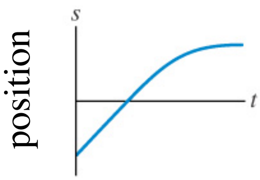
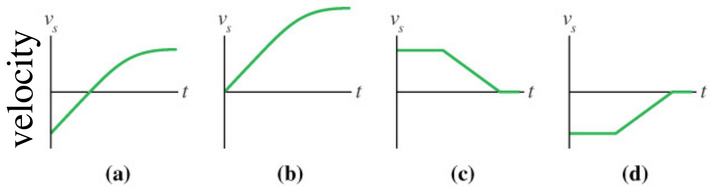
Which velocity-versus-time graph goes with this position-versus-time graph?

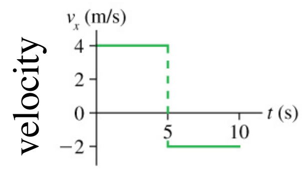


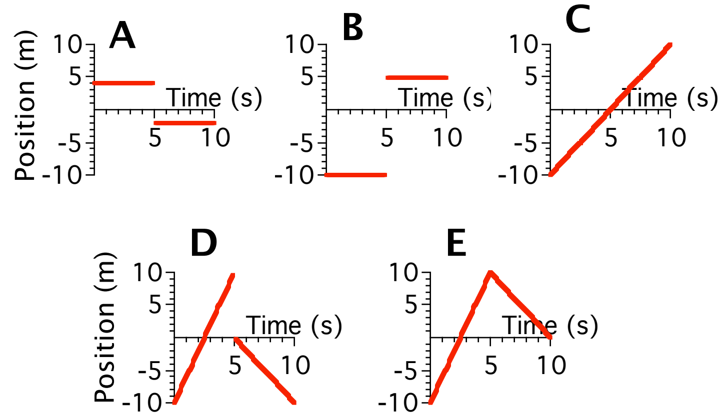


C2 Q1

26 Sep 08

Which position-versus-time graph goes with this velocity-versus-time graph?
The particle's position at $t = 0$ s is $x = -10$ m .

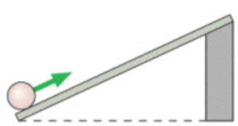


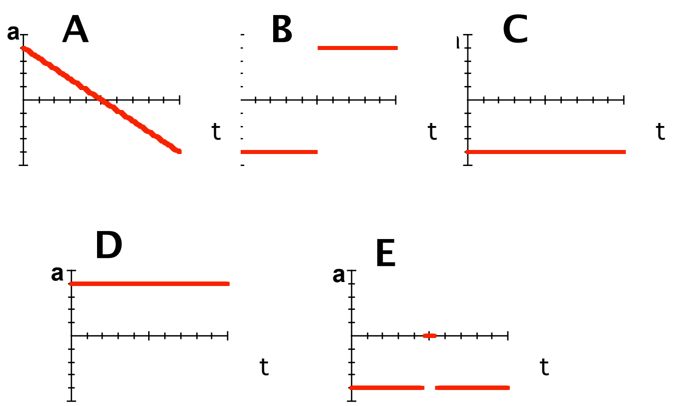


C2 Q2

24 Sep 08

The ball rolls up the ramp, then back down. Let +x direction be up the ramp. Which is the correct acceleration graph?

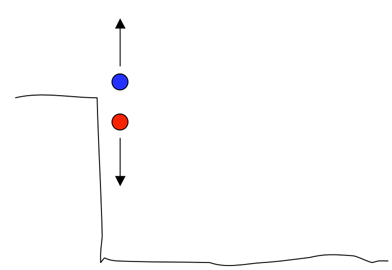




C2 Q3 / C3 Q1

26/29 Sep 08

A physics student stands on the edge of a cliff with two similar rubber balls. He throws the blue one upwards and the red one downwards, but throws them each with the same speed. The acceleration of the blue ball is:

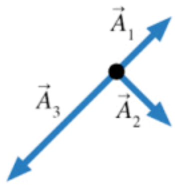


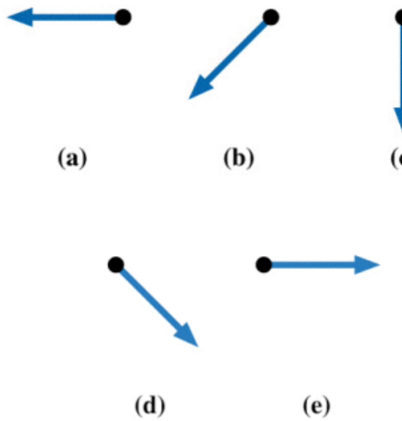
A. Less than the acceleration of the red
B. Greater than the acceleration of the red
C. Equal to the acceleration of the red
D. Equal in magnitude but opposite in sign
E. Bogus! There's no way to know

C3 Q2

29 Sep 08

Which figure shows $\vec{A}_1 + \vec{A}_2 + \vec{A}_3$?

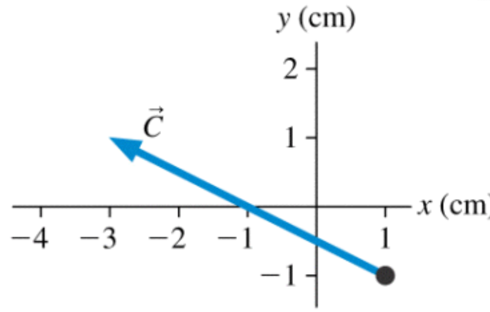




C3 Q3

29 Sep 08

What are the x- and y-components C_x and C_y of vector $\vec{C}$?

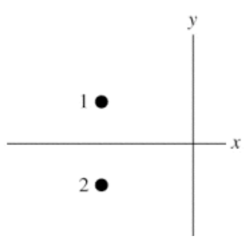


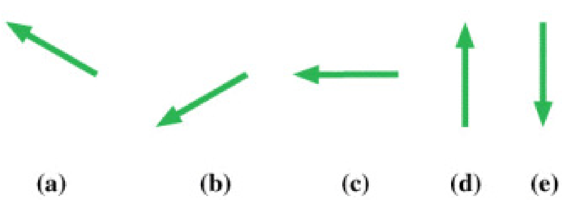
A. $C_x = -3$ cm, $C_y = 1$ cm
B. $C_x = -4$ cm, $C_y = 2$ cm
C. $C_x = -2$ cm, $C_y = 1$ cm
D. $C_x = -3$ cm, $C_y = -1$ cm
E. $C_x = 1$ cm, $C_y = -1$ cm

C3 Q4

29 Sep 08

A particle moves from position 1 to position 2 during the interval Δt. Which vector shows the particle's average velocity?





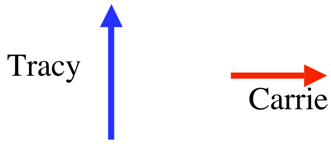
C4 Q1

01 Oct 08

If the gun is aimed at the monkey, what should the monkey do when it sees the flash of the shot?

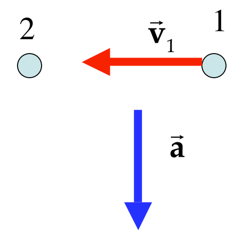
A. Hang on
B. Let go immediately

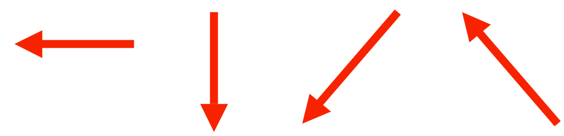
Tracy is sitting on a train going north at 20 m/s. Carrie is sitting in a car going east at 15 m/s. What is Tracy's speed relative to Carrie?



A. 5 m/s
B. 25 m/s
C. 45 m/s
D. 17 m/s
E. It varies with time

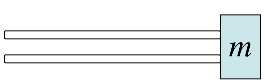
A particle undergoes acceleration $\vec{a}$ while moving from point 1 to point 2. Which of the choices shows the velocity vector $\vec{v}_2$ as the object moves away from point 2?



