Term Name

Class Name

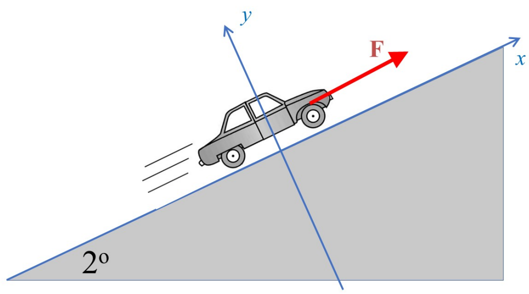
Yun Zhang College Physics 1 Problems - Work and Energy

Name: ____________________

Date: ____________________

Section: ____________________

Question 1 **(1 point)**



Power: a car climbs up an incline at constant speed)

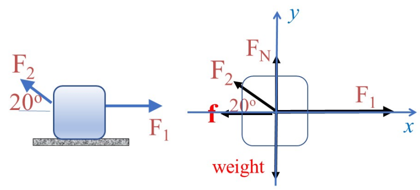
A 810-kg car climbs a 2.00° slope at a constant 25.0 m/s while encountering wind resistance and friction totaling 610 N.

Review on applying Newton's second law.
(a) How much engine force F (in Newtons) is needed to keep the car at constant speed up on the incline? DON't use scientific notation.

(b) Calculate the engine's power output in hp. (1 hp = 746 W)

Question 2 **(1 point)**
A pogo stick has a spring with a force constant of 2.10x10^4 N/m, which can be compressed 10.0 cm.
To what maximum height can a child jump on the stick using only the energy in the spring, if the child and stick have a total mass of 44.0 kg? Explicitly show how you follow the steps in the Problem-Solving Strategies for Energy.

Question 3 **(1 point)**



Work and Kinetic Energy: Horizontal Block Motion (5 forces)

As shown in the figure, Force F_1 = 59 N   is pulling the block of 7.4 kg to the right while force F_2 = 40 N tries to slow it down. The coefficient of kinetic friction is μk = 0.18.
The block moves to the right through a distance of 8.00 m.
Don't use scientific notation.

Review on application of Newton's Law.

Step 1: Start by drawing a **free body diagram** of the block, including all the forces exerted on the block. Label the normal force as F_N, label the weight as weight, the kinetic frictional force as fk.
You should be able to calculate the weight of the block. Force F1 and F2 are given.
But the kinetic frictional force fk, and the normal force F_N are unknown.

For each force, write its x component and y component. (Use F_N as "space holder" , write fk from its formula)

Step 2: Apply NEwton's second law

Apply $\sum F_y = ma_y$, what should a_y be equal to?, obtain an equation.

(a) Solve for the magnitude of the normal force FN (in Newtons), it is:

Before calculating work, DRAW a DISPLACEMENT VECTOR on the figure.

Calculate the work (in Joules) done by the normal force. Pay attention to the angle in the work formula and the sign of work.

(b) What is the magnitude of the kinetic frictional force (in Newtons)?

Calculate the work (in Joules) done by the kinetic frictional force. Pay attention to the angle in the work formula and the sign of work.

(c) Calculate the work (in Joules) done by the Force F1. Pay attention to the angle in the work formula and the sign of work.

(d) Calculate the work (in Joules) done by the Force F2. Pay attention to the angle in the work formula and the sign of work.

(e) Calculate the work (in Joules) done by the gravitational force. Pay attention to the angle in the work formula and the sign of work.

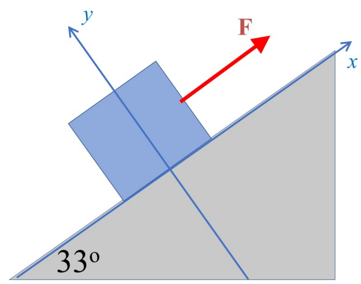
(f) Calculate the total work or net work (in Joules).
Note: If the ***total work is graded incorrect*** but ***all the above individual works were graded correct***, the incorrect total work may be due to the accuracy of the individual works. When you encounter such situation, recalculate the individual works to make them more accurate, and use the accurate values to calculate the total work.

(g) Apply the Work-Kinetic Energy Theorem:

$$\mathrm{netWork} = \mathrm{TotalWork} = \frac{1}{2}\mathrm{mv_f^2} - \frac{1}{2}\mathrm{mv_i^2} = \frac{1}{2}\mathrm{m}(\mathrm{v_f^2} - \mathrm{v_i^2})$$

After being pulled through 8.00 m, the block's speed is 7.6 m/s, what was its initital speed (in m/s)?

