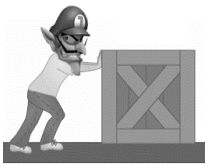
AP Physics 1 Name: _____

Unit 3 Test: Work & Energy

Multiple Choice - Choose the answers that best answers the questions below. If an exact answer is not present, chose the closest available answer. (4 pts each)

1. A baguette is dropped off the top of the Eiffel Tower. What is true concerning of the mechanical energy of the ball as it falls?

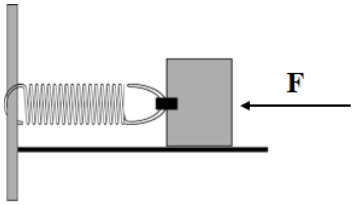
   A) The potential energy of the baguette is conserved as it falls.
   B) The sum of the kinetic and potential energies of the baguette is a constant.
   C) The kinetic energy of the baguette is conserved as it falls.
   D) The total energy of the object increases as it falls since it gains speed.



2. Waluigi pushes a crate across the ground at constant speed. There is friction between the ground and the crate. Which of the following is true of the work done by Waluigi and friction on the crate?

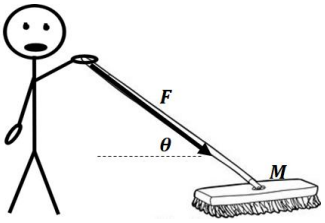
   A) The work done by Waluigi pushing the crate is greater than the work done by friction.
   B) The work done by Waluigi pushing the crate is the same as the work done by friction.
   C) The work done by Waluigi pushing the crate is less than the work done by friction.
   D) Both Waluigi and friction do zero work on the crate.

3. A spring is compressed by a force F against a wall as shown. Which of the following describes the sign of work done by the spring as it is being compressed?

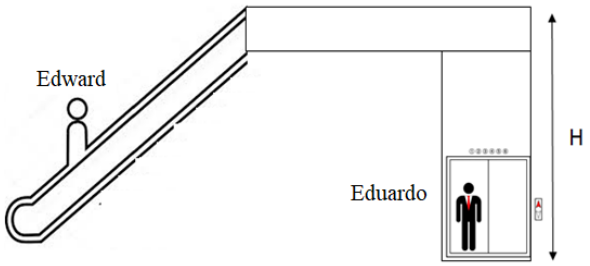


   A) The spring does positive work since it is gaining potential energy.
   B) The spring does negative work since it applies a force against the direction of its compressing motion.
   C) The spring does zero work since all the work is done by force F, not the spring.
   D) The spring works part-time at Chik Fil-A.

4. A street sweeper applies a force of F = 100 N at angle of $\theta = 60°$ above the horizontal to push a broom of mass M = 25 kg across a smooth floor. How much kinetic energy does the broom gain as it moves 2 m across the floor?



A) 50 J B) 100 J C) 170 J D) 200 J



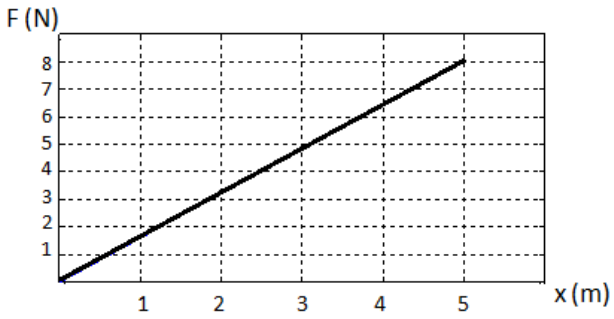
5. Escalating Edward and Elevating Eduardo both travel from the ground floor to the second floor of a building. Edward takes an escalator and is lifted up along a frictionless inclined path at constant speed. Eduardo is lifted straight upwards at constant speed. Assume that Edward and Eduardo have equal mass. Is more work done by the escalator lifting Edward or the elevator lifting Eduardo?

A) More work is done to lift Edward since he travels a longer distance.

B) More work is done to lift Eduardo since it takes a greater force.

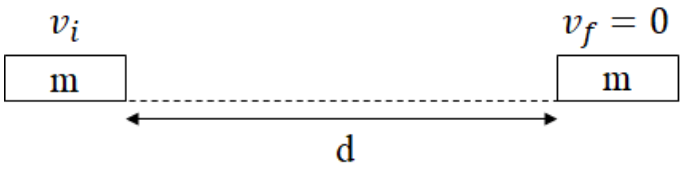
C) It takes the same work to lift both, since the incline of the escalator decreases the force by the same factor it increases the distance.

