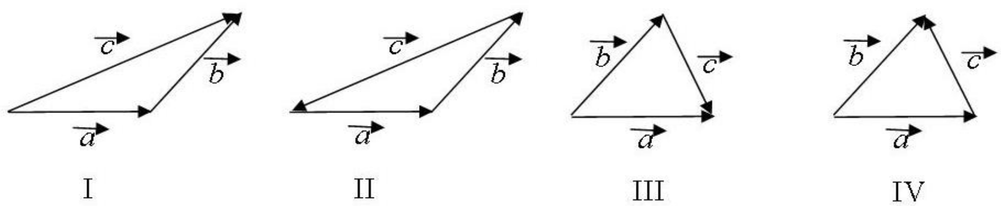
NOTE: For problems involving gravitational force, use g = 9.80 m/s^2 unless otherwise specified.

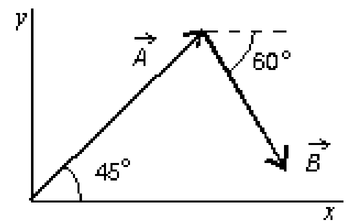
Q1) A car travels 40 kilometers at an average speed of 80 km/h and then travels 40 kilometers at an average speed of 40 km/h. The average speed (in km/h) of the car for this 80 km trip is:
A) 40 B) 45 **C)** 53 D) 60 E) 80

Q2) The vectors $\vec{a}$, $\vec{b}$, and $\vec{c}$ are related by $\vec{c} = \vec{a} - \vec{b}$. Which diagram below illustrates this relationship?

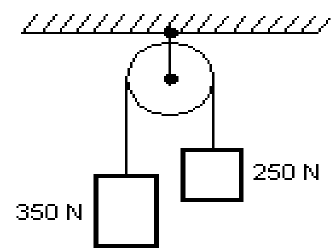


A) I. B) II. **C)** III. D) IV. E) None of these

Q3) In the diagram, $\vec{A}$ has magnitude 12 m and $\vec{B}$ has magnitude 8 m. The x component (in m) of $\vec{A} + \vec{B}$ is:
A) 1.5 B) 4.5 **C)** 12.5 D) 15 E) 20



Q4) 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 N) in the string is:
A) 210 **B)** 290 C) 410 D) 500 E) 4900



Q5) A 32-N force, parallel to the incline, is required to push a certain block at constant velocity up a frictionless incline that is 30° above the horizontal. The mass (in kg) of the block is:
A) 3.3 B) 3.8 C) 5.7 **D)** 6.5 E) 160

Q6) A 12-kg block rests on a horizontal surface and a boy pulls on it with a force that is 30° below the horizontal. If the coefficient of static friction is 0.40, the minimum magnitude force (in N) he needs to start the block moving is:
A) 44 B) 47 C) 54 D) 56 **E)** 71

Q7) A 5.0-kg block is resting on a horizontal plank. The coefficient of static friction is 0.50 and the coefficient of kinetic friction is 0.40. After one end of the plank is raised so the plank makes an angle of 25° with the horizontal, the force of friction (in N) is:
A) 0 B) 17.8 **C)** 20.7 D) 22.2 E) 44

Q8) A 5.0-kg block is resting on a horizontal plank. The coefficient of static friction is 0.50 and the coefficient of kinetic friction is 0.40. After one end of the plank is raised so the plank makes an angle of 30° with the horizontal, the force of friction (in N) is:
A) 0 **B)** 17 C) 20 D) 25 E) 49

Q9) A 5.0-kg block is on an incline that makes an angle 30° with the horizontal. If the coefficient of static friction is 0.50, the **minimum** force (in N) that can be applied parallel to the plane to hold the block at rest is:

A) 0 B) 3.4 C) 21.1 D) 24.5 E) 46

Q10) A 5.0-kg block is on an incline that makes an angle 30° with the horizontal. If the coefficient of static friction is 0.5, the **maximum** force (in N) that can be applied parallel to the plane without moving the block is:

A) 0 B) 3.4 C) 21.1 D) 45.6 E) 55

Q11) Block A, with mass m_A, is initially at rest on a horizontal floor. Block B, with mass m_B, is initially at rest on the horizontal top surface of A. The coefficient of static friction between the two blocks is μ_s. Block A is pulled with a horizontal force. It begins to slide out from under B if the force is greater than:

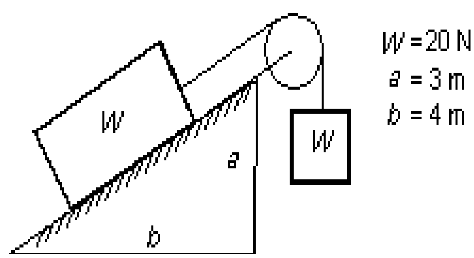
A) $m_A g$ B) $m_B g$ C) $\mu_s m_A g$ D) $\mu_s m_B g$ E) $\mu_s(m_A + m_B)g$

Q12) A 1000-kg airplane moves in straight flight at constant speed. The force of air friction is 1800 N. The net force (in N) on the plane is:

A) 0 B) 11600 C) 1800 D) 9800 E) none of these

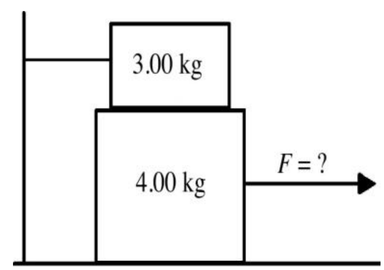
Q13) The system shown remains at rest. The force (in N) of friction on the block on the slope is:

A) 4 B) 8 C) 12 D) 16 E) 20



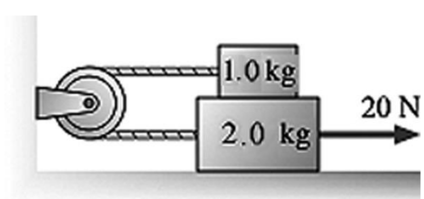
Q14) A 4.00-kg block rests between the floor and a 3.00-kg block as shown in the figure. The 3.00-kg block is tied to a wall by a horizontal rope. If the coefficient of static friction is 0.800 between each pair of surfaces in contact, what horizontal force F (in N) must be applied to the 4.00-kg block to make it move?

