Test 5

Corrected

Consider two less-than-desirable options. In the first you are driving 30 mph and crash head-on into an identical car also going 30 mph. In the second option you are driving 30 mph and crash head-on into a stationary brick wall. In neither case does your car bounce off the thing it hits, and the collision time is the same in both cases. Which of these two situations would result in the greatest impact force?

Item 1

- hitting the brick wall
- hitting the other car
- The force would be the same in both cases.
- We cannot answer this question without more information.
- None of these is true.

It makes no difference in both cases.

A car on a roller coaster starts at zero speed at an elevation above the ground of 26 m. It coasts down a slope, and then climbs a hill. The top of the hill is at an elevation of 16 m. What is the speed of the car at the top of the hill? Neglect any frictional effects.

Item 2

- 10 m/s
- 9.0 m/s
- 6.0 m/s
- 18 m/s
- 14 m/s

$$v_f^2 = v_0^2 + 2a(y_f - y_0)$$

$= 0 + 2(-9.80665 \text{ m/s}^2)(16\text{m} - 26\text{m})$

$= (-19.6133 \text{ m/s}^2)(-10 \text{ m})$

$= 196.133 \text{ (m/s)}^2$

Now take the square root of both sides to isolate vf which will give you the final answer:

$$v_f = \sqrt{(196.133 \text{ (m/s)}^2)} = 14 \text{ m/s}$$

Given:	Find:	Formulae:
$y_f = 16$ m $y_0 = 26$ m $v_0 = 0$ m/s $a = -9.8$ m/s^2 down a slope,	v_f	$v_f^2 = v_0^2 + 2a(y_f - y_0)$

Block 1 and block 2 have the same mass, m, and are released from the top of two inclined planes of the same height making 30° and 60° angles with the horizontal direction, respectively. If the coefficient of friction is the same in both cases, which of the blocks is going faster when it reaches the bottom of its respective incline?

Item 3

- ○ Both blocks have the same speed at the bottom.
- ◉ Block 2 is faster.
- ○ Block 1 is faster.
- ○ We must know the actual masses of the blocks to answer.
- ○ There is not enough information to answer the question because we do not know the value of the coefficient of kinetic friction.

$v_0 = 0\ m/s$

$v_f = \sqrt{2as}$

$$v_f^2 - v_0^2 = 2as$$

$$F_{parallel} = m * g * \sin(\theta)$$

$$f = \mu * m * g * \cos(\theta)$$

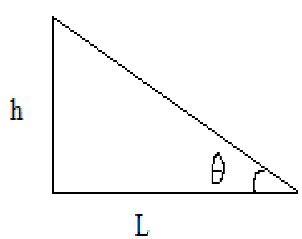
$$F_{net} = F_{parallel} - f = [m \cdot a]$$

So,

$$\frac{[\cancel{m} \cdot a]}{\cancel{m}} = \frac{[\cancel{m} * g * \sin(\theta)] - [\mu * \cancel{m} * g * \cos(\theta)]}{\cancel{m}}$$

$$a = g\sin(\theta) - \mu g \cos(\theta)$$

$$a = g[\sin(\theta) - \mu \cos(\theta)]$$



$\sin(\theta)$= height / length

$L = h/\sin(\theta)$

Final velocity = (2 * a * L)^0.5

Final velocity = [2 * g * (sin θ – μ * cos θ) * h/sin θ]^0.5

Final velocity = [2 * g * h * (1 – μ * cotan θ)]^0.5

For 30°

Final velocity = [2 * g * h * (1 – μ * cotan 30°)]^0.5

Final velocity = [2 * g * h * (1 – μ * 1.732)]^0.5

For 60°

Final velocity = [2 * g * h * (1 – μ * tan 60°)]^0.5

Final velocity = [2 * g * h * (1 – μ * 0.577)]^0.5

(1 – μ * 0.577) > (1 – μ * 1.732)

SO

The final velocity will be higher for the block on the 60° inclined plane

Block 2!

A small car has a head-on collision with a large truck. Which of the following statements concerning the magnitude of the average force due to the collision is correct?

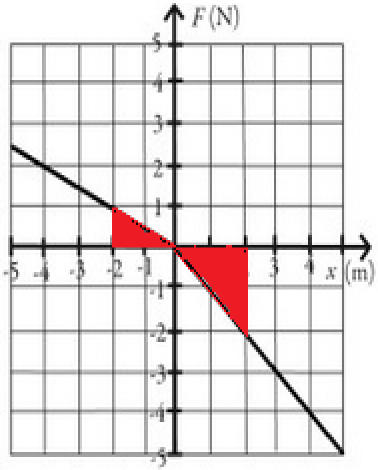
Item 4

- The small car experiences the greater average force.
- The truck experiences the greater average force.
- The small car and the truck experience the same average force.
- It is impossible to tell since the masses are not given.
- It is impossible to tell since the velocities are not given.

(1) Momentum / Energy can explain this.

(2) Newton's 3rd law of motion, action-reaction pair can, too.

A graph of the force on an object as a function of its position is shown in the figure. Determine the amount of work done by this force on the object during a displacement from x = -2.00 m to x = 2.00 m. (Assume an accuracy of 3 significant figures for the numbers on the graph.)

