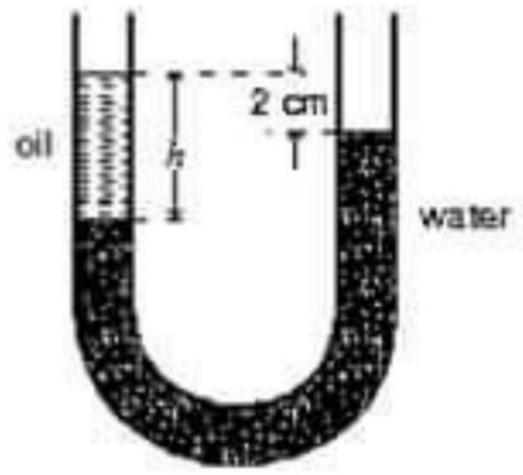
1) The density of water is 1.0 g/cm^3. If $h = 20$ cm, the density of the oil in the left column of the U-tube shown below is:



A) 0.20 g/cm^3
B) 0.90 g/cm^3
C) 1.0 g/cm^3
D) 1.3 g/cm^3
E) 5.0 g/cm^3

2) One piston in a hydraulic lift has an area that is twice the area of the other. When the pressure at the smaller piston is increased by Δp the pressure at the larger piston:
A) increases by $2\Delta p$
B) increases by $\Delta p/2$
C) increases by Δp
D) increases by $4\Delta p$
E) does not change

3) A boat floating in fresh water displaces 16,000 N of water. How many newtons of salt water would it displace if it floats in salt water of specific gravity 1.10?
A) 12,800 N
B) 14,400 N
C) 16,000 N
D) 17,600 N
E) 19,200 N

4) An object hangs from a spring balance. The balance indicates 30 N in air, 20 N when the object is submerged in water. What does the balance indicate when the object is submerged in liquid with a density that is half of water?
A) 20 N
B) 25 N
C) 30 N
D) 35 N
E) 40 N

5) The dimensions of a wooden raft (density = 150 kg/m^3) are 3.0 m × 3.0 m × 1.0 m. What maximum load can it carry in sea water (density =1020 kg/m^3)?

A) 1350 kg7830 kg
B) 9200 kg
D) 19,500 kg
E) 24,300 kg

6) A lawn sprinkler is made of a 1.0 cm diameter garden hose with one end closed and 25 holes, each with a diameter of 0.050 cm, cut near the closed end. If water flows at 2.0 m/s in the hose, the speed of the water leaving a hole is:

A) 2.0 m/s
B) 32 m/s
C) 40 m/s
D) 600 m/s
E) 800 m/s

7) Water is streaming downward from a faucet opening with an area of 3.0×10^{-5} m^2. It leaves the faucet with a speed of 5.0 m/s. The cross sectional area of the stream 0.50 m below the faucet is:

A) 1.5×10^{-5} m^2
B) 2.0×10^{-5} m^2
C) 2.5×10^{-5} m^2
D) 3.0×10^{-5} m^2
E) 3.5×10^{-5} m^2

8) A fluid of density 9.1×10^2 kg/m^3 is flowing through a tube at a speed of 5.3 m/s. What is the kinetic energy density of the fluid?

A) cannot be calculated without knowing the pressure
B) cannot be calculated without knowing the elevation
C) 4.8×10^3 J/m^3
D) 1.3×10^4 J/m^3
E) 2.5×10^6 J/m^3

9) Water (density = 1.0×10^3 kg/m^3) flows downhill through a pipe of diameter 1.5 cm. Its speed at the top of the hill is 7.2 m/s. If the hill is 9.5 m high, what is the gravitational potential energy density of the water at the top of the hill relative to the bottom?

A) cannot be calculated without knowing the pressure
B) 120 J/m^3
C) 7.2 x 10^3 J/m^3
D) 9.5 x 10^3 J/m^3
E) 9.3 x 10^4 J/m^3

10) Water (density = 1.0×10^3 kg/m^3) flows through a horizontal tapered pipe. At the wide end its speed is 4.0 m/s. The difference in pressure between the two ends is 4.5 $\times 10^3$ Pa. The speed of the water at the narrow end is:

A) 2.6 m/s

B) 3.2 m/s
C) 4.0 m/s
D) 4.5 m/s
E) 5.0 m/s

11) A large tank filled with water has two holes in the bottom, one with twice the radius of the other. In steady flow the speed of water leaving the larger hole is _____ the speed of the water leaving the smaller.