Question 4 **(1 point)**



Work and Kinetic Energy Theorem ALTERNATE form

This problem is similar to the discussion problem where a tractor tows a car up a rough incline (it was solved by applying the work-kinetic energy theorem in the ORIGINAL form). It is also similar to a problem in a short assignment.

Here you will apply the work-kinetic energy theorem in the ALTERNATE form.

As shown in the figure, a 6.2 kg block is being pulled by a force F = 74 N up along a rough incline. The coefficient of kinetic friction between the block and the incline is μk = 0.40. The block is pulled through a distace of 16.0 m.

Review on application of Newton's Second Law
Step 1: Start by drawing a **free body diagram** of the block, including all the forces exerted on the block. Label the normal force as FN, label the weight as weight. Since the type of the frictional force is kinetic, represent it by vector fk

Among the forces exerted on the block, which is (are) **NON-CONSERVATIVE?**

a. Normal force, Kinetic friction, pulling force, Gravitational force

b. Normal force, pulling force

c. Normal force, Kinetic friction, pulling force

d. Normal force, Kinetic friction

e. Kinetic friction, pulling force

You should be able to calculate the weight of the block. Pulling force F is given.
But the normal force F_N , and kinetic friction fk are unknown.

For each force, write its x component and y component. (Use F_N as "space holder"). You can write fk from its formula. Pay attention to the geometry and trigonometrical functions.

Step 2: Apply NEwton's second law

Apply $\sum F_y = ma_y$, what should a_y be equal to?, obtain first equation.

(a) Solve for the magnitude of the normal force FN (in Newtons), it is:

Before calculating work, DRAW a DISPLACEMENT VECTOR on the figure.

Calculate the work (in Joules) done by the normal force. Pay attention to the angle in the work formula and the sign of work.

(b) What is the magnitude of the kinetic frictional force (in Newtons)?

Calculate the work (in Joules) done by the kinetic frictional force. Pay attention to the angle in the work formula and the sign of work.

(c) Calculate the work (in Joules) done by the pulling force F. Pay attention to the angle in the work formula and the sign of work.

(d) Add up the works (in Joules) done by **all NON-CONSERVATIVE Forces:**

(e) Apply the work - KE theorem in alternate form: Wnc = $[\frac{1}{2}mv_f^2 + mgh_f] - [\frac{1}{2}mv_0^2 + mgh_i]$

The block starts from rest. What is its speed (in m/s) after being pulled through 16.0 m?
Hint: what is hf? hi? v0? no submission to the hint.
Summary: You have solved this problem in two ways:

using the **Work-Kinetic Energy Theorem in ORIGINAL form** (in a short assignment)**:**

$$netWork = TotalWork = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2 = \frac{1}{2}m(v^2 - v_0^2)$$

using the work - Kinetic Energy theorem in ALTERNATE form:

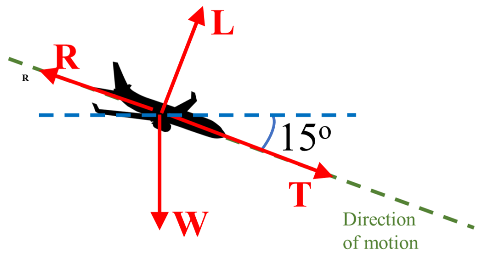
Wnc = $[\frac{1}{2}mv_f^2 + mgh_f] - [\frac{1}{2}mv_0^2 + mgh_i]$

Compare the difference on the left-hand-side of the two equations, as well as on the right-hand-side.

Question 5 **(1 point)**
A car has a mass of 775-kg.
(a) Calculate the force needed to bring the car to rest from a speed of 90 km/h in a distance of 115 m (a fairly typical distance for a non-panic stop). Note: since the force to slow down the car is opposite to the car’s motion, the force should be represented by a NEGATIVE quantity.
(b) Suppose instead the car hits a concrete abutment at full speed and is brought to a stop in 2.00 m. Calculate the force exerted on the car.
(c) Compare the force found in part (b) with the force found in part (a).

Question 6 (1 point)

Problem 4 Airplane Dive



The above drawing shows a model airplane diving toward ground. Its direction of motion is 15^{o} below the horizontal. The engine of the plane exerts a thrust force **T**, which points in the direction of the plane's motion and has a magnitude of **T**= 45.0 N. The lift force **L =** 24.64 N acts perpendicular to the direction of the plane's motion. The weight **W** of the plane has a magnitude of **W** = 25.51 N (mass = 2.6 kg). The air resistance force **R** is opposite to the plane's motion and has a magnitude of **R** = 7.39 N. The model airplane moves through a distance of **d** = 13.0 m in its direction of motion.