D) It cannot be known who does more work without know the time it takes person to ascend.



6. A force is applied to a 0.4 kg object that is initially rest. The force applied vs. distance is shown in the graph above. What is the speed of the object at x = 5 m?

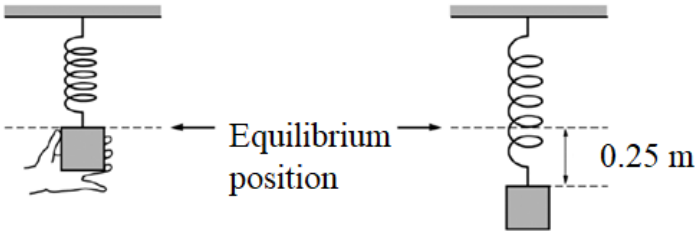
A) 8 m/s B) 100 m/s C) 20 m/s D) 10 m/s



7. A biology book of mass m slides across the ground with an initial speed of v_i. A physics book slides across the same floor with an initial speed of $3v_i$, three times the speed of the biology book. How far does the physics book slide before stopping?

A) $9d$ B) $3d$ C) $d/3$ D) d

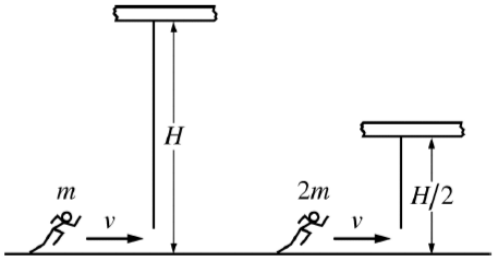
8. A block of mass m = 1.0 kg is attached to a spring of spring constant k = 64 N/m as shown. In the left picture, the spring is at its equilibrium position. On the right, the spring is stretch a distance of 0.25 down past equilibrium.



What is the magnitude in the change in total mechanical energy between the two positions of the spring?

A) 0.50 J B) 2.0 J C) 2.5 J D) 3.50 J

9. A stick figure of mass m running at speed v grabs a light rope that hangs from a ceiling of height H and swings to a maximum height of h_1. In another room with a ceiling of height H/2, a second stick figure with mass $2m$ running at the same speed v grabs a light rope hanging from the ceiling and swings to a height of h_2. How does the maximum height reached by the two stick figures compare and why?

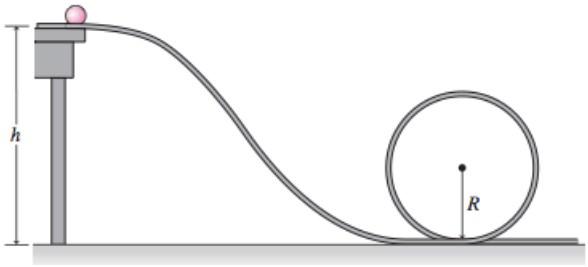


A) The first stick figure swings to a higher height since he swings from a higher rope.
B) The second stick figure swings to a higher height since he has more mass.
C) The two stick figures reach the same height, because the length of the second rope offsets the mass of the second stick figure.
D) Both stick figures swing to the same height because they have the same initial speed.

10. A bouncy ball with a mass of 0.50 kg is dropped vertically from a height of 1.0 m above the floor. The ball bounces off the floor. During the bounce, the ball loses 2.0 J of energy from interacting with the ground. What is the maximum height the ball will reach after bouncing back up?

A) 0.2 m B) 0.5 m C) 0.6 m D) 1.0 m

11. Okay, this is epic. An object of mass M is released from rest on a frictionless track. The object slides along the frictionless track and goes through a vertical loop of radius R, as shown.



What is the minimum starting height of the object required so that the object makes it through the circle without falling off the track?

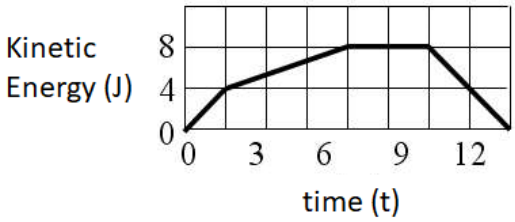
A) 2R B) 3R C) 3R/2 D) 5R/2

12. Russel holds a book still two feet above his desk. He then lowers the book at a constant speed and places it on the desk. Which of the following describes the change in total mechanical-energy of the book?