A) twice
B) four times
C) half
D) one-fourth
E) the same as

12) Some species of whales can dive to depths of one kilometer. What is the total pressure they experience at this depth? ($\rho_{sea} = 1\,020$ kg/m^3 and 1.01×10^5 N/m$^2 = 1$ ATM.)

a. 9.00 ATM
b. 90.0 ATM
c. 100 ATM
d. 111 ATM
e. 130 ATM

13) Water is flowing at 4.0 m/s in a circular pipe. If the diameter of the pipe decreases to 1/2 its former value, what is the velocity of the water downstream?

a. 1.0 m/s
b. 2.0 m/s
c. 8.0 m/s
d. 16 m/s
e. 4.0 m/s

14) What is the net force inward acting on a spherical bathysphere of diameter 2.00 m at an ocean depth of 1 000 m? (The pressure inside the bathysphere is, hopefully, 1 ATM.) $\rho_{(sea\ water)} = 1.02 \times 10^3$ kg/m^3.

a. 1.26×10^4 N
b. 1.26×10^6 N
c. 1.26×10^8 N
d. 1.26×10^{10} N
e. 1.26×10^2 N

15) How much power is theoretically available from a mass flow of 1 000 kg/s of water when it falls a vertical distance of 100 meters?

a. 980 kW
b. 98 kW
c. 4 900 W
d. 980 W

e. 9 600 W

16) A cubical box, 5.00 cm on each side, is immersed in a fluid. The gauge pressure at the top surface of the box is 594 Pa and the gauge pressure on the bottom surface is 1133 Pa. What is the density of the fluid?

A) 1000 kg/m^3

B) 1100 kg/m^3

C) 1220 kg/m^3

D) 2340 kg/m^3

E) 12,000 kg/m^3

17) The weight of a car of mass 1.20×10^3 kg is supported equally by the four tires, which are inflated to the same gauge pressure. What gauge pressure in the tires is required so the area of contact of each tire with the road is 1.00×10^2 cm^2? (1 atm = 1.01×10^5 Pa.)