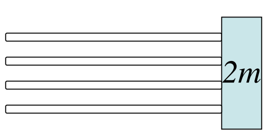


A **B** **C** **D**

Two rubber bands stretched a distance d cause an object of mass m to accelerate at $a = 2$ m/s^2.

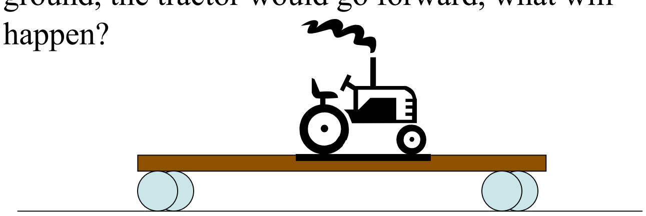


Another object with twice the mass ($2m$) is pulled by four rubber bands stretched the same distance d. The acceleration of this second object is:



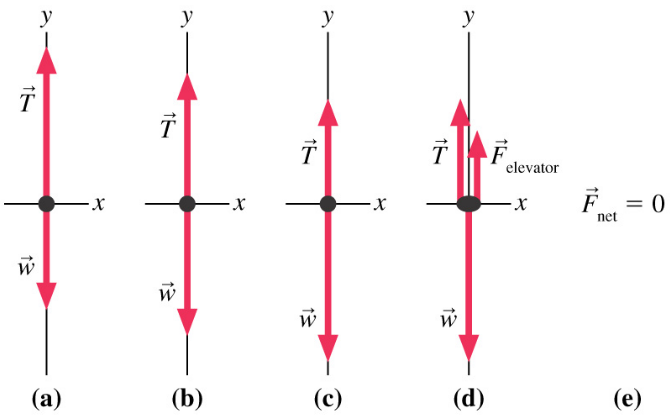
A. 1 m/s^2 .
B. 2 m/s^2 .
C. 4 m/s^2 .
D. 8 m/s^2 .
E. 16 m/s^2 .

Consider a remote control tractor on a skateboard. The skateboard has a larger mass than the tractor. When the tractor wheels start to turn such that on the ground, the tractor would go forward, what will happen?

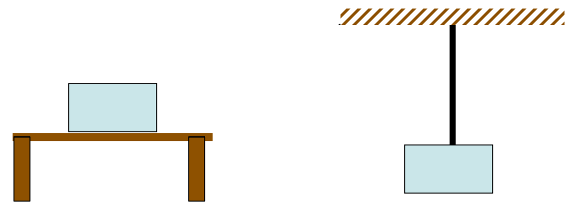


A. The tractor stays stationary relative to the ground; the skateboard moves backwards.
B. The tractor moves forward; the skateboard stays stationary rel. to the ground.
C. The tractor and skateboard both go forwards; the tractor goes *faster* than the skateboard.
D. The tractor goes forward relative to the ground; The skateboard goes backwards at the *same speed*.
E. The tractor goes forward relative to the ground; the skateboard goes backwards at a *slower speed*.

An elevator suspended by a cable is moving upward and slowing to a stop. Which free-body diagram is correct?



Two identical blocks have mass m. Block 1 is sitting on a table and block 2 is hanging on a string. Compare the magnitudes of the force exerted on the table by block 1, N_{1T} and the string tension T.



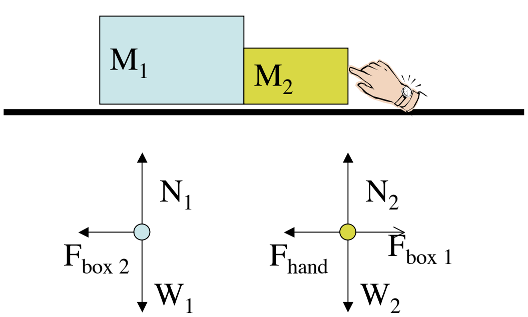
A. $N_{T1} > T$

B. $N_{T1} = T$

C. $N_{T1} < T$

D. The situation is different, and you cannot compare them without additional information.

Two blocks are being pushed together on a frictionless surface. Which of the following are 3rd Law Pairs?



A. W_2 and N_2

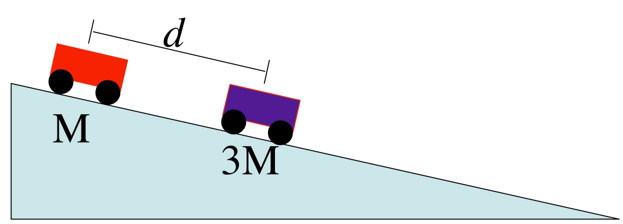
B. $F_{box\ 1}$ and $F_{box\ 2}$

C. F_{hand} and $F_{box\ 1}$

D. Both A and B

E. Both B and C

A light cart M_1 and a heavy cart $M_2 = 3M_1$ are released from rest at two points a distance d apart on a tilted track. Cart 1 is above Cart 2. What happens to their separation with time?

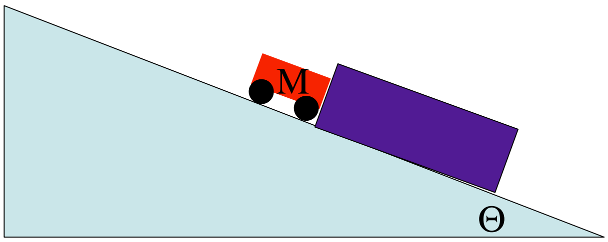


A. d increases with time

B. d decreases with time

C. d stays the same.

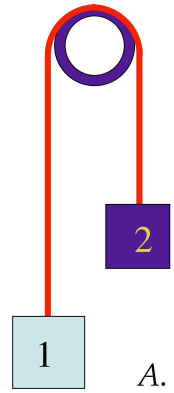
If the frictionless cart of mass M is sitting still, what is the force of the purple block on the cart?

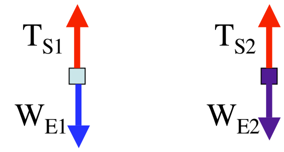


A. Mg
B. $Mg\cos\theta$
C. $Mg\sin\theta$
D. $Mg\tan\theta$
E. 0

C8 Q1 10 Oct 08

Consider this massless pulley supporting two blocks, with FBD for each mass. Below the FBD are 2 equations with 4 unknowns. Which two other equations allow you to solve the problem?





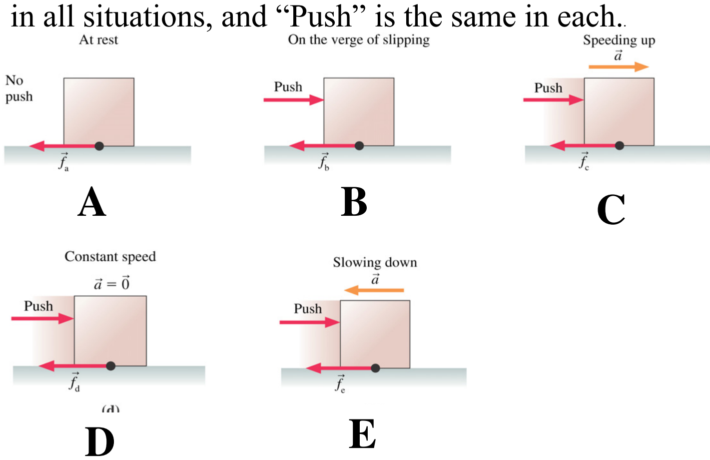
$$T_{S1} - W_{S1} = M_1 a_1$$
$$T_{S2} - W_{S2} = M_2 a_2$$

A. $T_{S1} = T_{S2}$ $\quad a_1 = a_2$
B. $T_{S1} = T_{S2}$ $\quad a_1 = -a_2$
C. $\dfrac{T_{S1}}{M_1} = \dfrac{T_{S2}}{M_2}$ $\quad a_1 = -a_2$
D. $M_1 T_{S1} = M_2 T_{S2}$ $\quad a_1 = a_2$
E. $T_{S1} = T_{S2}$ $\quad m_1 a_1 = -m_2 a_2$

C8 Q2 10 Oct 08

Rank order, from largest to smallest, the size of the friction forces $\vec{f}_a$ to $\vec{f}_e$ in these 5 different situations.