Keep 2 decimal places in all answers.

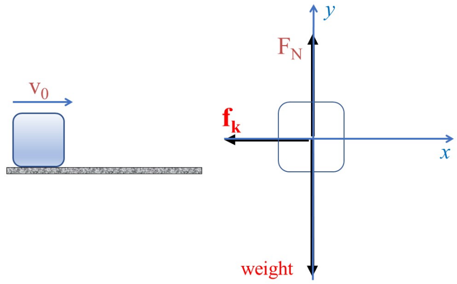
(a) Calculate the work (in Joules) done by the lift force **L**. Pay attention to the angle in the work formula and the sign of work.
(b) Calculate the work (in Joules) done by the air resistance force **R**. Pay attention to the angle in the work formula and the sign of work.
(c) Calculate the work (in Joules) done by the thrust force **T**. Pay attention to the angle in the work formula and the sign of work.
(d) Calculate the work (in Joules) done by the gravitational force. Pay attention to the angle in the work formula and the sign of work.
(e) Calculate the total work or net work (in Joules).
(f) If the initial speed of the airplane when the diving started is 8.4 m/s, what is its speed (in m/s) after moving through 13.0 m?
(g) The situation changes to:
The magnitude of thrust **T** is unknown, but the final speed after the plane moves through a distance of 13.0 m is required to be 27.17 m/s. The plane's initial speed when the diving started is still 8.4 m/s, and all the other forces remain unchanged.

What is the total work in this **new situation**?
(h) How much work is done by the thrust **T** in this **new situation?**
(Be careful with calculations. There are a lot of data punching. The online system can't award partial credits if mistake is made.)
(h) How much thrust **T** is needed in this **new situation?**

Question 7 (1 point)

Suppose a 380-g kookaburra (a large kingfisher bird) picks up a 79-g snake and raises it 2.8 m from the ground to a branch.
(a) How much work did the bird do on the snake?
(b) How much work did it do to raise its own center of mass to the branch?

Question 8 **(1 point)**



Work and Energy Horizontal Motion Stops. This problem is similar to discussion.

As shown in the figure, a 10 kg block moves with an intial speed of 7.0 m/s on a rough floor. The coefficient of kinetic friction between the block and the floor is μk = 0.28.
You will find the distance through which the block slows down and comes to a stop.

Review on application of Newton's second law.

Step 1: Start by drawing a **free body diagram** of the block, including all the forces exerted on the block. Label the normal force as FN, label the weight as weight, the kinetic frictional force fk.
Step 2: Apply NEwton's second law

Apply $\sum F_y = ma_y$, what should a_y be equal to?, obtain an equation.

(a) Solve for the magnitude of the normal force FN, it is:
Before calculating work, DRAW a DISPLACEMENT VECTOR on the fgure.

What is the work (in Joules) done by the normal force? Pay attention to the angle in the work formula and the sign of work. Hint: even though the distance is not known yet, this question can still be answered.
(b) What is the work done by the gravitational force? Pay attention to the angle in the work formula and the sign of work. Hint: even though the distance is not known yet, this question can still be answered.

(c) What is the magnitude of the kinetic frictional force (in Newtons)?

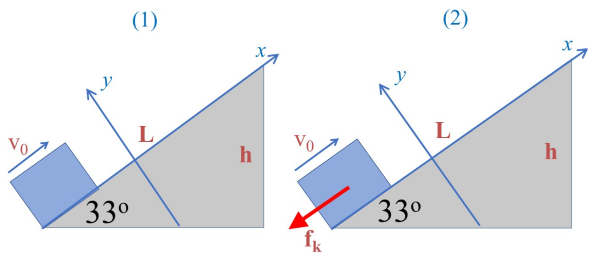
(d) Write the work done by the kinetic frictional force in terms of the distance (distance is unknown). Pay attention to the angle in the work formula and the sign of work.

Apply the Work-Kinetic Energy Theorem:

$$\mathbf{netWork = TotalWork = \frac{1}{2}mv^2 - \frac{1}{2}mv_0^2 = \frac{1}{2}m(v^2 - v_0^2)}$$

What is the distance (in meters) after which the block comes to a stop?
Now the situation changes to:
The same block of 10 kg moves with the same intial speed of 7.0 m/s on another rough floor. The coefficient of kinetic friction between the block and the other floor μk is unknown. It is measured that the block comes to a stop after moving through a distance of 14.93 m. What is the μk ?