A) The total mechanical energy is unchanged since there is no net work done as the book is lowered.
B) The total mechanical energy decreases because Russel does positive work on the book.
C) The total mechanical energy is unchanged because no work is done on the book while it is lowered.
D) The total mechanical energy decreases, because Russel does negative work on the book.

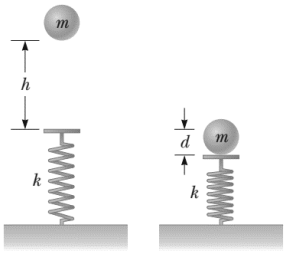
13. The graph on the right shows the kinetic energy over time for a lit tinsel llama in motion. At time t = 0, the potential energy of the llama is 10 J. Determine the potential energy of the object at time t = 9 s.

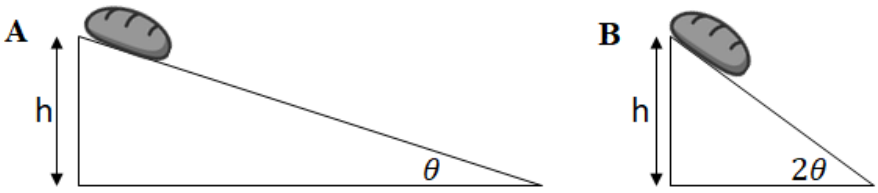
A) 10 J B) 8 J
C) 2 J D) 4 J



14. A ball of mass m is dropped from a height of h above an unstretched spring, as shown. The spring is compressed a maximum distance d when the ball lands. Which of the following gives the value of the elastic constant, k, of the spring?

A) $\frac{2mgh}{d^2}$ B) $\frac{4mgh}{d^2}$ C) $\frac{mgh}{4d^2}$ D) $\frac{mgh}{2d^2}$





15. Let's get this bread downhill. Two identical loafs of bread are placed on rough inclines, as shown. Incline A make an angle of θ with the horizontal and incline B makes an angle of 2θ with the horizontal. Both inclines are of equal height, h. There is an equal coefficient of friction on both inclines. Which of the following correctly compares the magnitude of the changes in potential energies (ΔU_A and ΔU_B) and kinetic energies (ΔK_A and ΔK_B) of the blocks when they reach the bottom of the incline.

A) $\Delta U_A = \Delta U_B,\ \Delta K_A < \Delta K_B$ B) $\Delta U_A < \Delta U_B,\ \Delta K_A < \Delta K_B$

C) $\Delta U_A < \Delta U_B,\ \Delta K_A = \Delta K_B$ D) $\Delta U_A = \Delta U_B,\ \Delta K_A = \Delta K_B$

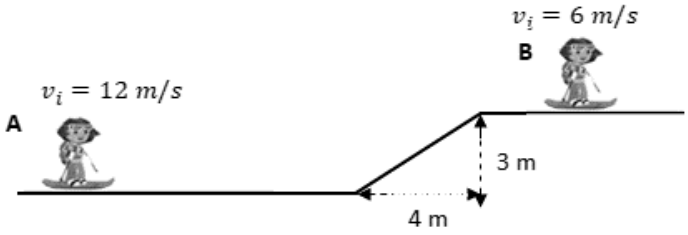
Part 2: Free Response. **You must show all required work to for problem-solving questions to receive credit**. You are graded for the method used in solving each question, and not the final answer. (15 points each)

16. ¡Hola niños! Vamos a explorar con Dora The Explorer. Dora tiene curiosidad por velocidad, so Dora skis down an incline that makes an angle of $\theta = 30°$ with level ground, as shown. The snowy incline has a coefficient of friction of $\mu = 0.2$. Dora skies down from a starting height of h = 100 m and is going to need YOUR help to calculate her speed. Dora has a mass of 40 kg.

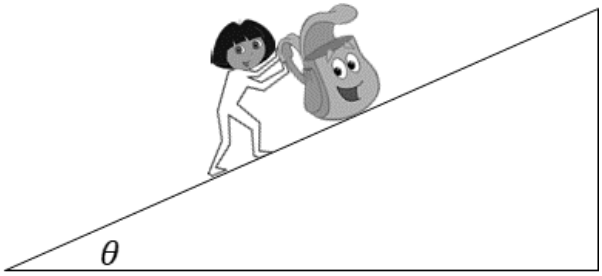
a) Determine the speed of Dora at the bottom of the incline.

b) How does the kinetic energy of Dora at the bottom of the incline compare with her potential energy at the top of the incline? Justify your answer.

c) Later, Dora is skiing 12 m/s a la derecha at point A. ¡Que rapido! She skies up a small hill of height h = 3 m and sometime later uphill is going at 6 m/s at point B. Calculate the work done by friction between points A and B.