A) 11.6×10^5 Pa

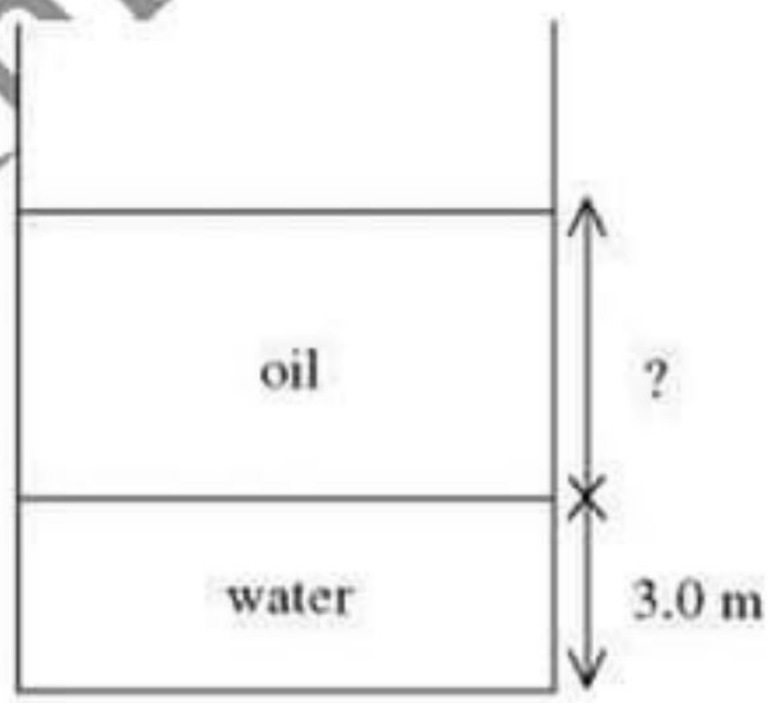
B) 11.6×10^4 Pa

C) 2.94×10^5 Pa

D) 2.94×10^4 Pa

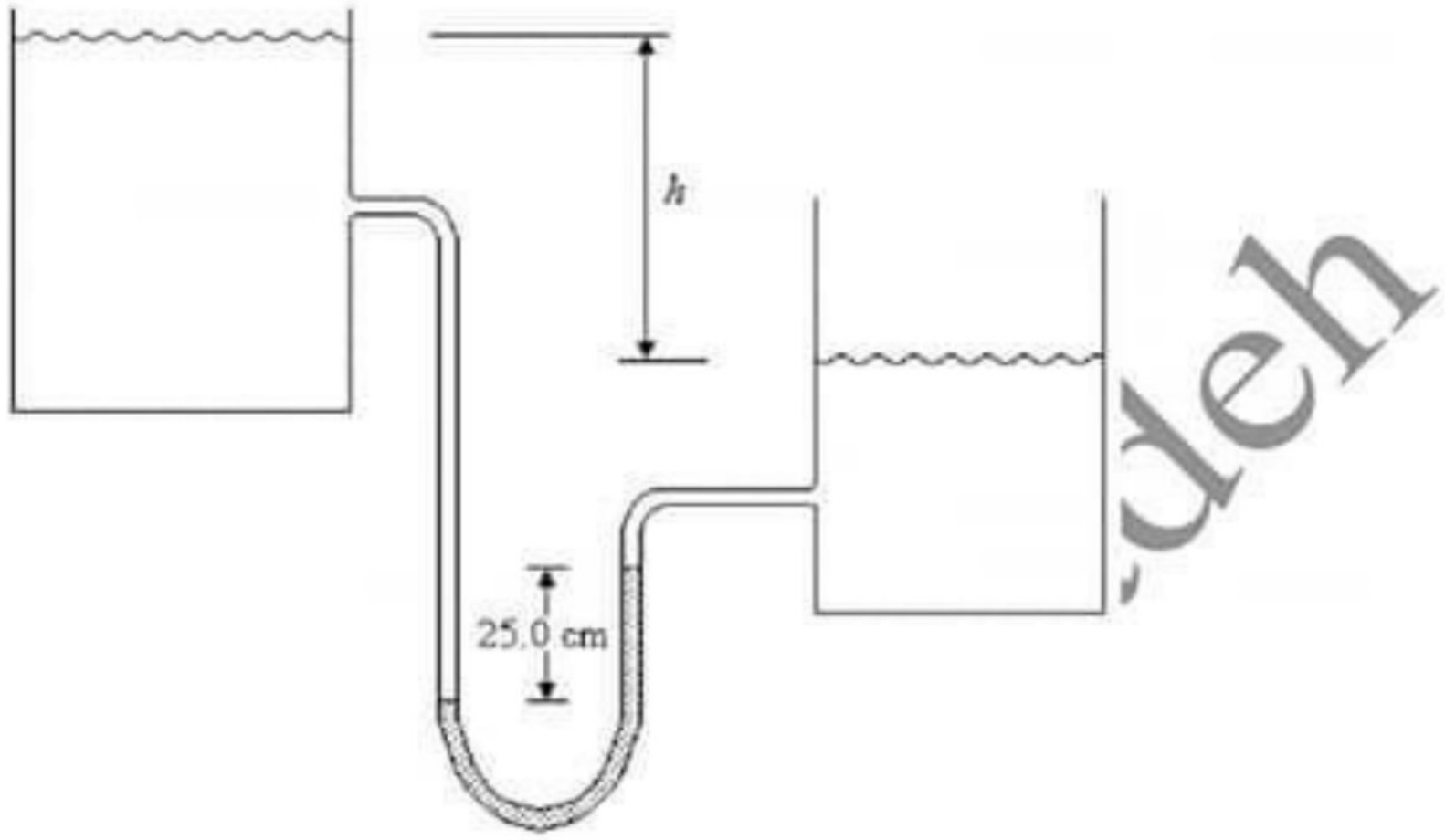
E) 2.94×10^3 Pa

18) In the figure, an open tank contains a layer of oil floating on top of a layer of water (of density 1000 kg/m^3) that is 3.0 m thick, as shown. What must be the thickness of the oil layer if the gauge pressure at the bottom of the tank is to be 5.0×10^4 Pa? The density of the oil is 510 kg/m^3.



Answer: 4.12 m

19) The two water reservoirs shown in the figure are open to the atmosphere, and the water has density 1000 kg/m^3. The manometer contains incompressible mercury with a density of 13,600 kg/m^3. What is the difference in elevation h if the manometer reading m is 25.0 cm?



A) 1.58 m
B) 4.20 m
C) 3.75 m
D) 3.40 m
E) 3.15 m

20) A board that is 20.0 cm wide, 5.00 cm thick, and 3.00 m long has a density 350 kg/m^3. The board is floating partially submerged in water of density 1000 kg/m^3. What fraction of the volume of the board is above the surface of the water?
A) 0.350
B) 0.650
C) zero
D) 0.200
E) The answer depends on which edge of the board is vertical.