Question 9 **(1 point)**



Car Coasts Up an Incline (NO Engine Force), without friction, then with friction

IN the above figures, A car (represented by the block) has an initial speed of 117 km/h and climbs up an incline with its engine DISENGAGED (**no engine force**). DON"T use scientific notation.

Convert the speed to m/s.

In Case (1) if **work done by friction is negligible,** How high (the **h** in the figure) a hill can the car coast up (engine disengaged) before coming to a stop?

Think: what is the best way to solve this problem?

Conservation of mechanical energy (Check that condition $\mathbf{W_{nc} = 0}$ is satisdied: work done by friction is zero, no engine force ; work done by normal force is zero)

$$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$$

(a) Submit the height h (in meters):

In case (2), If, in actuality, a 700-kg car with an initial speed of 117 km/h is observed to coast up a hill to a vertical height h_f of only 43.9 m above its starting point before coming to a stop, how much thermal energy was generated by friction?

Think: what is the best way to solve this case?
Obviously the Conservation of mechanical energy is **NOT valid** because some mechanical energy is dissipated into heat due to friction. work done by friction $\mathbf{W_{fk} \neq 0}$

Use the work - KE theorem in alternate form:

$$W_nc = [\frac{1}{2}mv_f^2 + mgh_f] - [\frac{1}{2}mv_i^2 + mgh_i]$$

(b) Submit the thermal energy as a positive number (in Joules):

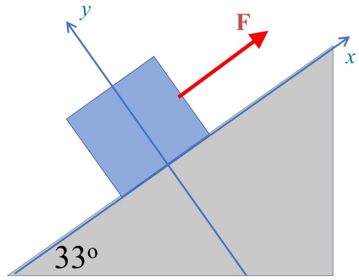
(c) In case (2) What is the magnitude of the average force (in Newtons) of kinetic friction f_k if the hill has a slope 33 degrees above the horizontal?

Hint: apply the general work formula W = Fdcosθ to the kinetic frictional force. What should be the correct sign of work done by friction? What is the displacement d? what should be the angle in the work formula? no submission to the hint.

What is the magnitude of the normal force (in Newtons)?

What is the coeficient of kinetic friction?

Question 10 **(1 point)**



Work and Kinetic Energy - Up Incline Pulling

This problem is similar to discussion problem.

As shown in the figure, a 8.6 kg block is being pulled by a force F = 91 N up along a rough incline. The coefficient of kinetic friction between the block and the incline is μk = 0.30. The block is pulled through a distace of 13.0 m.

Review on application of Newton's Second Law

Step 1: Start by drawing a **free body diagram** of the block, including all the forces exerted on the block. Label the normal force as FN, label the weight as weight. Since the type of the frictional force is kinetic, represent it by vector fk
You should be able to calculate the weight of the block. Pulling force F is given.
But the normal force F_N , and kinetic friction fk are unknown.

For each force, write its x component and y component. (Use F_N as "space holder"). You can write fk from its formula. Pay attention to the geometry and trigonometrical functions.

Step 2: Apply NEwton's second law

Apply $\sum F_y = ma_y$, what should a_y be equal to?, obtain first equation.

(a) Solve for the magnitude of the normal force (in Newtons) FN, it is:

Before calculating work, DRAW a DISPLACEMENT VECTOR on the fgure.

Calculate the work (in Joules) done by the normal force. Pay attention to the angle in the work formula and the sign of work.

(b) What is the magnitude of the kinetic frictional force (in Newtons)?

Calculate the work (in Joules) done by the kinetic frictional force. Pay attention to the angle in the work formula and the sign of work.

(c) Calculate the work (in Joules) done by the pulling force F. Pay attention to the angle in the work formula and the sign of work.

(d) Calculate the work (in Joules) done by the gravitational force. Pay attention to the angle in the work formula and the sign of work.

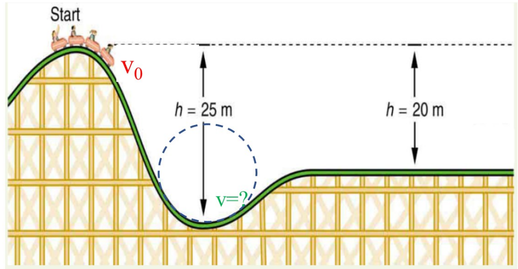
(e) Calculate the total work or net work (in Joules).