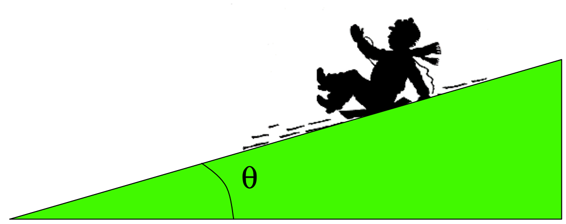
The box and the floor are made of the same materials in all situations, and "Push" is the same in each.

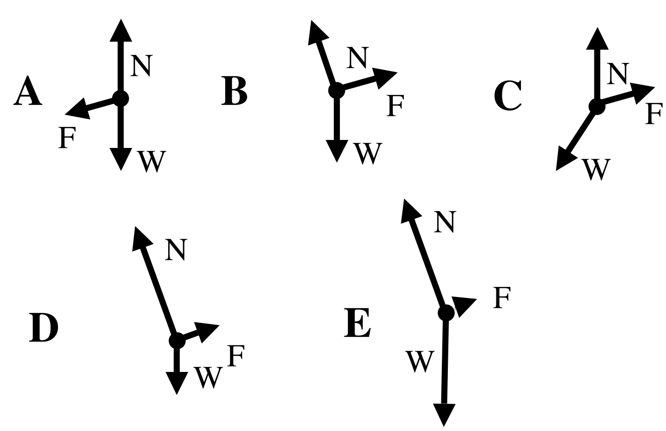


A. $f_E > f_D > f_C > f_B > f_A$.
B. $f_B > f_C > f_D > f_E > f_A$.
C. $f_A > f_C = f_D = f_E > f_B$.
D. $f_A = f_B > f_C = f_D = f_E$.
E. $f_B > f_C = f_D = f_E > f_A$.

C9 Q1 15 Oct 08

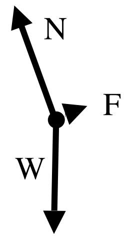
A student of mass m = 60 kg slides down a grassy hill with angle θ = 20° to horizontal. The coefficient of kinetic friction between her cardboard seat and the grass $\mu_k = 0.2$. Which of the following is the appropriate free body diagram?





C9 Q2 15 Oct 08

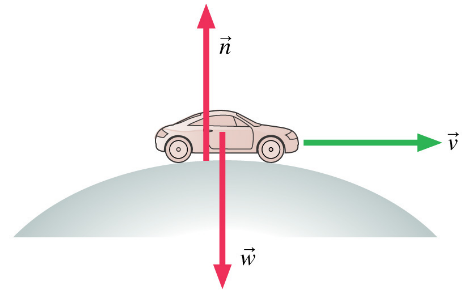
Now that we have the correct free body diagram, what are the correct equations to solve for the acceleration down the slope?



A. $mg = N\sin\theta \qquad F = \mu N\cos\theta = ma$
B. $N = mg\cos\theta \qquad N\sin\theta - \mu N = ma$
C. $mg = N\cos\theta \qquad N\sin\theta - \mu N\cos\theta = ma$
D. $mg = N \qquad mg\sin\theta - \mu N = ma$
E. $N = mg\cos\theta \qquad mg\sin\theta - \mu N = ma$

C9 Q3 15 Oct 08

A car is rolling over the top of a hill at speed *v*. At this instant,



A. $n > w$.
B. $n = w$.
C. $n < w$.
D. We can't tell about *n* without knowing *v*.

An engineer is designing a banked curve. For a radius of curvature *r*, maximum car speed *v*, gravitational acceleration *g*, what should she use as the banking angle (angle of road wrt horizontal) if she does not want to require friction for a car to navigate the curve?

A. $\sin\theta = \dfrac{rg}{v^2}$

B. $\tan\theta = \dfrac{v^2}{gr}$

C. $g\cos\theta = \dfrac{v^2}{r}$

D. $\sin\theta = \dfrac{v^2}{rg}$

E. *need to know mass*

C9 Qskipped 15 Oct 08

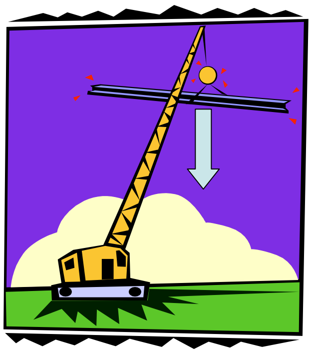
Working Newton's Law Problems

1. Draw a diagram
2. Determine what forces are present and what you want to learn
3. Draw FBD for each entity
4. Pick coordinate system
5. Write down components of vector force equations for each object, plus any 3rd law pairs and relations between accelerations (keeping consistent signs).
6. Check # of equations = # of unknowns
7. Solve.
8. Do a reality check.

Things to remember:

- If a = 0 (v = constant or zero) then $F_{net} = 0$.
- If going in a circle, then $\vec{\mathbf{F}}_{net} = -\dfrac{mv^2}{r}\hat{\mathbf{r}}$
- "Fictitious" forces are not on your FBD.
- Tension is constant in massless, frictionless rope; Pulleys can change its direction.
- Kinetic friction is always $F_{kin} = \mu_k N$
- Static Friction $F_{stat} \le \mu_s N$
- Normal force ⊥, Friction force | |

A crane lowers a steel girder into place at a construction site. The girder moves with constant speed. Consider the work W_g done by gravity and the work W_T done by the tension in the cable. Which of the following is correct?

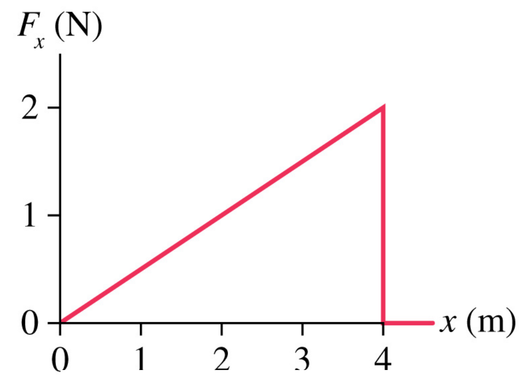


A. W_g is positive and W_T is positive.
B. W_g is negative and W_T is negative.
C. W_g is positive and W_T is negative.
D. W_g is negative and W_T is positive.
E. W_g and W_T are both zero.

C11 Q1

20 Oct 08

A particle moving along the x-axis experiences the force shown in the graph. If the particle has 2.0 J of kinetic energy as it passes $x = 0$ m, what is its kinetic energy when it reaches $x = 4$ m?

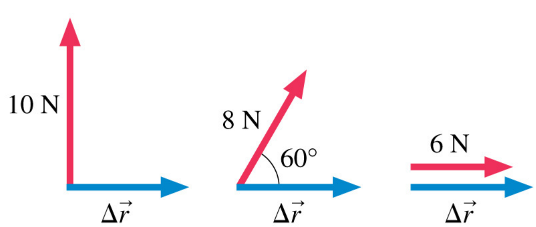


A. – 2.0 J
B. 0.0 J
C. 2.0 J
D. 4.0 J
E. 6.0 J

C11 Q2

20 Oct 08

Which force does the most work?