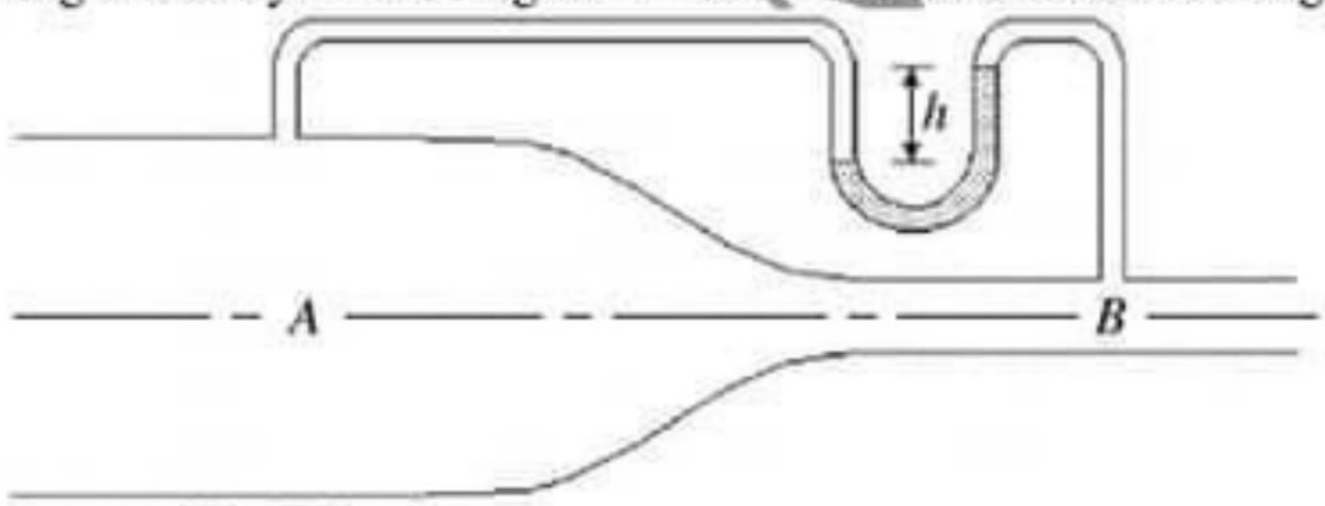
21) A person who weighs 550 N empties her lungs as much as possible and is then completely immersed in water (of density 1000 kg/m^3) while suspended from a harness. Her apparent weight is now 21.2 N. What is her density?
A) 1050 kg/m^3
B) 1040 kg/m^3
C) 1030 kg/m^3
D) 960 kg/m^3
E) 56.1 kg/m^3

22) A 7.8-kg solid sphere, made of metal whose density is 2500 kg/m^3, is suspended by a cord. When the sphere is immersed in water (of density 1000 kg/m^3), what is the

tension in the cord?
A) 46 N
B) 61 N
C) 76 N
D) 92 N
E) 110 N

23) Water flowing through a pipe suddenly comes to a section of pipe where the pipe diameter decreases to 86% of its previous value. If the speed of the water in the larger section of the pipe was 36m/s, what is its speed in this smaller section?
A) 49 m/s
B) 42 m/s
C) 31 m/s
D) 27 m/s

24) Water flows in the horizontal pipe shown in the figure. At point *A* the area is 25.0 cm^2 and the speed of the water is 2.00 m/s. At *B* the area is 16.0 cm^2. The fluid in the manometer is mercury, which has a density of 13,600 kg/m^3. We can treat water as an ideal fluid having a density of 1000 kg/m^3. What is the manometer reading *h*?



A) 0.546 cm
B) 1.31 cm
C) 2.81 cm
D) 2.16 cm
E) 3.36 cm

The University Of Jordan

Faculty of Science

Department Of Physics

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 done on it by all the forces acting on it?
A) 60 J
B) 100 J
C) 600 J
D) 1000 J
E) 4900 J

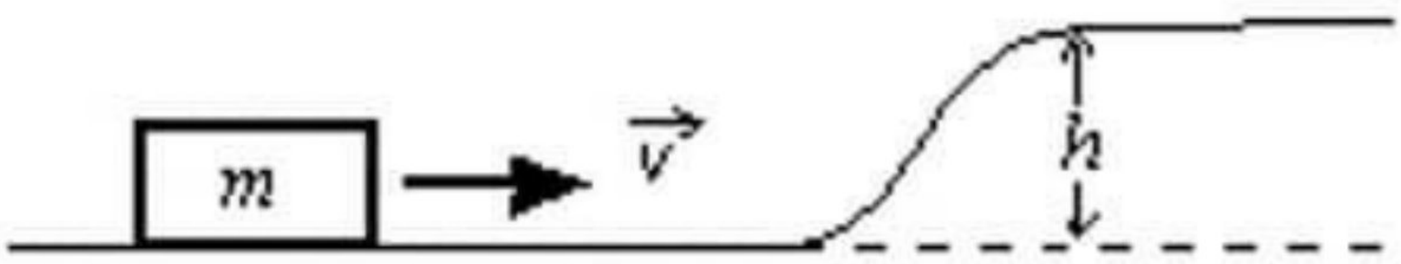
2) Two objects with masses, m_1 and m_2, have the same kinetic energy and are both moving to the right. The same constant force $\vec{F}$ is applied to the left to both masses. If $m_1 = 4m_2$, the ratio of the stopping distance of m_1 to that of m_2 is: A) 1:4
B) 4:1
C) 1:2
D) 2:1
E) 1:1

3) A 4-kg cart starts up an incline with a speed of 3 m/s and comes to rest 2 m up the incline. The total work done on the cart is:
A) –6 J
B) –8 J
C) –12 J
D) –18 J
E) impossible to calculate without knowing the coefficient of kinetic friction