A) 16.2 B) 54.9 C) 21.1 D) 23.5 E) 78.4

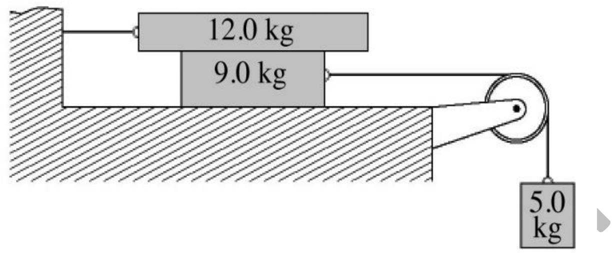


Q15) A rope pulls on the lower block in the figure with a tension force of 20 N. The coefficient of kinetic friction between the lower block and the surface is 0.16. The coefficient of kinetic friction between the lower block and the upper block is also 0.16. The pulley has no appreciable mass or friction. What is the acceleration (in m/s^2) of the 2.0 kg block?

A) 4.1 B) 5.1 C) 8.4 D) 9.2 E) 0.7

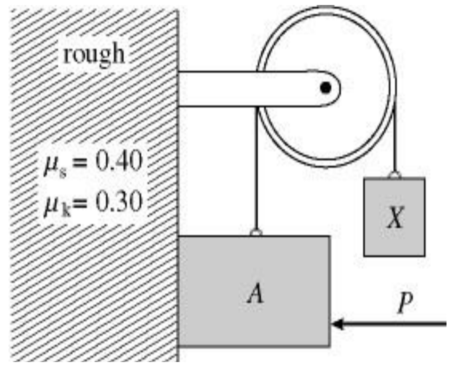


Q16) A system comprised blocks, a light frictionless pulley, and connecting ropes is shown in the figure. The 9.0-kg block is on a perfectly smooth horizontal table. The surfaces of the 12-kg block are rough, with μ_k = 0.30 between the two blocks. If the 5.0-kg block accelerates downward when it is released, then its acceleration (in m/s^2) is



A) 1.0 B) 1.2 C) 1.4 D) 1.6 E) 1.8

Q17) Consider the system of problem 16 with the following statement: The 9.0-kg block is on a perfectly smooth horizontal table. The surfaces of the 12-kg block are rough, with μ_k = 0.30 between the two blocks. The mass of the hanging block, M, is unknown. If the hanging block is moving downward with a constant velocity of 1 m/s, what is its mass M? **Answer:** [μ_k*12-kg]

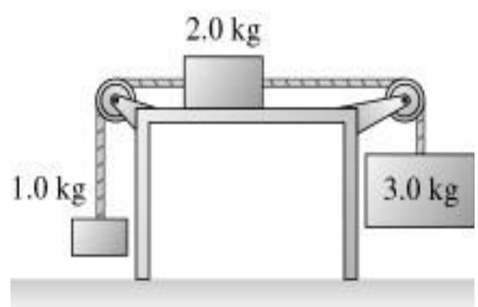


Q18) Block *A* of mass 5.0 kg and block *X* are attached to a rope which passes over a pulley, as shown in the figure. An 80-N force *P* is applied horizontally to block *A*, keeping it in contact with a rough vertical face. The coefficients of static and kinetic friction between the wall and block *A* are μ_s = 0.40 and μ_k = 0.30. The pulley is light and frictionless. The mass of block *X* is adjusted until block *A* moves upward with an acceleration of 1.6 m/s^2. What is the mass (in kg) of block *X*?

A) 9.9 B) 9.3 C) 8.7 D) 8.1 E) 7.5

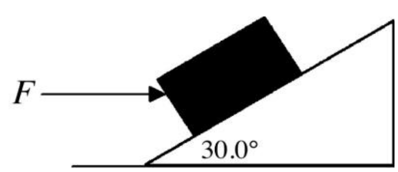
Q19) Consider the figure of problem 18. Block *A* of mass 8.0 kg and block *X* are attached to a rope that passes over a pulley. A 50-N force *P* is applied horizontally to block *A*, keeping it in contact with a rough vertical face. The coefficients of static and kinetic friction between the wall and block *A* are μ_s = 0.40 and μ_k = 0.30. The pulley is light and frictionless. In the figure, the mass of block *X* is adjusted until block *A* descends at constant velocity of 4.75 cm/s when it is set into motion. What is the mass (in kg) of block *X*?

A) 6.5 B) 7.2 C) 8.0 D) 8.8 E) 9.5



Q20) Three objects are connected as shown in the figure. The strings and frictionless pulleys have negligible masses, and the coefficient of kinetic friction between the 2.0-kg block and the table is 0.25. What is the acceleration (in m/s^2) of the 2.0-kg block?

A) 2.5 B) 1.7 C) 3.2 D) 4.0 E) 8.2



Q21) A 4.00-kg block rests on a 30.0° incline as shown in the figure. The coefficients of static friction and kinetic friction between the block and the incline are 0.700 and 0.500 respectively. The magnitude of the force *F* (in N) that must act on the block to start it moving up the incline is: A) 34.0 B) 51.1 C) 54.7 **D)** 84.0 E) 76.4