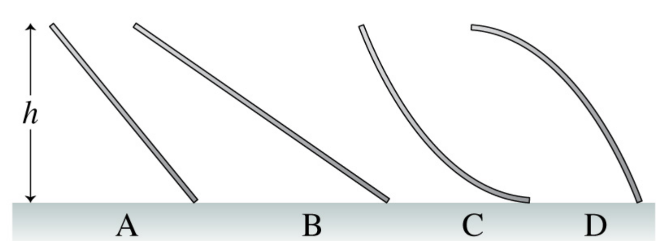


A. The 6 N force.
B. The 8 N force.
C. The 10 N force.
D. They all do the same amount of work.

C11 Q3

20 Oct 08

A small child slides down the four frictionless slides A–D. Each has the same height. Rank in order, from largest to smallest, her speeds v_A to v_D at the bottom

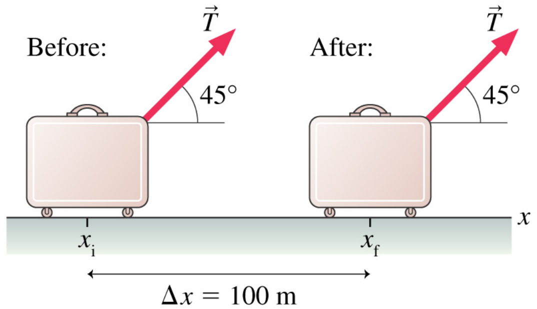


A. $v_A = v_B = v_C = v_D$
B. $v_D > v_A = v_B > v_C$
C. $v_D > v_A > v_B > v_C$
D. $v_C > v_A = v_B > v_D$
E. $v_C > v_B > v_A > v_D$

C11 Q4

20 Oct 08

A student pulls a suitcase with a handle at 45° a distance of 100 m. If T = 100 N, how much work does the student do on the suitcase?

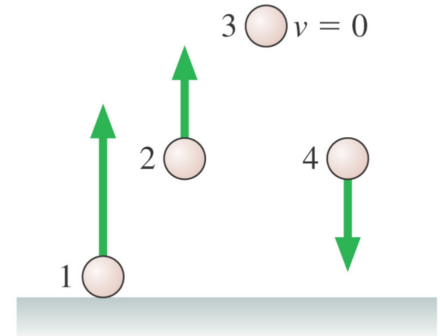


A. 10,000 J
B. 7100 J
C. It depends on the coefficient of friction.
D. It depends on the mass of the suitcase.
E. It depends on whether or not the suitcase is accelerating

C11 Q5

20 Oct 08

Rank in order, from largest to smallest, the gravitational potential energies of balls 1 to 4.
(green arrow denotes velocity)



A. $(U_g)_1 > (U_g)_2 > (U_g)_3 > (U_g)_4$
B. $(U_g)_4 > (U_g)_3 > (U_g)_2 > (U_g)_1$
C. $(U_g)_1 > (U_g)_2 = (U_g)_4 > (U_g)_3$
D. $(U_g)_3 > (U_g)_2 = (U_g)_4 > (U_g)_1$
E. $(U_g)_4 = (U_g)_2 > (U_g)_3 > (U_g)_1$

C12 Q1

22 Oct 08

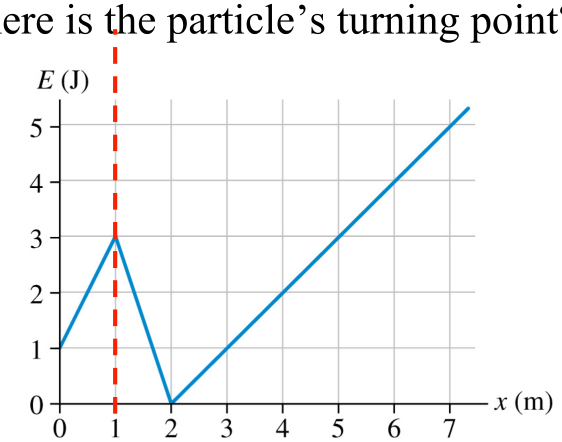
A spring-loaded gun shoots a plastic ball with a speed of 4 m/s. If the spring is compressed twice as far, the ball's speed will be

A. 16 m/s.
B. 8 m/s.
C. 4 m/s.
D. 2 m/s.
E. 1 m/s.

C12 Q2

22 Oct 08

A particle with the potential energy shown in the graph is moving to the right.
It has 1 J of kinetic energy at $x = 1$ m.
Where is the particle's turning point?

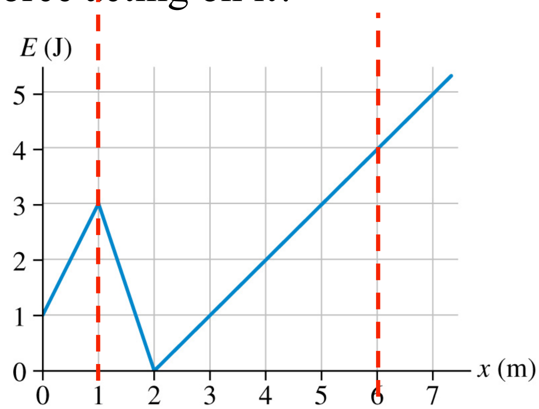


A. $x = 2$ m
B. $x = 3$ m
C. $x = 4$ m
D. $x = 5$ m
E. $x = 6$ m

C12 Q3

22 Oct 08

A particle with the potential energy shown in the graph is moving to the right.
When it turns around at $x = 6$ m, what is the force acting on it?

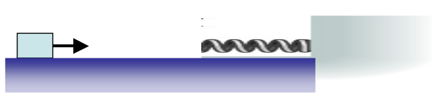


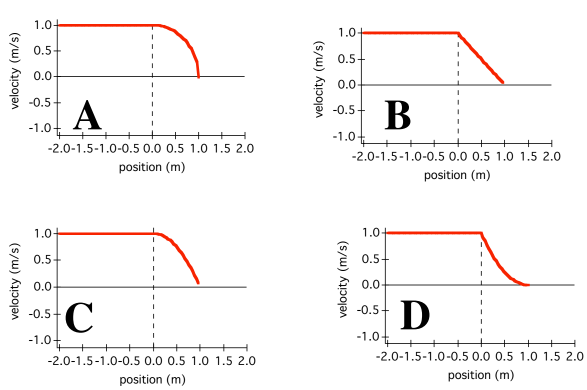
A. $F = \ \ 4$ N
B. $F = -4$ N
C. $F = \ \ 1$ N
D. $F = -1$ N
E. $F = \ \ 0$ N

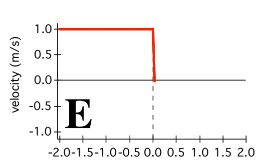
Which of the following is not a conservative force?

A. *Gravity*
B. *Spring Force*
C. *Normal Force*
D. *String tension*
E. *Both C and D.*

A mass approaches a relaxed spring with spring constant $k = 2$ N/m. It has kinetic energy K=1 J (m =2.0 kg, $v = 1$ m/s).
Which of these graphs reflects its <u>*speed*</u> as a function of position ($x = 0$ = collision)?







A student with $m = 50$ kg bungee jumps off a bridge of height $H = 50$ m. The equilibrium length of the bungee cord (without student on it) $L_o = 20$ m.
What bungee cord spring constant is needed to keep the student from hitting the water?
(take $g = 10$ m/s² and ignore student's height)