4) A 50-N force is the only force acting on a 2-kg crate that starts from rest. When the force has been acting for 2 s the rate at which it is doing work is:
A) 100 W
B) 1000 W
C) 2500 W
D) 5000 W
E) 63000 W

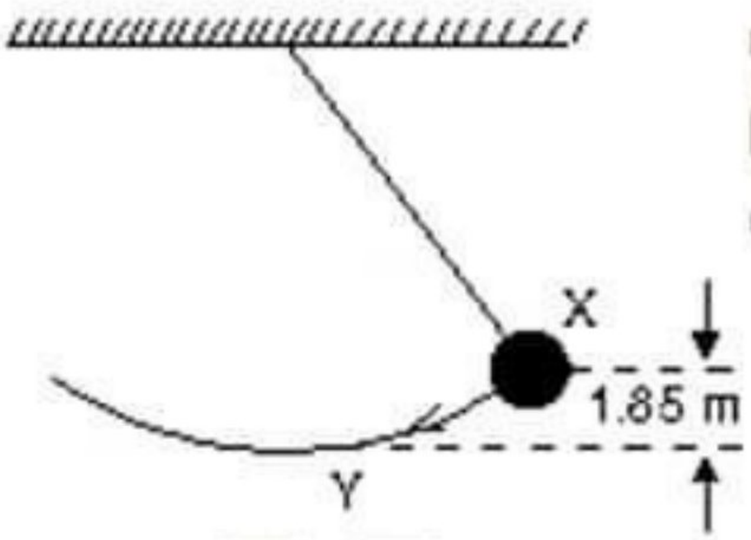
5) A 6.0-kg block is released from rest 80 m above the ground. When it has fallen 60 m its kinetic energy is approximately:
A) 4700 J
B) 3500 J
C) 1200 J
D) 120 J
E) 60 J

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) $gh/2$
D) $mgh/2$
E) $2mgh$

7) 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 at the lowest point Y is:

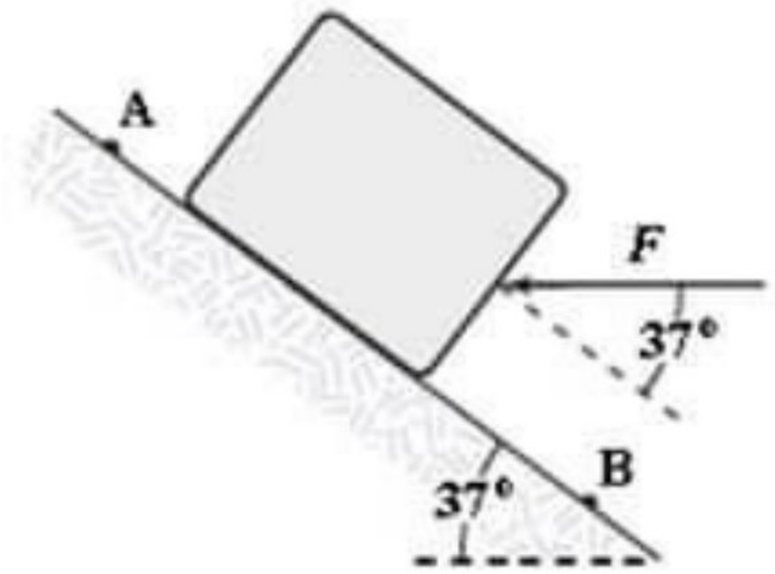


A) 1.9 m/s
B) 3.7 m/s
C) 4.4 m/s
D) 6.0 m/s
E) 36 m/s

8) 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 by:

A) 0 J
B) –9.8 J
C) 9.8 J
D) –18 J
E) 18 J

12) A 4.0-kg block is lowered down a 37° incline a distance of 5.0 m from point A to point B. A horizontal force (F = 10 N) is applied to the block between A and B as shown in the figure. The kinetic energy of the block at A is 10 J and at B it is 20 J. How much work is done on the block by the force of friction between A and B?



a. –58 J
b. –53 J
c. –68 J
d. –63 J
e. –47 J

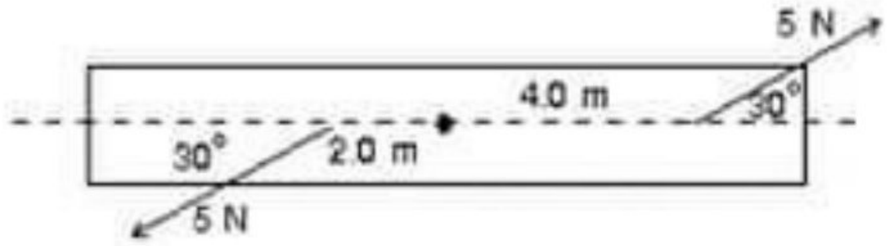
13) A 0.60-kg object is suspended from the ceiling at the end of a 2.0-m string. When pulled to the side and released, it has a speed of 4.0 m/s at the lowest point of its path. What maximum angle does the string make with the vertical as the object swings up?

a. 61°
b. 54°
c. 69°
d. 77°
e. 47°

14) 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 at an instant when the string makes an angle of 50° with the vertical?

