NOTE: For problems involving gravitational force, use $g = 9.80\ \text{m/s}^2$ unless otherwise specified.

1 A 100-kg box rolls down a 20° incline. A man tries to keep it from accelerating, and manages to keep its acceleration to 1.2 m/s^2. If the box rolls 5 m, what is the net work (in J) done on it by all the forces acting on it?

A) 60 B) 100 C) 600 D) 1000 E) 4900

2 Two objects with masses, m_1 and m_2, have the same kinetic energy and are both moving to the right. The same constant force $\vec{F}$ is applied to the left to both masses. If $m_1 = 4m_2$, the ratio of the stopping distance of m_1 to that of m_2 is:

A) 1:4 B) 4:1 C) 1:2 D) 2:1 E) 1:1

3 The same force F is applied horizontally to bodies 1, 2, 3 and 4, of masses m, $2m$, $3m$ and $4m$, initially at rest and on a frictionless surface, until each body has traveled distance d. The correct listing of the magnitudes of the velocities of the bodies, v_1, v_2, v_3, and v_4 is

a. $v_4 = \sqrt{\frac{4}{3}}v_3 = \sqrt{\frac{3}{2}}v_2 = 2v_1.$

b. $v_4 = v_2 > v_3 = v_1.$

c. $v_1 = \sqrt{2}v_2 = \sqrt{3}v_3 = 2v_4.$

d. $v_1 = 2v_2 = 3v_3 = 4v_4.$

e. $v_4 = \frac{3}{4}v_3 = \frac{2}{3}v_2 = \frac{1}{2}v_1.$

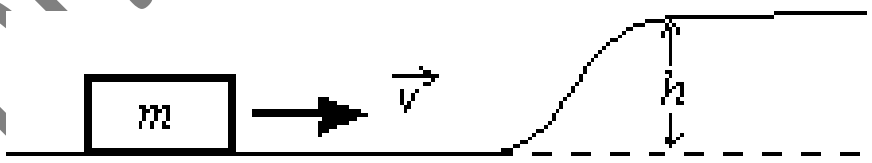
4 A 1000.0 kg car is moving at 15 km/h. If a 2000.0 kg truck has 18 times the kinetic energy of the car, how fast (in km/h) is the truck moving?

A) 45 B) 63 C) 54 D) 36

5 A 6.0-kg block is released from rest 80 m above the ground. When it has fallen 60 m its kinetic energy (in J) is approximately:

A) 4700 B) 3500 C) 1200 D) 120 E) 60

6 For a block of mass m to slide without friction up the rise of height h shown, it must have a minimum initial kinetic energy of:



A) gh B) mgh C) $mgh/4$ D) $mgh/2$ E) $2mgh$

7 A car needs to generate 75.0 hp in order to maintain a constant velocity of 27.3 m/s on a flat road. What is the magnitude of the total resistive force (in N) acting on the car (due to friction, air resistance, etc.)? (1 hp = 746 W)

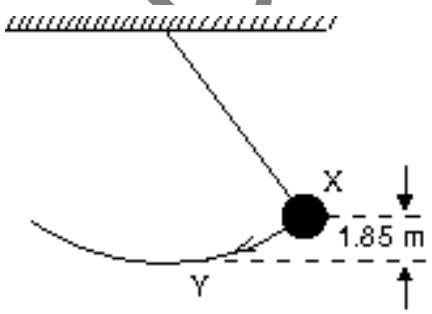
A) 2.05×10^3 B) 2.75 C) 1.03×10^3 D) 2.87×10^3

8 How long (in s) will it take a 7.08 hp motor to lift a 250 kg beam directly upward at constant velocity from the ground to a height of 45.0 m? Assume frictional forces are negligible. (1 hp = 746 W)

A) 20.9 B) 1.56×10^4 C) 2.18×10^4 D) 39.7

9 A simple pendulum consists of a 2.0 kg mass attached to a string. It is released from rest at X as shown.
Its speed (in m/s) at the lowest point Y is:

A) 1.9 B) 3.7 C) 4.4 D) 6.0 E) 36



10 A 0.60-kg object is suspended from the ceiling at the end of a 2.0-m string. When pulled to the side and released, it has a speed of 4.0 m/s at the lowest point of its path. What maximum angle does the string make with the vertical as the object swings up?

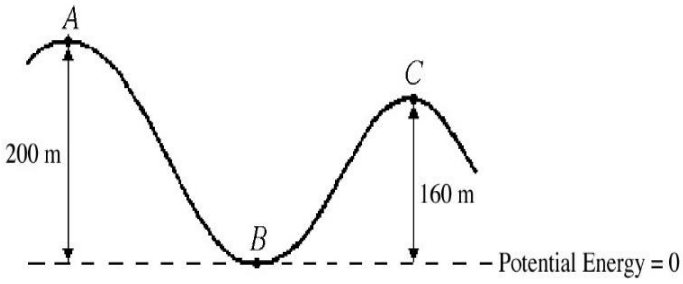
A) 61° B) 54° C) 69° D) 77° E) 47°

11 A 2.0-kg mass swings at the end of a light string (length = 3.0 m). Its speed at the lowest point on its circular path is 6.0 m/s. What is its kinetic energy (in J) at an instant when the string makes an angle of 50° with the vertical?

A) 21 B) 15 C) 28 D) 36 E) 23

12 A roller coaster of mass 80.0 kg is moving with a speed of 20.0 m/s at position *A* as shown in the figure. The vertical height above ground level at position *A* is 200 m. Hint: neglect friction.

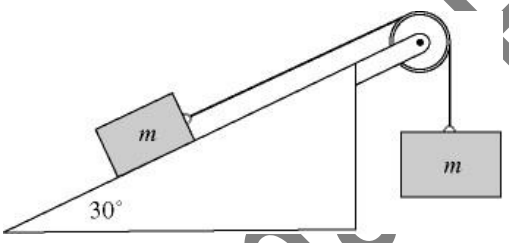
(a) What is the total mechanical energy of the roller coaster at point B?
Answer: 1.73×10^5 J
(b) What is the speed of the roller coaster at point *C*?
Answer: 34.4 m/s



13 A 2.2-kg block starts from rest on a rough inclined plane that makes an angle of 25° with the horizontal. The coefficient of kinetic friction is 0.25. As the block goes 2.0 m down the plane, the mechanical energy of the whole system changes (in J) by:
A) 0 B) –9.8 C) 9.8 D) –18 E) 18

14 A crane lifts a 425 kg steel beam vertically a distance of 117 m. How much work (in J) does the crane do on the beam if the beam accelerates upward at 1.8 m/s^2? Hint: neglect friction.
A) 5.8×10^5 B) 3.4×10^5 C) 4.0×10^5 D) 4.9×10^5

15 In the figure, two boxes, each of mass 24 kg, are at rest and connected as shown. The coefficient of kinetic friction between the inclined surface and the box is 0.31. Find the speed of the boxes just after they have moved 1.6 m. Answer: 1.91 m/s



16 In the figure, a block of mass *m* is moving along the horizontal frictionless surface with a speed of 5.70 m/s. If the slope is 11.0° and the coefficient of kinetic friction between the block and the incline is 0.260, how far does the block travel up the incline? Answer: 3.72 m