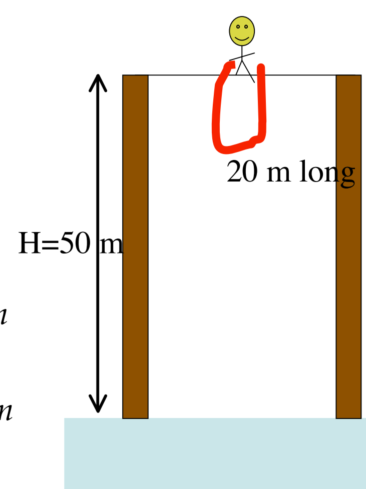
A. $\frac{mg}{h} = 10\ N/m$

B. $\frac{2mgH}{L_o^2} = 125\,N/m$

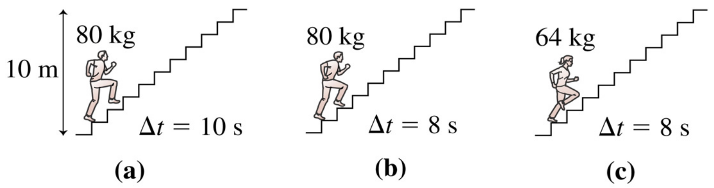
C. $\frac{mgH}{L_o^2} = 63\ N/m$

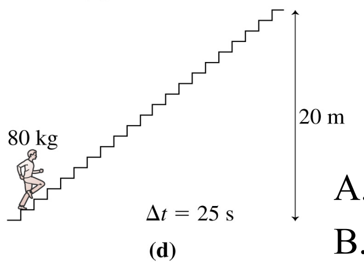
D. $\frac{mg}{(H - L_o)} = 17\ N/m$

E. $\frac{2mgH}{(H - L_o)^2} = 56\ N/m$



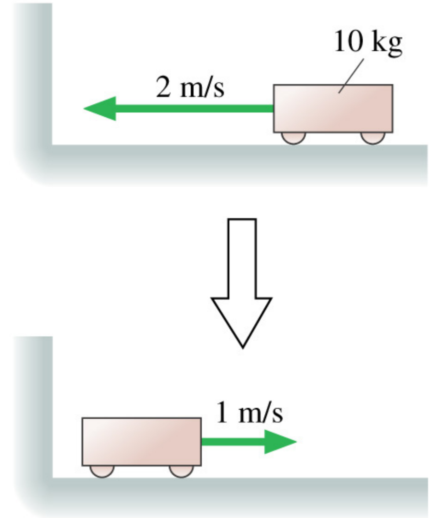
Four students run up the stairs in the time shown. Rank in order, from largest to smallest, their power outputs P_a to P_d.





A. $P_b > P_a = P_c > P_d$
B. $P_d > P_a = P_b > P_c$
C. $P_d > P_b > P_a > P_c$
D. $P_b > P_a > P_c > P_d$
E. $P_c > P_b = P_a > P_d$

C13 Q4 24 Oct 08



The cart's change of momentum is

A. –30 kg m/s.
B. –20 kg m/s.
C. –10 kg m/s.
D. 10 kg m/s.
E. 30 kg m/s.

C14 Q1 27 Oct 08

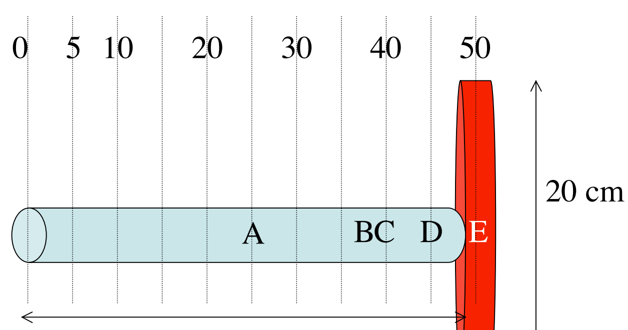
A 10 g rubber ball and a 10 g clay ball are thrown at a wall with equal speeds. The rubber ball bounces, the clay ball sticks. Which ball exerts a larger impulse on the wall, and why?

A. The clay ball exerts a larger impulse because it sticks.
B. The rubber ball exerts a larger impulse because it bounces.
C. They exert equal impulses because they have equal momenta.
D. Neither exerts an impulse on the wall because the wall doesn't move.

C14 Q2 27 Oct 08

A Disk of radius R = 10 cm and mass M = 4 kg is attached to the end of a rod of length L = 50 cm and mass 1 kg.

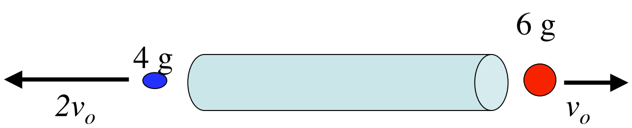
Where is the center of mass of this object?



A. 25 cm
B. 37.5 cm
C. 40 cm
D. 45 cm
E. 50 cm

C15 Q1 29 Oct 08

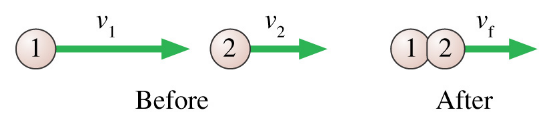
An explosion in a rigid pipe shoots out three pieces. A 6 g piece comes out the right end. A 4 g piece comes out the left end with twice the speed of the 6 g piece. From which end does the third piece emerge?



A. Right end
B. Left end
C. Not enough information

C15 Q2 29 Oct 08

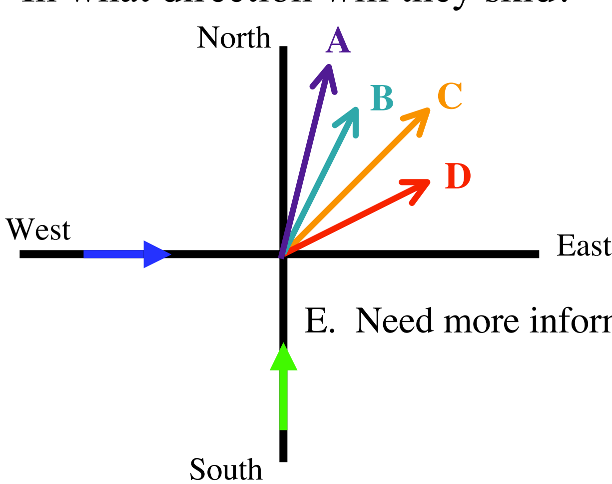
The two particles are both moving to the right. Particle 1 catches up with particle 2 and collides with it. The particles stick together and continue on with velocity v_f. Which of these statements is true?



A. v_f is greater than v_1.
B. $v_f = v_1$.
C. v_f is less than v_2.
D. $v_f = v_2$.
E. v_f is greater than v_2, but less than v_1.

C16 Q1 31 Oct 08

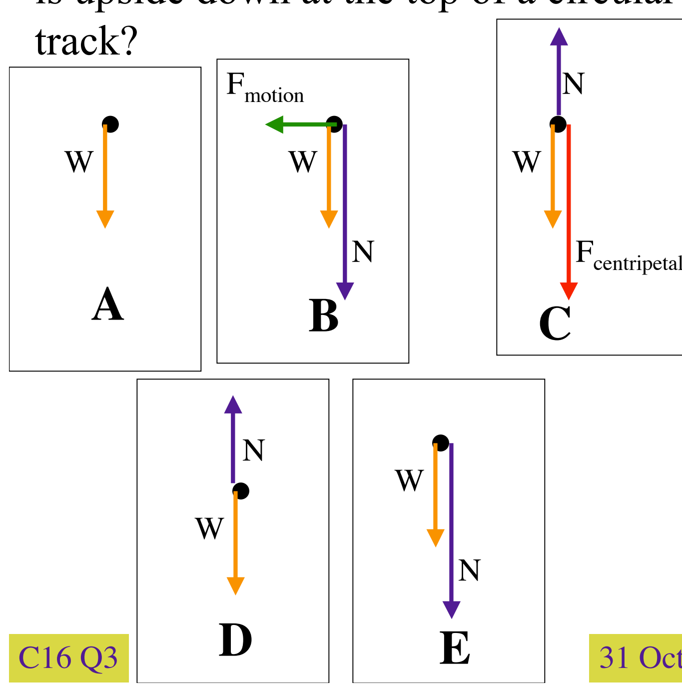
A 1000 kg car enters an intersection from the west and a 2000 kg SUV enters from the south. They have the same speed until they crash at the center of the intersection and then skid. In what direction will they skid?



E. Need more information

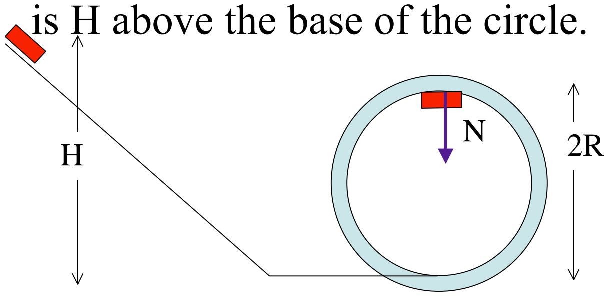
C16 Q2 31 Oct 08

A frictionless car has enough energy to successfully navigate a vertical circle. Which of the following free body diagrams best describes the car when it is upside down at the top of a circular track?



C16 Q3 31 Oct 08

Now that we have the right free body diagram, what equation can we use to find the normal force? The circle has radius R and the initial height of the car is H above the base of the circle.



