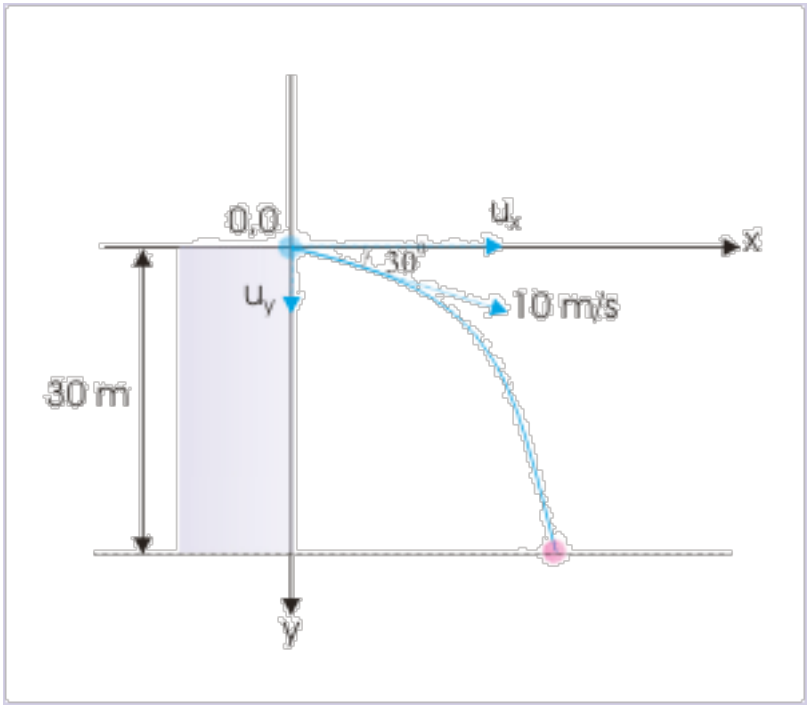
Closed book. No work needs to be shown for multiple-choice questions.

1. A ball from a tower of height 30 m is projected down at an angle of 30° from the horizontal with a speed of 10 m/s. How far horizontally from the base of the building will the ball strike the ground?.



a. 10 m.
b. 17 m.
c. 20 m.
d. 23 m.
e. 30 m.

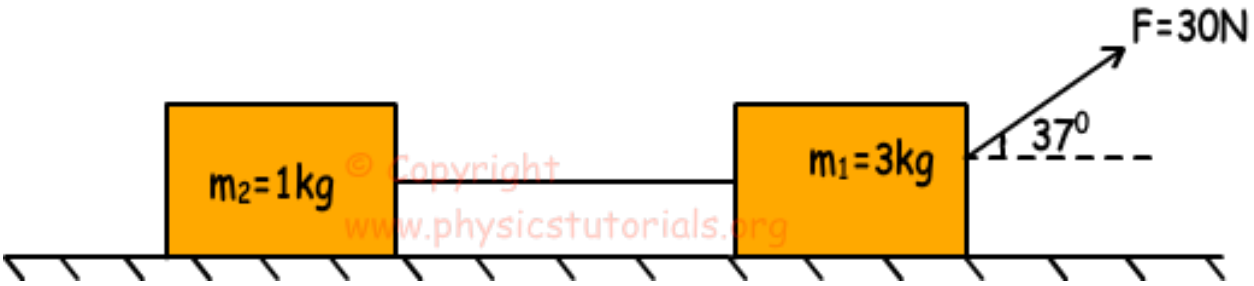
2. A boy kicks a soccer ball directly at a wall 41.8 m away. The ball leaves the ground at 42.7 m/s with an angle of 33.0 degrees to the ground. What height will the ball strike the wall?

a. 18.2 m.
b. 23.3 m.
c. 27.6 m.
d. 20.5 m.
e. 14.4 m.

3. A motorboat traveling 4 m/s, East encounters a current traveling 7.0 m/s, North. If the width of the river is 80 meters wide, then how much time does it take the boat to travel shore to shore?

a. 10 s.
b. 15 s.
c. 20 s.
d. 25 s.
e. 30 s.

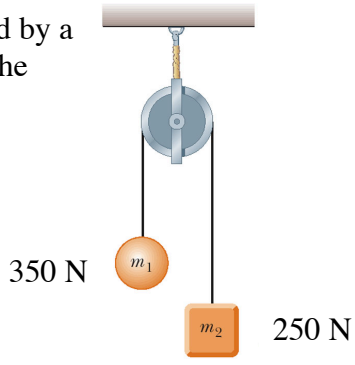
4. Picture given below shows the motion of two boxes under the effect of applied force. There is no friction constant between the box and the surface. Find the acceleration of the boxes.



a. 3 m/s.
b. 4.5 m/s.
c. 6.0 m/s.
d. 10.0 m/s.
e. 30.0 m/s.