(f) Apply the Work-Kinetic Energy Theorem:

$$\mathrm{netWork} = \mathrm{TotalWork} = \frac{1}{2}\mathrm{mv}^2 - \frac{1}{2}\mathrm{mv}_0^2 = \frac{1}{2}\mathrm{m}(\mathrm{v}^2 - \mathrm{v}_0^2)$$

The block starts from rest. What is its speed (in m/s)after being pulled through 13.0 m?

Question 11 **(1 point)**



Conservation of Mechanical Energy in a roller coaster.

In the figure, the roller coaster car with a mass of 280 kg starts with an initial speed v0 = 8.0 m/s at the top of the track. What is its speed (in m/s) at the lowest point of the track (which is 25m below the start point)? Keep 2 decimal places.

Recall what you learned in **vertical circular motion.**
If the lowest part of the track is approximated as circular with a radius of 6.00 m, What is the magnitude of the normal force (in Newtons) on the roller coaster car?
Don't use scientific notation.

Question 12 **(1 point)**
A 1490-kg elevator car by its cable to lift it 35.0 m at constant speed, assuming friction averages 100 N.
(a) Calculate the work done on the elevator.
(b) What is the work done on the lift by the gravitational force in this process?
(c) What is the total work done on the lift?

Question 13 **(1 point)**
Using energy considerations, calculate the average force a 54.0-kg sprinter exerts backward on the track to accelerate from 2.00 to 7.80 m/s in a distance of 31.0 m, if he encounters a headwind that exerts an average force of 25.0 N against him. In this problem, only report the MAGNITUDE of the force.

Question 14 **(1 point)**

Integrated Concepts: Newton's Laws, 1D kinematics, Work, Energy

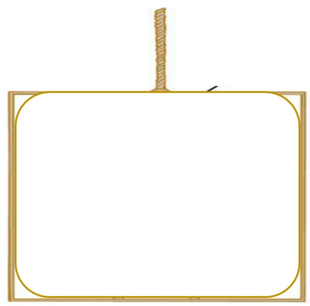
Don't use scientific notation in all answers.

Review on applying Newton's second law. Draw a complete force diagram.

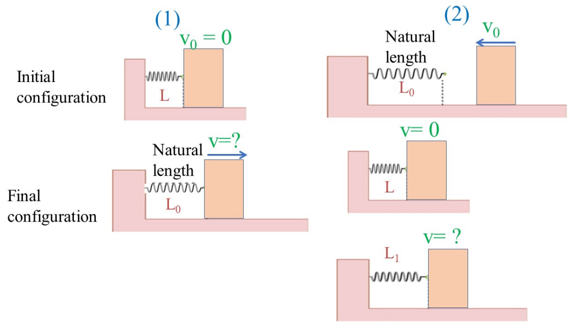
(a) What force must be supplied by an elevator cable to produce an upward acceleration of 0.90 m/s² against a 190.00-N frictional force, if the mass of the loaded elevator is 1050.0 kg?
Hint: if your cable force is wrong, keep in mind that in applying Newton's second law **ALL forces** must be taken into account.

(b) How much work (in Joules) is done by the cable in lifting the elevator upward through 25.0 m?
(c) What is the final speed (in m/s) of the elevator after being lifted upward through 25.0 m if it starts from rest?
(d) How much work (in Joules) went into thermal energy?

Note: the work that went into thermal energy is due to the kinetic friction. Though this work done by kinetic friction should be negative, here report the thermal energy as positive.



Question 15 **(1 point)**



Conservation of Mechanical Energy in Spring + Block

In the figures, the block has a mass of 4.0 kg. The spring's natural length L_0 = 25 cm.

In case (1), inititally a hand holds the block to compress the spring to a length L = 15 cm. The spring constant is 348 N/m. Then the block is released.

(a) What is the initial compression (in meters) of the spring from its natural length? **Report all compressions as positive values.**

In case (1) What is the speed (in m/s) of the block when the spring restores to its natural length?
 In the figures, the block has a mass of 4.0 kg. The spring's natural length L_0 = 25 cm.

In case (2), the block moves to the left with an initial speed of 0.93 m/s. After making contact with the spring, in the middle figure, it compresses the spring to a length L = 15 cm and comes to a momentary stop.

(b) What is the compression of the spring (in meters) from its natural length?