A. mg

B. $mg\left(\frac{H}{2R}\right)$

C. $mg\left(2\frac{H}{R}-5\right)$

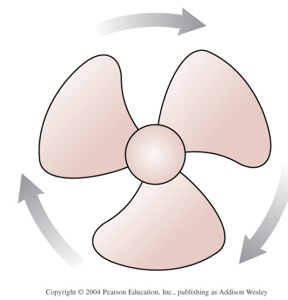
D. $2mg\left(\frac{H}{R}-2\right)$

E. $mg\left(\frac{2H}{R}\right)$

C16 Q4

31 Oct 08

The fan blade is slowing down.
What are the signs of ω and α?

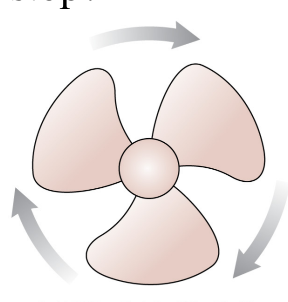


A. ω is positive and α is positive
B. ω is positive and α is negative
C. ω is negative and α is positive
D. ω is negative and α is negative

C17 Q1

05 Nov 08

The fan blade is slowing down.
It has a frequency $f = 1$ cycle/second and angular acceleration $\alpha = 1$ rad/s^2.
When will it stop?

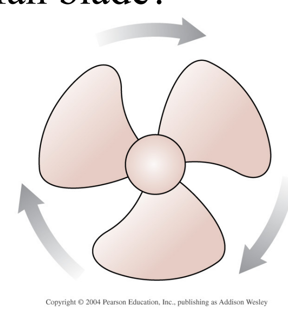


A. 1 sec
B. 2π sec
C. 1/2π sec
D. 2 sec
E. π sec

C17 Q2

05 Nov 08

The edge of the fan blade is 10 cm from the center of rotation.
It has a frequency $f = 1$ cycle/second.
What is the speed of a point on the edge of the fan blade?

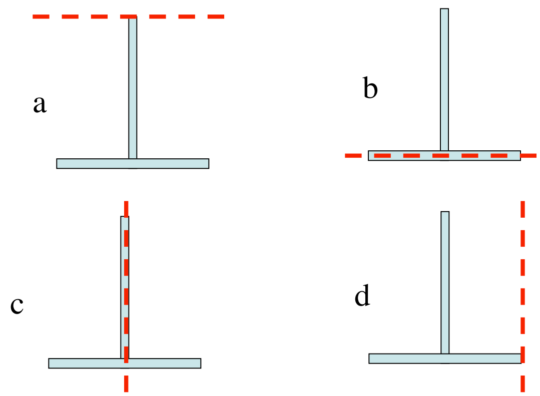


A. 10 cm/sec
B. 20π cm/sec
C. 1/20π cmsec
D. 20 cm/sec
E. 10π cm/sec

C17 Q3

05 Nov 08

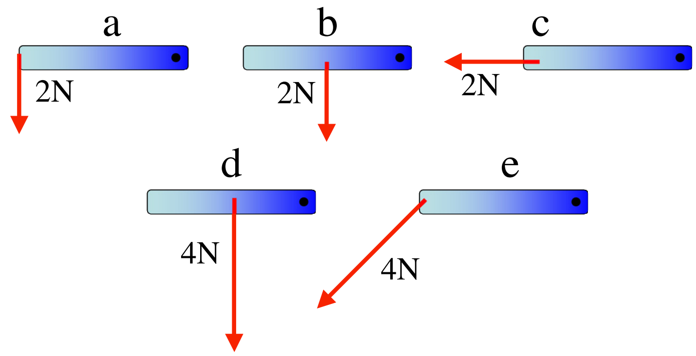
Four Ts are made from two identical rods of equal mass and length. Rank in order, from largest to smallest, the moments of inertia I_a to I_d for rotation about the dotted line.



A. $I_c > I_b > I_d > I_a$
B. $I_c = I_d > I_a = I_b$
C. $I_a = I_b > I_c = I_d$
D. $I_a > I_d > I_b > I_c$
E. $I_a > I_b > I_d > I_c$

C18 Q1 07 Nov 08

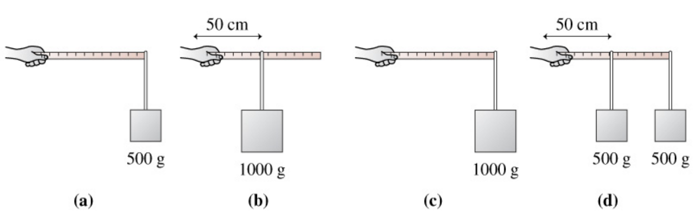
Rank in order, from largest to smallest, the five torques. The rods all have the same length and are pivoted at the dot.



A. $\tau_e > \tau_a = \tau_d > \tau_b > \tau_c$
B. $\tau_d = \tau_e > \tau_a = \tau_b = \tau_c$
C. $\tau_d > \tau_e > \tau_a = \tau_b > \tau_c$
D. $\tau_d = \tau_e > \tau_d = \tau_b > \tau_c$
E. $\tau_e > \tau_a > \tau_d > \tau_b > \tau_c$

C19 Q1 10 Nov 08

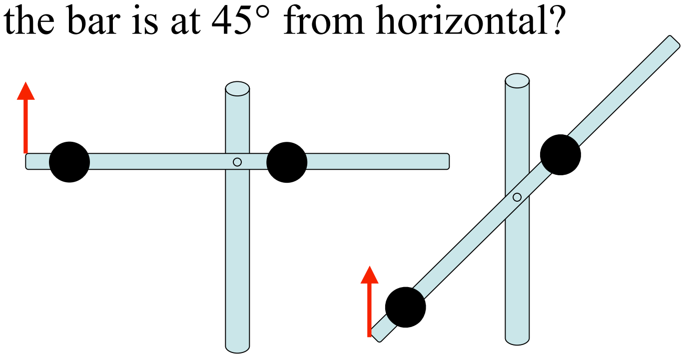
A student holds a meter stick straight out with one or more masses dangling from it. Rank in order, from most difficult to least difficult, how hard it will be for the student to keep the meter stick from rotating.



A. c > d > b > a
B. b = c = d > a
C. c > b > d > a
D. b > d > c > a
E. c > d > a = b

C19 Q2 10 Nov 08

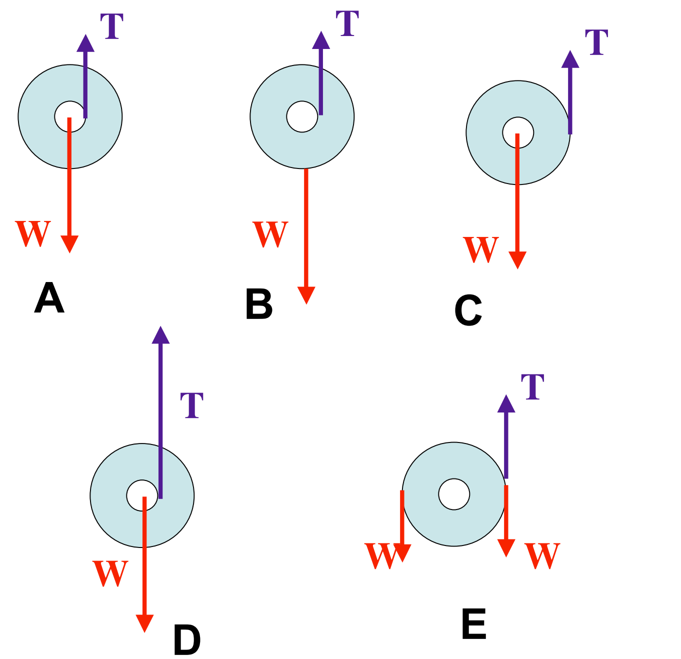
The bar is balanced with a vertical force $F = 10$ N applied at the end. What vertical force is required when the bar is at 45° from horizontal?