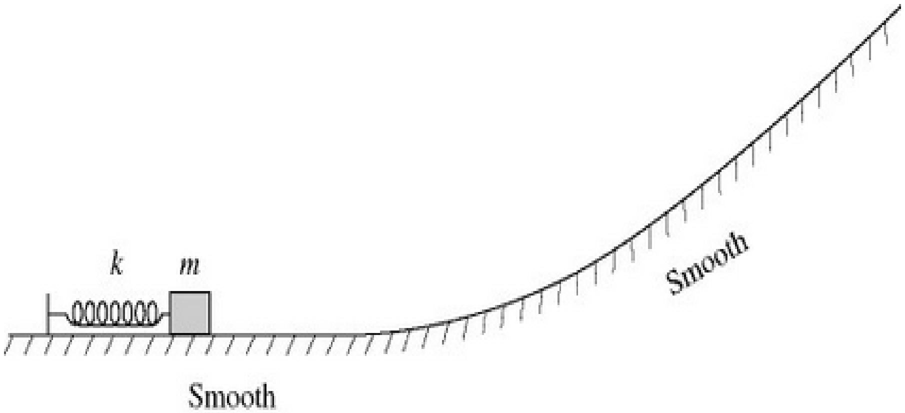


Work is the area under the curve

- 3.00 J
- -3.00 J
- -1.00 J
- 12.0 J
- -12.0 J

Item 5

A box of mass m is pressed against (but is not attached to) an ideal spring of force constant k and negligible mass, compressing the spring a distance x. After it is released, the box slides up a frictionless incline as shown in the figure and eventually stops. If we repeat this experiment but instead compress the spring a distance of $\boxed{2x}$



- just as it moves free of the spring, the box will be traveling four times as fast as before.
- the box will go up the incline twice as high as before.
- just as it moves free of the spring, the box will be traveling twice as fast as before.
- just as it moves free of the spring, the box will have twice as much kinetic energy as before.
- just before it is released, the box has twice as much elastic potential energy as before.

Item 6

$$\frac{1}{2}k \cdot x^2 = \frac{1}{2}m \cdot v^2 = m \cdot g \cdot h$$

A plate falls vertically to the floor and breaks up into three pieces, which slide along the floor. Immediately after the impact, a 350-g piece moves along the *x*-axis with a speed of 2.00 m/s and a 385-g piece moves along the *y*-axis with a speed of 1.50 m/s. The third piece has a mass of 100 g. In what direction does the third piece move? You can neglect any horizontal forces during the crash.

Item 7

- 87.8° from the *x*-axis
- 263.4° from the *x*-axis
- 219.5° from the *x*-axis
- 175.6° from the *x*-axis
- 131.7° from the *x*-axis

Consider the floor be the coordinate axis .

then Initial momentum along any direction on plane =0 (As itfell vertically)

So Final momentum should be zero .

Momentum along x axis = $0.350\ \text{kg} * 2.0\ \text{m/s} = 0.70i\ \text{kg.m/s}$

Momentum along y axis = $0.385\ \text{kg} * 1.5\ \text{m/s} = 0.5775j\ \text{kg.m/s}$

As total is zero .

So momentum of third part should be

P = $-0.70i\ \text{kg.m/s} - 0.5775j\ \text{kg.m/s}$

As mass =100 gm =0.1 kg

velocity = P/m = $-7.0i\ \text{m/s} - 5.775j\ \text{m/s}$

This is in vector form

it's magnitude = 9.075 m/s = $\sqrt{(-7)^2 + (-5.775)^2}$

find it's direction .

$$\boxed{\tan^{-1}\left((-5.775)/(-7)\right) + 180° = 219.523°}$$

A student slides her 80.0-kg desk across the level floor of her dormitory room a distance 3.20 m at constant speed. If the coefficient of kinetic friction between the desk and the floor is 0.400, how much work did she do?

- 13.0 J
- 1.00 kJ
- 6.02 J
- 10.0 J
- 15.1 J

Item 8

$$W = \mu * m * g * d$$

$$W = 0.400 \cdot 80.0\,\mathrm{kg} \cdot 9.8\,\mathrm{m/s^2} \cdot 3\,\mathrm{m}$$

$$\boxed{W = 1003.52\,\mathrm{J} \text{ or } 1.00352\,\mathrm{kJ}}$$

A girl throws a stone from a bridge. Consider the following ways she might throw the stone. The speed of the stone as it leaves her hand is the same in each case, and air resistance is negligible.

Case A: Thrown straight up.

Case B: Thrown straight down.

Case C: Thrown out at an angle of 45° above horizontal.

Case D: Thrown straight out horizontally.

In which case will the speed of the stone be greatest when it hits the water below?

Item 9

- Case A
- Case B
- Case C
- Case D
- The speed will be the same in all cases.

Horizontal velocity is constant in projectile motion.

A stock person at the local grocery store has a job consisting of the following five segments:
(1) picking up boxes of tomatoes from the stockroom floor
(2) accelerating to a comfortable speed
(3) carrying the boxes to the tomato display at constant speed
(4) decelerating to a stop
(5) lowering the boxes slowly to the floor.
During which of the five segments of the job does the stock person do positive work on the boxes?

Item 10

- (2) and (3)
- (1) and (5)
- (1) only
- (1), (2), (4), and (5)
- (1) and (2)

$W = F * d = m * a * d$