In case (2) What is the force constant k of the spring (in N/m)?

In case (2) from the middle figure to the bottom figure, the block moves to the right, and the spring reaches a length of L_1 = 23.00 cm. What is the compression of the spring (in meters) from its natural length?

(c) In case (2) bottom figure, what is the speed (in m/s) of the block?

Hint: apply conservation of mechanical energy to TOP and BOTTOM figures:
$KE_{top} + PE_{top} = KE_{bottom} + PE_{bottom}$ solve for v_{bottom}

Question 16 **(1 point)**

Power (basics)

A person does 7.0x10^6 J of useful work in 8.00 h. DON"T use schientific notation when entering your answers.

(a) What is the person's average useful power output (in Watts)?

(b) Working at this rate, how long will it take this person to lift 1600 kg of bricks vertically upwards through 1.2 m to a platform? (Work done to lift his body can be omitted because it is not considered useful output here.) Give your answer in seconds.

(c) An 810.0 kg car wants to accelerate from rest to a speed of 17.0 m/s. It has a useful power output of 50.0 hp (1 hp = 746 W). Neglect friction.

How much work must the car's engine produce to achieve this increase in speed? DON"T use schientific notation when entering your answers. Hint: Consider the work-kinetic energy theorem.

How long (in seconds) does it take the car to achieve this speed increase?

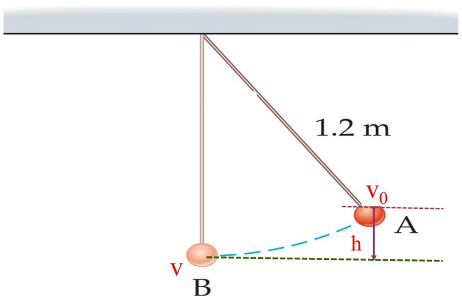
Question 17 **(1 point)**

A 71.0-kg person climbs stairs, gaining 4.50 meters in height.
Find the work done to accomplish this task.

Question 18 **(1 point)**

How much gravitational potential energy (relative to the ground on which it is built) is stored in the Great Pyramid of Cheops, given that its mass is about 7×10^9 kg and its center of mass is 36.5 m above the surrounding ground?

Question 19 **(1 point)**



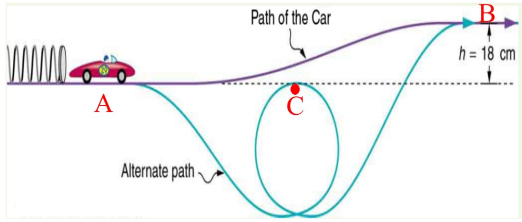
Conservation of mechanical energy in a pendulum.

This problem is modified from the pendulum example in lecture. Reviewing the lecture example first will help you solve this problem.

In the figure, the pendulum bob with a mass of 0.9 kg starts with an initial speed v0 = 0.40 m/s at point A. What is its speed (in m/s) at the point B? the height h = 0.46 m. Keep 2 decimal places.

Recall (and review) what you learned in **vertical circular motion.**
What is the magnitude of the tension force (in Newtons) in the string at point B?

Question 20 **(1 point)**



Conservation of mechanical Energy in a spring + block system. Conservation of Mechanical Energy in a roller coaster.
Review on relevant examples in lecture will help you solve this problem.
Keep 2 decimal places.

In the figure, a toy car with a mass of 0.2 kg is propelled by a compressed spring. The spring is conpressed by 0.09 m and the spring constant is 364 N/m.
(a) What is the speed (in m/s) of the toy car after the spring is completely released (no compression, no stretch)?

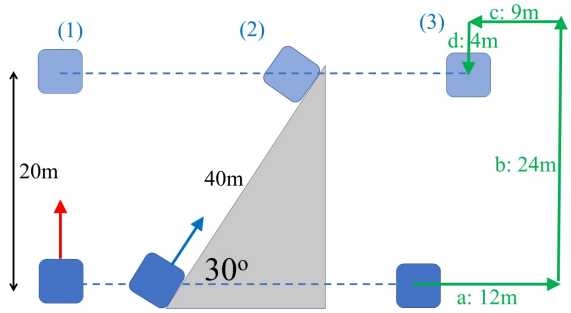
(b) From Point A in the figure, with the speed in question (a), the toy car takes the upper path (the slope) . Find its speed (in m/s) when it reaches the top of the slope, Point B. Ignore friction.