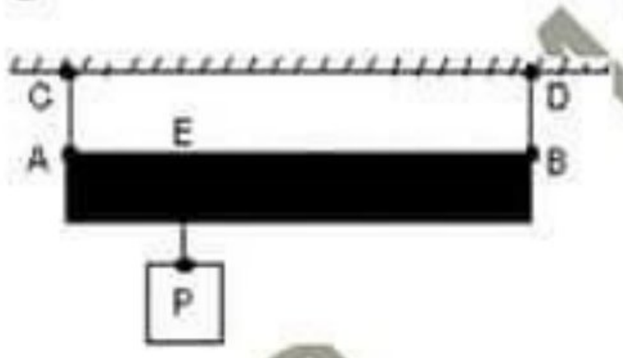
a. 21 J
b. 15 J
c. 28 J
d. 36 J
e. 23 J

9) A rod is pivoted about its center. A 5-N force is applied 4 m from the pivot and another 5-N force is applied 2 m from the pivot, as shown. The magnitude of the total torque about the pivot is:



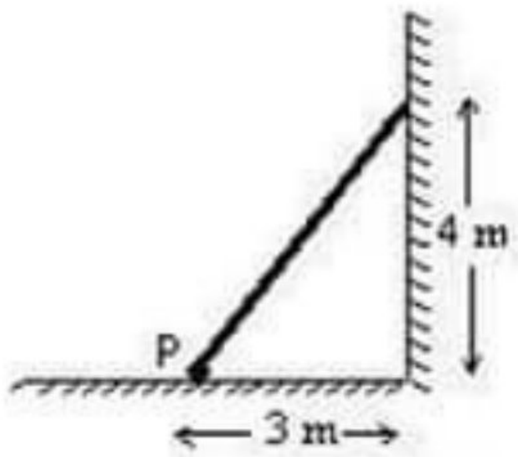
A) 0 N·m
B) 5.0 N·m
C) 8.7 N·m
D) 15 N·m
E) 26 N·m

10) A uniform rod AB is 1.2 m long and weighs 16 N. It is suspended by strings AC and BD as shown. A block P weighing 96 N is attached at E, 0.30 m from A. The magnitude of the tension force in the string BD is:



A) 8.0 N
B) 24 N
C) 32 N
D) 48 N
E) 80 N

11) An 80-N uniform rod leans against a frictionless wall as shown. The torque (about point P) applied to the rod by the wall is:



A) 40 N·m
B) 60 N·m
C) 120 N·m
D) 160 N·m
E) 240 N·m

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

16) A 3.0-kg block is on a frictionless horizontal surface. The block is at rest when, at t = 0, a force (magnitude P = 2.0 N) acting at an angle of 22° above the horizontal is applied to the block. At what rate is the force P doing work at t = 2.0 s?

a. 2.3 W
b. 2.0 W
c. 1.4 W
d. 1.7 W
e. 1.2 W

17) A 3.0-kg block is on a horizontal surface. The block is at rest when, at t = 0, a force (magnitude P = 12 N) acting parallel to the surface is applied to the block causing it to accelerate. The coefficient of kinetic friction between the block and the surface is 0.20. At what rate is the force P doing work on the block at t = 2.0 s?