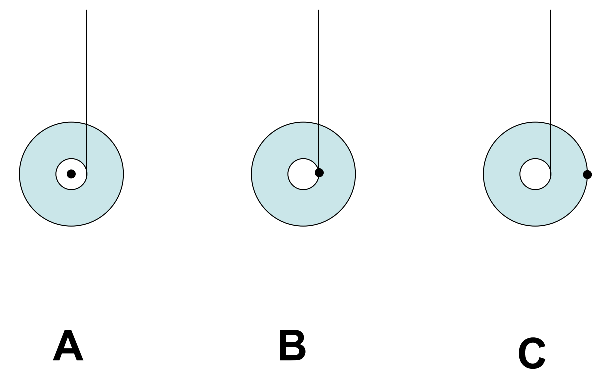
A. 10 N
B. 14 N
C. 7 N
D. 20 N
E. Need more information

C20 Qskipped 12 Nov 08

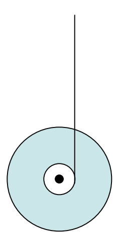
Which is the correct extended free body diagram for a descending yo-yo?



Around which axis should you calculate the torque to find the tension and angular acceleration?

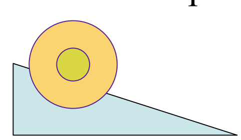


Which two equations will give you the tension T and the angular acceleration α? Let r = shaft radius, I = Yo-yo moment of inertia, M = mass of yo-yo.

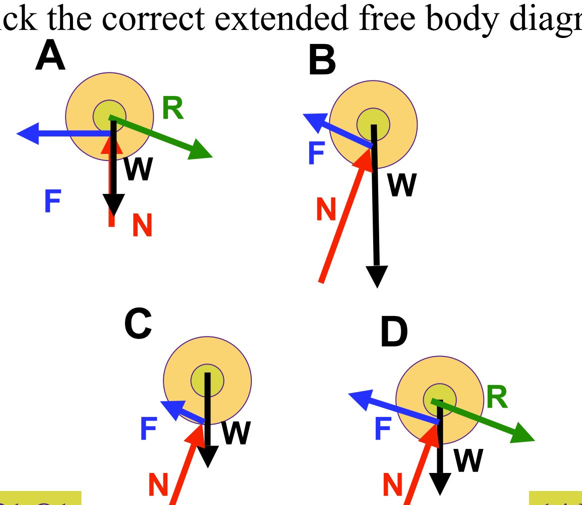


A.	$T = Mg$	$Mgr = IT / R$
B.	$T - Mg = -M\alpha R$	$rT = I\alpha$
C.	$T = M(g - \alpha R)$	$Mgr = I\alpha$
D.	$T = M\alpha$	$rT = I\alpha$
E.	$T = Mg$	$RT = I\alpha$

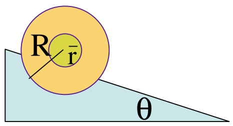
A spool with outer radius R and shaft radius r rolls without slipping down a ramp at an angle θ relative to the horizontal. It rolls on its shaft (see demo). Your goal in the next few clicker questions is to find the frictional force between the shaft and the ramp.

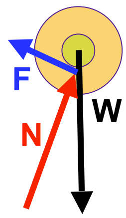


Pick the correct extended free body diagram.



Now that you have the E-FBD, which of these equations is not true?





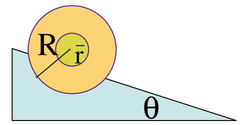
A. $mg\sin\theta - F_f = ma$

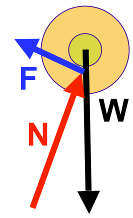
B. $mg\cos\theta - N = 0$

C. $F_f r = I\alpha$

D. $a = \alpha r$

E. $F_f = \mu N$





Solve the relevant equations from previous question for F_f.

A. $mg\sin\theta$

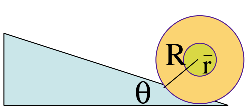
B. $\dfrac{mg\sin\theta}{1+\dfrac{mr^2}{I}}$

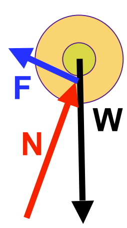
C. $\dfrac{I}{r^2}g$

D. $\dfrac{mg\sin\theta}{1-\dfrac{mr^2}{I}}$

E. $\mu_s mg\cos\theta$

At the instant the spool's outer rim hits the floor. What changes?





A. F_f

B. V_{CM}

C. ω

D. all of the above

E. just V_{CM} and ω

A train of mass m starts from rest an accelerates up to speed v_T relative to the ground on a circular track of mass M. The track is mounted on a frictionless bearing. The radius of the track is R, so its moment of inertia $I \sim MR^2$. What is the speed of a point on the edge of the track (relative to the ground) once the train has reached speed v_T?

A. v_T

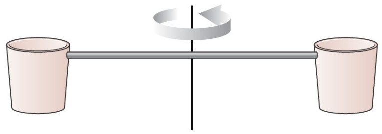
B. 0

C. $\dfrac{M}{m}v_T$

D. $\dfrac{m}{M}v_T$

E. $(M-m)v_T$

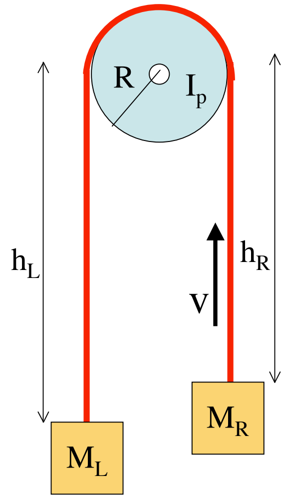
Two buckets spin around in a horizontal circle on frictionless bearings. Suddenly, it starts to rain. As a result,



A. The buckets slow down because the angular momentum of the bucket + rain system is conserved.
B. The buckets continue to rotate at constant angular velocity because the rain is falling vertically while the buckets move in a horizontal plane.
C. The buckets continue to rotate at constant angular velocity because the total mechanical energy of the bucket + rain system is conserved.
D. The buckets speed up because the potential energy of the rain is transformed into kinetic energy.
E. None of the above.

C22 Q2 17 Nov 08

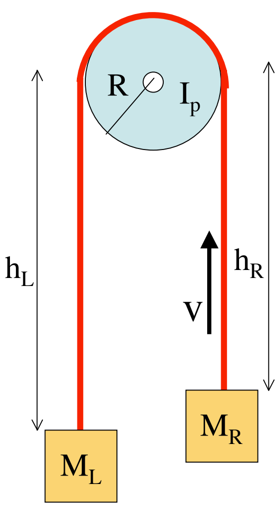
Consider an Attwood's Machine. What is the total angular momentum around the center of the pulley?



A. $I\frac{v}{R}$
B. $(M_L + M_R + \frac{I}{R^2})Rv$
C. $(M_L - M_R + \frac{I}{R^2})Rv$
D. $(M_L h_L + M_R h_R)v$
E. $(M_L - M_R)Rv$

C22 Q3 17 Nov 08

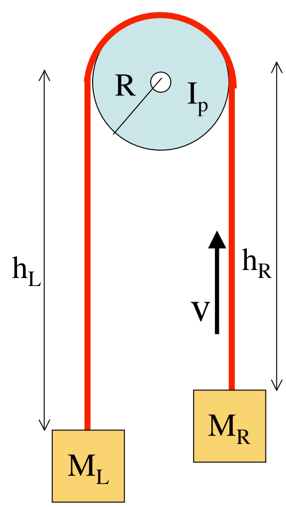
Consider an Attwood's Machine. What is the total torque around the center of the pulley?



A. 0
B. $Rg(M_L - M_R)$
C. $M_L h_L g - M_R h_R g$
D. $Rg(M_L + M_R)$
E. $Rg\left(M_L + M_R + \frac{I}{R^2}\right)$

C22 Q4 17 Nov 08

Given your answers to the previous, what is the acceleration?