(c) New scenario: From Point A in the figure, with the speed in question (a), the toy car takes the "Alternate path" (the roller coaster). What is its speed (in m/s) when it reaches the top of the circular loop, Point C, which is at the ground level? Ignore friction.

Recall what you learned in **vertical circular motion.**
If the radius of the circular loop is 0.20 m. What is the magnitude of the normal force (in Newtons) on the toy car when it is at the top of (and inside) the circular track, Point C?

Question 21 **(1 point)**
Calculate the work done by an 81.0-kg man who pushes a crate 3 m up along a ramp that makes an angle of 22 with the horizontal. (Optional: see Figure 7.35 of textbook.) He exerts a force of 360 N on the crate parallel to the ramp and moves at a constant speed. Be certain to include the work he does on the crate and on his body to get up the ramp. Find the work done. To find the work he does on his body to get up the ramp, problem 7.1 number 2 is useful.

Question 22 **(1 point)**



This problem explores the characteristics of the work done by the Gravitational force.

A block of 6.0 kg follows three paths. The darker squares respresent the initial locations, and the lighter squares represents the final locations. The initial height are all the same. The final heights are all the same.

You will calculate the **WORK done by the Gravitational force** when the block follows each path.
Draw the gravitational force vector. Draw displacement vector. Pay attention to the angle used in the work formula and the sign of work.

DON't use scientific notation.Keep 2 decimal places.

(1) What is the **WORK (in Joules) done by the Gravitational force** when the block follows path (1)?

(2) What is the **WORK (in Joules) done by the Gravitational force** when the block follows path (2)?

(3) What is the **WORK in Joules) done by the Gravitational force** when the block follows path (3) Segment a?

What is the **WORK (in Joules) done by the Gravitational force** when the block follows path (3) Segment b?

What is the **WORK (in Joules) done by the Gravitational force** when the block follows path (3) Segment c?

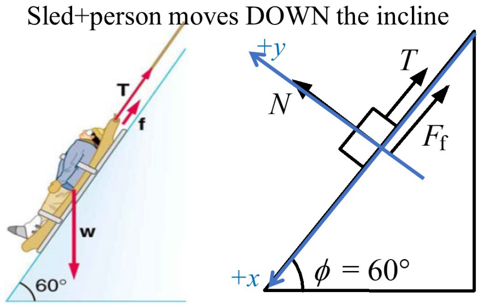
What is the **WORK (in Joules) done by the Gravitational force** when the block follows path (3) Segment d?

What is the total **WORK (in Joules) done by the Gravitational force** when the block follows the entire path (3)?

Summary: does the work done by gravity depend on the path?

a. No. Work done by gravity is independent of path, as long as the differrence in height is fixed.
b. Yes, work done by gravity depends on path.

Question 23 **(1 point)**



Sled+Person moves down an incline with const speed.

The above figures show that the ski patrol lowers a rescue sled and victim, having a total mass of 80.0 kg, down a slope at constant speed, and the force diagram. The coefficient of friction between the sled and the snow is 0.070. The sled+person moves 26.0 m down the hill.
DON"T use scientific Notation. Keep 2 decimal places (unless otherwise specified.)

Review on how to apply Newton's Second Law:

You should be able to calculate the weight of the block.
But the other 3 forces: the normal force F_N , the kinetic frictional force fk, and the tension force T are unknown.

For each force, write its x component and y component. (Use F_N , fk, and T as "space holder" for the unknowns). Pay attention to the geometry and trigonometrical functions.

Apply $\sum F_y = ma_y$, what should a_y be equal to?, obtain first equation.

(a) Solve for the magnitude of the normal force FN, it is:

Before calculating work, DRAW a DISPLACEMENT VECTOR on the fgure.

Calculate the work done by the normal force. Pay attention to the angle in the work formula.

Insight: In this problem if it were just for the purpose of calculating work done by the normal force, do you need to caclulate the magnitude of the normal force? Why or why not. (no submission needed)

(b) What is the magnitude of the kinetic fricitonal force?

How much work is done by kinetic friction? Pay attention to the angle in the work formula, and the sign of the work.

Apply $\sum F_x = ma_x$, to this problem, (the sled+person has constant velocity, what is a_x? .), obtain an equation and solve for the tension force.

(c) What is the magnitude of the tension force in the rope?

How much work is done by the tension force in the rope on the sled in this distance? Pay attention to the angle in the work formula, and the sign of the work.

(d) What is the work done by the gravitational force on the sled? Pay attention to the angle in the work formula, and the sign of the work.