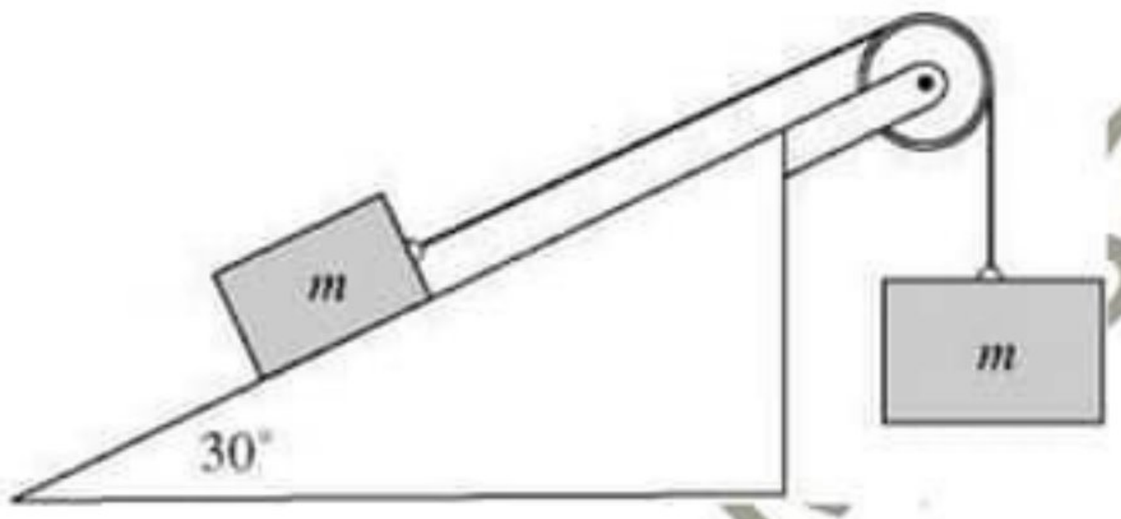
a. 54 W
b. 49 W
c. 44 W
d. 59 W
e. 24 W

18) A crane lifts a 425 kg steel beam vertically a distance of 117 m. How much work does the crane do on the beam if the beam accelerates upward at 1.8 m/s^2 ? Neglect frictional forces.

A) 5.8×10^5 J
B) 3.4×10^5 J
C) 4.0×10^5 J
D) 4.9×10^5 J

19) 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 is the truck moving?
A) 45 km/h
B) 63 km/h
C) 54 km/h
D) 36 km/h

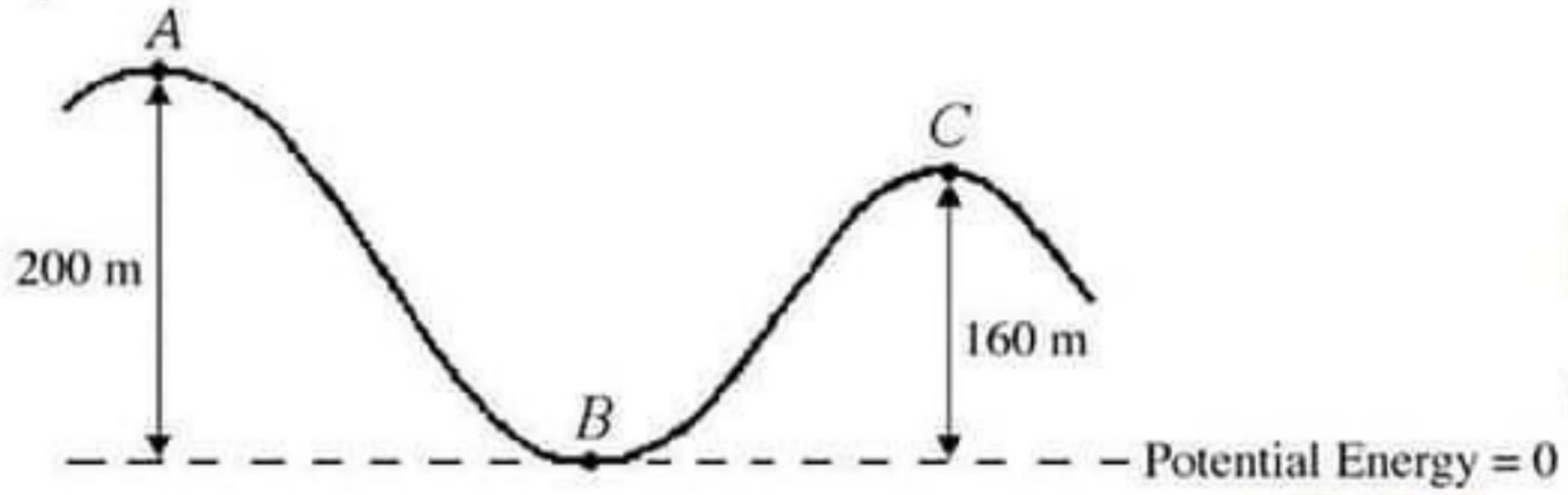
20) In the figure, two boxes, each of mass 24 kg, are at rest and connected as shown. The coefficient of kinetic friction between the inclined surface and the box is 0.31. Find the speed of the boxes just after they have moved 1.6 m. Answer: 1.91 m/s



21) 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 acting on the car (due to friction, air resistance, etc.)? (1 hp = 746 W)
A) 2.05×10^3 N
B) 2.75 N
C) 1.03×10^3 N
D) 2.87×10^3 N

22) How long 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 s
B) 1.56×10^4 s
C) 2.18×10^4 s
D) 39.7 s

23) 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. Neglect friction.