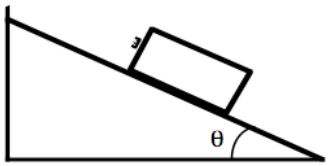
5. Two blocks, weighing 250 N and 350 N, respectively, are connected by a string that passes over a massless pulley as shown. The tension in the string is:

a. 210 N.
b. 290 N.
c. 410 N.
d. 500 N.
e. 4900 N.



6. A 20-N crate starting at rest slides down a smooth 5.0-m long ramp, inclined at 25°. What will be the speed of the crate at the bottom of the incline? (you have to find the acceleration first)

a. 0.98 m/s.
b. 4.7 m/s.
c. 8.4 m/s.
d. 3.5 m/s.
e. 6.4 m/s.



7. Suppose that a student pulls with two large forces (F_1 and F_2) in order to lift a 1-kg book by two similar cables. If both cables make a 1-degree angle with the horizontal, then what is the tension in the cable?

a. 70 N.
b. 482 N.
c. 141 N.
d. 281 N.
e. 210 N.

8. A constant net force of 8.0 N is exerted for 4.0 sec on a 16 kg object initially at rest. The change in speed at the end of the 4.0 sec for this object will be:

a. 0.5 m/s.
b. 2.0 m/s.
c. 4.0 m/s.
d. 8.0 m/s.
e. 32 m/s.

Equations and constants:

$$\left\{\begin{array}{l} x = r\cos\theta \\ y = r\sin\theta \end{array}\right\};\quad \left\{\begin{array}{l} r = \sqrt{x^2 + y^2} \\ \theta = \tan^{-1}\left(\dfrac{y}{x}\right) \end{array}\right\};\quad \left\{\begin{array}{l} v_x = v_{ox} + a_x t \\ \Delta x = \frac{1}{2}\left(v_{ox} + v_x\right)t \\ \Delta x = v_{ox}t + \frac{1}{2}a_x t^2 \\ v_x^2 = \left(v_{ox}\right)^2 + 2a_x\Delta x \end{array}\right\};\quad \left\{\begin{array}{l} v_y = v_{oy} + a_y t \\ \Delta y = \frac{1}{2}\left(v_{oy} + v_y\right)t \\ \Delta y = v_{oy}t + \frac{1}{2}a_y t^2 \\ v_y^2 = \left(v_{oy}\right)^2 + 2a_y\Delta y \end{array}\right\};$$

$$\left\{\begin{array}{l} \Delta x = x_f - x_i \\ \\ speed_{avg} = \dfrac{d}{\Delta t} \end{array}\right\};$$

$\vec{v}_{AE} = \vec{v}_{AB} + \vec{v}_{BE}$ - relative motion

$\vec{a} = \vec{a}_r + \vec{a}_t$ where $a_r = v^2/r$ - circular motion

$range = v_o^{\,2}\sin(2\theta_o)/g$

$\max - height = v_o^{\,2}\sin^2(\theta_o)/2g$ - projectile motion when initial and final height are the same

$$\left\{\begin{array}{l} a_{avg} = \dfrac{\Delta v}{\Delta t} \\ \\ v_{avg} = \dfrac{\Delta x}{\Delta t} \end{array}\right\};\quad \left\{\begin{array}{l} a = \lim\limits_{\Delta t\to 0}\dfrac{\Delta v}{\Delta t} \\ \\ v = \lim\limits_{\Delta t\to 0}\dfrac{\Delta x}{\Delta t} \end{array}\right\};\quad \left\{\begin{array}{c} \sum \vec{\mathbf{F}} = 0;\ \vec{\mathbf{a}} = 0 \\ \sum \vec{\mathbf{F}} = m\vec{\mathbf{a}} \\ \vec{\mathbf{F}}_{2on1} = -\vec{\mathbf{F}}_{1on2} \end{array}\right\};\quad \left\{\begin{array}{l} F = G\dfrac{Mm}{r^2} \\ G = 6.67\times 10^{-11}\ \mathrm{N\cdot m^2/kg^2} \end{array}\right\};;$$

$\vec{\mathrm{v}}_{\mathrm{AC}} = \vec{\mathrm{v}}_{\mathrm{AB}} + \vec{\mathrm{v}}_{\mathrm{BC}};$

$g = 9.80\ \mathrm{m/s^2};\ 100\ \mathrm{cm} = 1\ \mathrm{m};\ 1{,}000\ \mathrm{m} = 1\ \mathrm{km};\ 60\ \mathrm{s} = 1\ \mathrm{min};\ 60\ \mathrm{min} = 1\ \mathrm{hr};\ 2.54\ \mathrm{cm} = 1\ \mathrm{in};$

$12\ \mathrm{in} = 1\ \mathrm{ft};\ 5{,}280\ \mathrm{ft} = 1\ \mathrm{mi};\ 1{,}609\ \mathrm{m} = 1\ \mathrm{mi};\ 0.3048\ \mathrm{m} = 1\ \mathrm{ft}.$