is **20.5 J**. Acceleration due to gravity is 10 m s^{-2}.

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(b) Calculate the **velocity** of the ball just before it hits the ground.

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Velocity = ___

Assessor's use only

(c) Give a clear explanation of the physical principle used to solve the problem (b). State any assumptions that you have made.

(d) The speed of the soccer ball after falling the distance of 1.0 m is v_1 and the speed of the soccer ball after falling the distance of 2.0m is v_2 , as shown in the diagram below. Determine a numerical value for the ratio of the speeds $\frac{v_2}{v_1}$