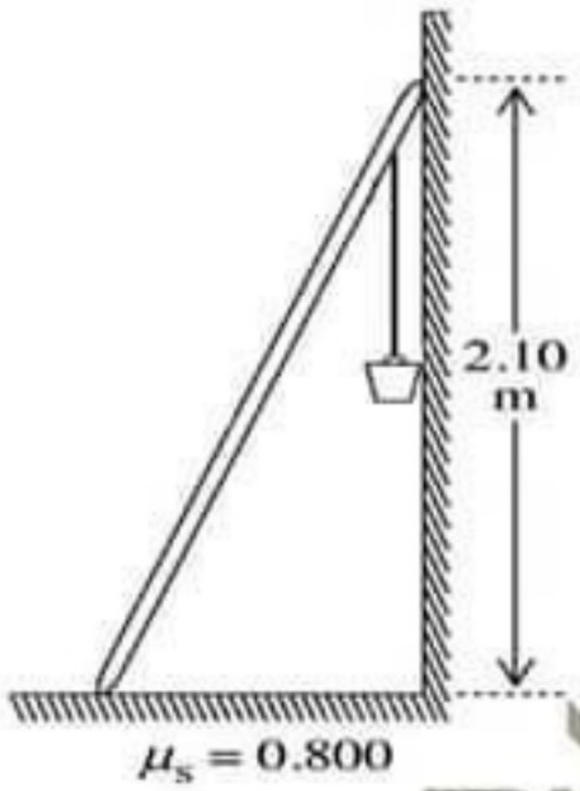


(a) What is the total mechanical energy of the roller coaster at point B?
Answer: 1.73×10^5 J
(b) What is the speed of the roller coaster at point *C*?
Answer: 34.4 m/s

24) 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?

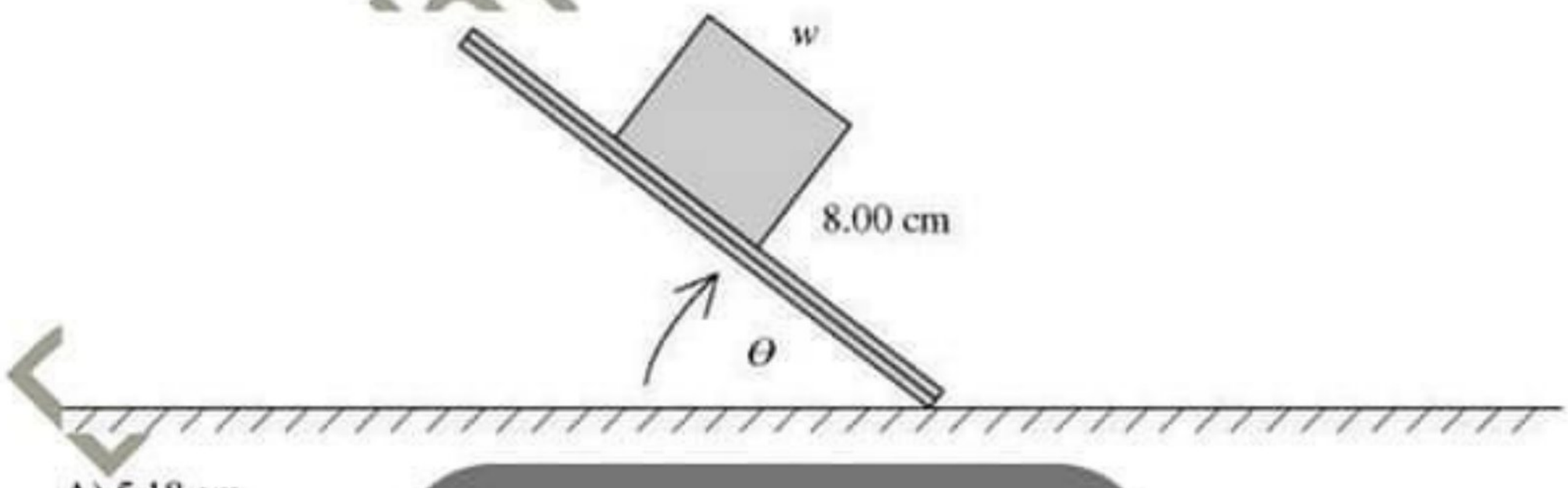
Answer: 3.72 m

25) A 10.0-kg uniform ladder that is 2.50 m long is placed against a smooth vertical wall and reaches to a height of 2.10 m, as shown in the figure. The base of the ladder rests on a rough horizontal floor whose coefficient of static friction with the ladder is 0.800. An 80.0-kg bucket of concrete is suspended from the top rung of the ladder, right next to the wall, as shown in the figure. What is the magnitude of the friction force that the floor exerts on the ladder?



A) 538 N
B) 706 N
C) 1290 N
D) 833 N
E) 601 N

26) A solid uniform brick is placed on a sheet of wood. When one end of the sheet is raised (see figure), you observe that the maximum that the angle θ can be without tipping over the brick is 49.6°. There is enough friction to prevent the brick from sliding. What is the width w of the brick?



A) 5.18 cm
B) 6.09 cm
C) 6.81 cm
D) 9.40 cm
E) 10.5 cm