17. Backpack, backpack, backpack, backpack, backpack, backpack, yeah! Dora pushes a backpack of mass $\boldsymbol{M}$ uphill at a **constant speed** of $\boldsymbol{v}$. The incline is rough, with a coefficient of friction of $\boldsymbol{\mu}$ and an incline angle of $\boldsymbol{\theta}$. ¡Fantastico!



a) On the diagram below, draw and label all forces acting on the backpack as it is pushed uphill.

b) As Dora pushes the backpack, various forces do work. Can you say "Trabajo?" Identify the force(s) that do:

i. Positive work: _____

ii. Negative work: _____

iii. Zero work: _____

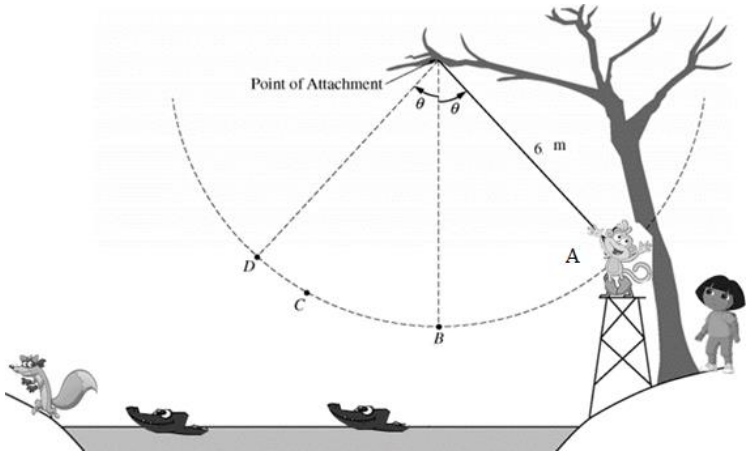
c) As Dora pushes the backpack up the incline, is the net-work done by non-conservative forces positive, negative or zero?

_____Positive _____Negative _____Zero

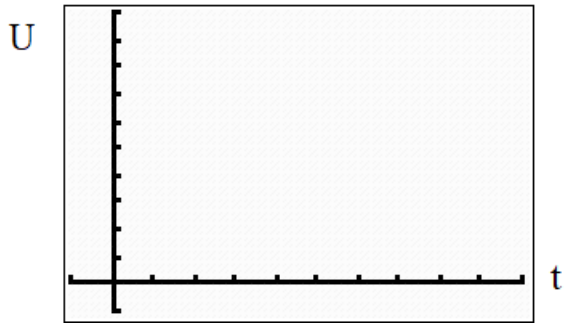
How can you tell?

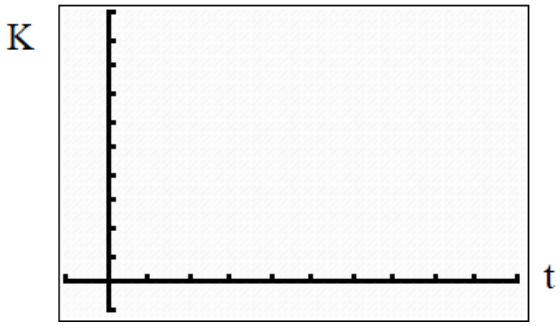
d) Can you calculate power? Determine an expression for the power developed by Dora as she pushes the backpack up the incline at constant speed. Answer in terms of M, μ, v, θ and fundamental constants.

18. Swiper steals Dora's map and flees across Crocodile Lake. Try saying: "Swiper, no Swiping"! Nevermind, there's no logical reason to expect that to work. Instead, Dora dispatches Boots the monkey to swing across the lake on a rope that acts as a pendulum, as shown. The string is 6 m long and makes an initial angle of 30^o with the vertical. Boots the monkey has a mass of 20 kg. ¡Massivo!



a) Sketch graphs of the kinetic energy and potential energy of the monkey as it swings to point D and then back to point A (one complete cycle).





b) Determine an expression for the maximum speed of the monkey.

c) Determine an expression for the tension in the rope is at the bottom of its swing.

d) Suppose Boots lets go at point D. On the diagram above, draw the path of the monkey.

¡Lo hicimos! We did it!