(f) What is the total work (net Work) done? Round your result to integers.

From the Work-Kinetic Energy Theorem:

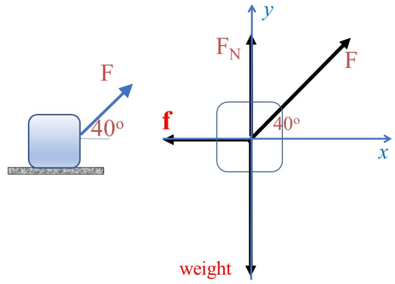
$$\mathbf{netWork} = \mathbf{TotalWork} = \frac{1}{2}\mathbf{mv}^2 - \frac{1}{2}\mathbf{mv}_0^2 = \frac{1}{2}\mathbf{m}(\mathbf{v}^2 - \mathbf{v}_0^2)$$

The sled+person has constant velocity, what should be the Total work or net work equal to?
Note: If your total work or net Work in (f) is different from what it should be, the difference is caused by rounding error.

Question 24 **(1 point)**
How long will it take an 750-kg car with a useful power output of 42.0 hp (1 hp = 746 W) to reach a speed of 11.0 m/s, neglecting friction?

Question 25 **(1 point)**
A 4.20x10^5-kg subway train is brought to a stop from a speed of 0.250 m/s in 0.260 m by a large spring bumper at the end of its track.
What is the force constant k of the spring?

Question 26 **(1 point)**



Work and Kinetic Energy - 4 Forces - Horizontal Motion

This problem is similar to lecture example and discussion problem.

As shown in the figure, a 25 kg block is pulled to the right by force F = 78 N. The coefficient of kinetic friction between the block and the floor is μk = 0.26. The block moves through a distance of 20.00 m.
DON"T use scientific notation.

Review on application of Newton's second law.

Step 1: Start by drawing a **free body diagram** of the block, including all the forces exerted on the block. Label the normal force as FN, label the weight as weight, the kinetic frictional force fk.
You should be able to calculate the weight of the block. Force F is given.
But the other 2 forces: the frictional force fk and the normal force F_N are unknown.

For each force, write its x component and y component. (Use F_N as "space holder", write fk with its formula).

Step 2: Apply Newton's second law

Apply $\sum F_y = ma_y$, what should a_y be equal to?, obtain an equation.

(a) Solve for the magnitude of the normal force FN (in Newtons), it is:

Before calculating work, DRAW a DISPLACEMENT VECTOR on the fgure.

Calculate the work (in Joules) done by the normal force. Pay attention to the angle in the work formula and the sign of work.

(b) What is the magnitude (in Newtons) of the kinetic frictional force?

Calculate the work (in Joules) done by the kinetic frictional force. Pay attention to the angle in the work formula and the sign of work.

(c) Calculate the work (in Joules) done by the pulling force F. Pay attention to the angle in the work formula and the sign of work.

(d) Calculate the work (in Joules) done by the gravitational force. Pay attention to the angle in the work formula and the sign of work.

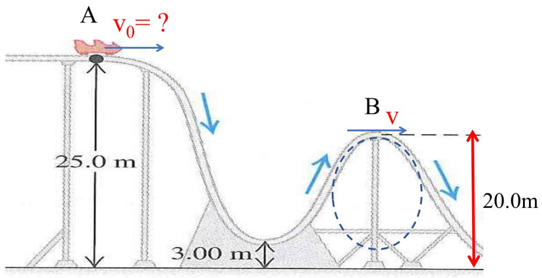
(e) Calculate the total work or the net work (in Joules).

(f) Apply the Work-Kinetic Energy Theorem:

$$\mathrm{netWork} = \mathrm{TotalWork} = \frac{1}{2}\mathrm{mv}^2 - \frac{1}{2}\mathrm{mv}_0^2 = \frac{1}{2}\mathrm{m}(\mathrm{v}^2 - \mathrm{v}_0^2)$$

The block's initial speed is 2.2 m/s What is its speed (in m/s) after being pulled through 20.00 m?

Question 27 **(1 point)**



Conservation of mechanical energy in a roller coaster.

In the figure, the roller coaster car with a mass of 280 kg has a speed of 10.8 m/s at point B. What is its initial speed (in m/s) at point A? Keep 2 decimal places.

Recall what you learned in **vertical circular motion**.
If the part of the track around point B is approximated as circular with a radius of 16.80 m, What is the magnitude (in Newtons) of the normal force on the roller coaster car?
Don't use scientific notation.