A. 0
B. g
C. $g\frac{M_L - M_R}{M_L + M_R}$
D. $g\frac{M_L - M_R}{M_L + M_R + \frac{I}{R^2}}$
E. $g\frac{M_L + M_R + \frac{I}{R^2}}{M_L - M_R}$

C23 Q1 19 Nov 08

A wheel with moment of inertia I_w is spinning clockwise with angular frequency ω_o. A brake is attached to a frame that can rotate, with moment of inertia I_f. The brake pushes in to the wheel and eventually the wheel is at rest relative to the frame. What is the final state of the wheel + frame?

A. Both at rest
B. Spinning clockwise
angular frequency ω_o
C. Spinning clockwise,
angular frequency $\omega_o \, I_f/I_w$
D. Spinning clockwise,
angular frequency $\omega_o \, (I_f+I_w)/I_w$
E. Spinning counterclockwise,
angular frequency $\omega_o \, (I_f+I_w)/I_w$

A stick of mass M *and* length L is at rest on a frictionless table. A small coated disk of mass m and speed v_o hits the stick a distance x from the center.

Which principles will allow you to solve for the final motion of the stick+disk?

A. Conservation of Energy
B. Conservation of Momentum
C. Conservation of Angular Momentum
D. A, B and C
E. B and C only

A stick of mass M *and* length L is at rest on a frictionless table. A small coated disk of mass m and speed v_o hits the stick a distance x from the center.

What is the right moment of inertia to use?

$$x_o = \frac{m}{M+m}x \qquad x - x_o = \frac{M}{M+m}x$$

A. $\frac{1}{12}ML^2 + mx^2$

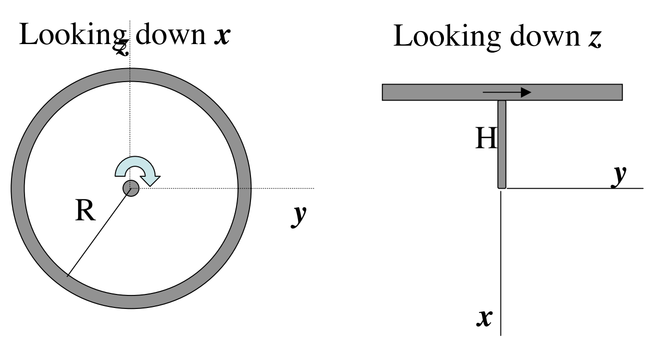
B. $\frac{1}{3}ML^2 + mx^2$

C. $\frac{1}{12}ML^2 + m(x-x_o)^2 + Mx_o^2$

D. $\frac{1}{12}ML^2 + m(x-x_o)^2$

E. $\frac{1}{12}ML^2 + mx^2 + Mx_o^2$

A wheel is spinning clockwise as viewed from a handle coming out from its center. It is suspended from a rope at the end of the handle. The wheel has radius R, mass M and angular speed ω.
The handle has length H.
At the instant that the handle is along the x axis, what is the torque on the wheel?



A. $-MgR\,\hat{\mathbf{z}}$
B. $MgH\,\hat{\mathbf{z}}$
C. $MgH\,\hat{\mathbf{y}}$
D. $MgR\,\hat{\mathbf{x}}$
E. $-MgH\,\hat{\mathbf{y}}$

The gravitational attraction between the Earth and a 60 kg student is about 600 N ($F = mg$). What is the approximate gravitational attraction between two 60 kg students sitting 2 meters apart? Model them as non-overlapping, constant density spheres with R < 1 m.

A. 60 Newton
B. 60 milliNewton
C. 60 microNewton
D. 60 nanoNewton
E. 60 picoNewton

$$milli = 10^{-3}$$
$$micro = 10^{-6}$$
$$nano = 10^{-9}$$
$$pico = 10^{-12}$$

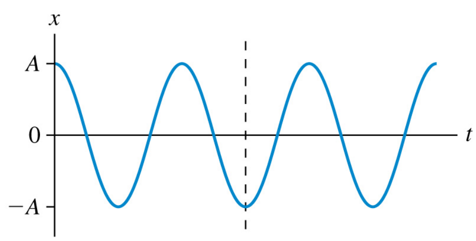
C24 Q1 26 Nov 08

A rocket is launched from the surface of the Earth with twice the escape velocity, v_{esc} (2*11.2 km/s = 22 km/s). What will be its speed when it leaves the solar system?

A. It never leaves, but will go into orbit
B. v_{esc}
C. $\sqrt{2}\ v_{esc}$
D. $\sqrt{3}\ v_{esc}$
E. $0.75\ v_{esc}$

C24 Q2 26 Nov 08

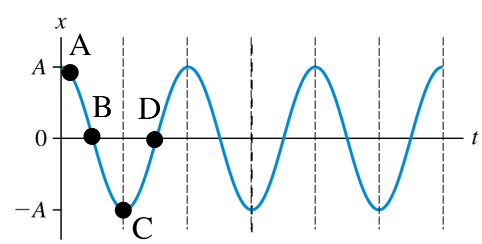
This is the position graph of a mass on a spring. What can you say about the velocity and the force at the instant indicated by the dotted line?



A. Velocity is positive; force is positive
B. Velocity is negative; force is negative
C. Velocity is negative; force is zero.
D. Velocity is zero; force is positive.
E. Velocity is zero; force is negative.

C25 Q1 01 Dec 08

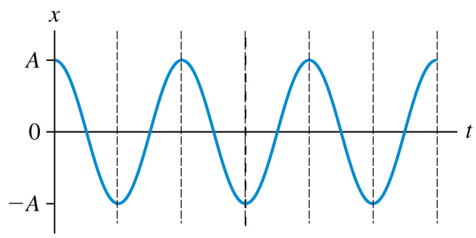
This is the position graph of a mass on a spring. At which point (A,B,C,D) is the **potential energy** stored in the spring at a maximum? The dashed lines are 1 second apart.



A. $t = 0.1$ sec
B. $t = 0.5$ sec.
C. $t = 1.0$ sec.
D. $t = 1.5$ sec.
E. None of the above.

C25 Q2 01 Dec 08

This is the position graph of a mass on a spring. The dashed lines are 1 second apart. Which of the following is a true statement?

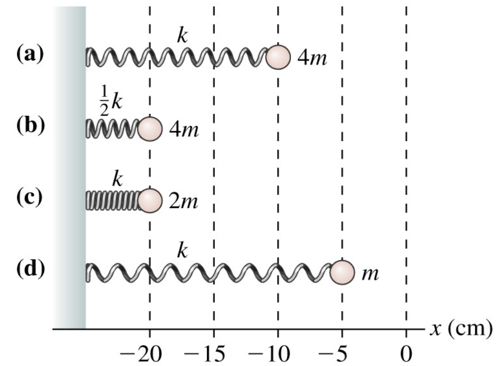


A. Velocity oscillates with period **4 seconds**.
B. Kinetic Energy oscillates with period **1 seconds**.
C. Total Energy oscillates with period **2 seconds**.
D. Force oscillates with period **1 second**.
E. Potential energy oscillates with period **2 second.**

C25 Q3

01 Dec 08

Four springs have been compressed from their equilibrium position at $x = 0$ cm. When released, they will start to oscillate. Rank in order, from highest to lowest, the maximum speeds of the oscillators.



A. c > b > a = d

B. c > b > a > d

C. d > a > b > c

D. a = d > b > c

E. b > c > a = d

C25 Q4

01 Dec 08

Consider a pendulum consisting of a pendulum bob of mass m suspended from a string of length L that is placed at an angle θ and then released. Which of the following statements is false?

A. The larger θ is, the larger the restoring force.

B. The larger θ is, the longer it takes the pendulum to reach the bottom of the swing.

C. The larger *m* is, the larger the restoring force.

D. Changing the mass does not affect the time to reach the bottom of the swing.

E. The longer the string, the longer it takes to reach the bottom of the swing.

C26 Q1

03 Dec 08

An oscillator is damped so that the amplitude decays as $A = A_o e^{-t/\tau}$. What is the correct expression for the total energy?

A. $E = E_o e^{-t/\tau}$

B. $E = E_o e^{-2t/\tau}$.

C. $E = E_o e^{-t/2\tau}$

D. $E = E_o$

E. None of the above

C26 Q2

03 Dec 08