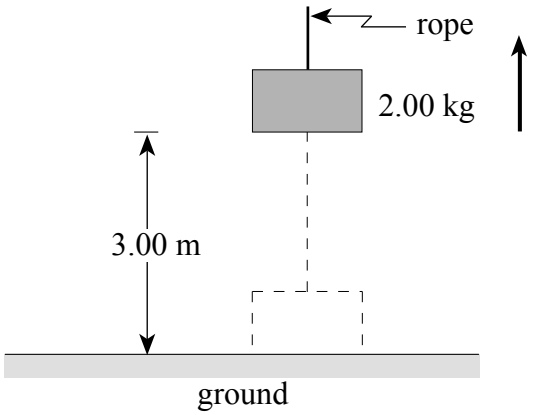
1. Unless acted on by an external net force, an object will stay at rest or

   A. come to rest.
   B. decelerate at a constant rate.
   C. slow down from a given speed.
   D. continue to move in a straight line at a constant speed.

2. A 65.0 kg block is being accelerated along a level surface. The applied force is 500 N and the friction force is 300 N. What is the coefficient of friction between the block and the surface?

   A. 0.31
   B. 0.47
   C. 0.78
   D. 1.30

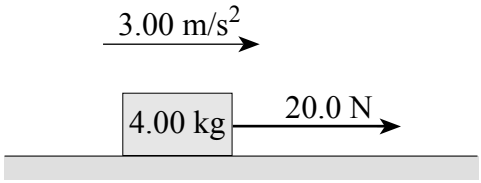
3. A 2.00 kg object, initially at rest on the ground, is accelerated vertically by a rope, as shown. The object reaches a height of 3.00 m in 1.50 s.



   What is the tension in the rope during the acceleration?

   A. 5.33 N
   B. 14.3 N
   C. 23.6 N
   D. 24.9 N

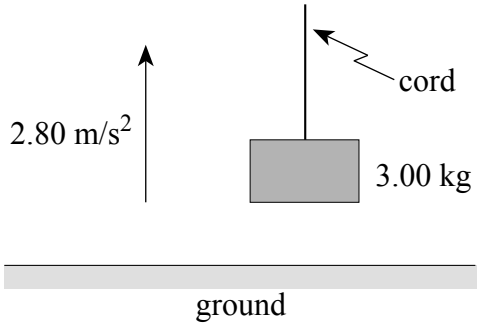
4. A 4.00 kg block is accelerated along a level surface at 3.00 m/s^2. The applied force is 20.0 N.



   What is the coefficient of friction between the block and the surface?

   A. 0.20
   B. 0.31
   C. 0.51
   D. 0.67

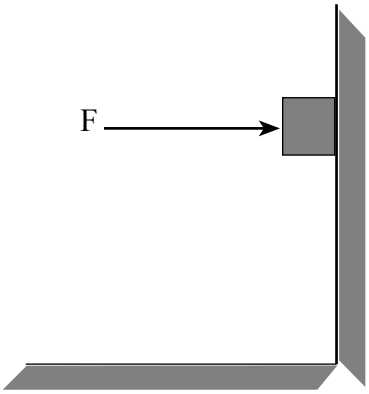
5. A 3.00 kg object is being accelerated vertically upwards at 2.80 m/s^2, as shown.



What is the tension in the cord?

A. 8.40 N
B. 21.0 N
C. 29.4 N
D. 37.8 N

6. What minimum horizontal force F will just prevent the 5.0 kg block from sliding if the coefficient of friction between the wall and the block is 0.65?

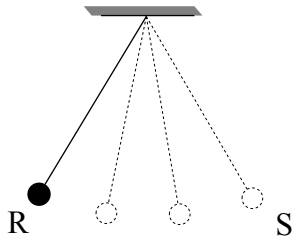


A. 6.4 N
B. 32 N
C. 49 N
D. 75 N

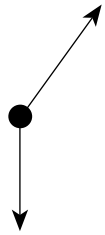
7. An object is sliding down a smooth incline. If friction is negligible, the object has

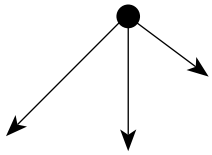
A. constant velocity.
B. constant momentum.
C. constant acceleration.
D. constant displacement.

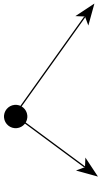
8. A pendulum is swinging freely between points R and S as shown in the diagram below.

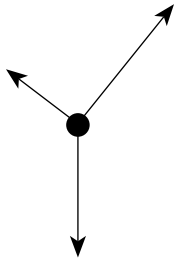


Which of the following diagrams best represents the forces acting on the pendulum bob at point R?

A. 

B. 

C. 

D. 

9. A constant force is applied to an object on a frictionless surface, as shown in the diagram below.

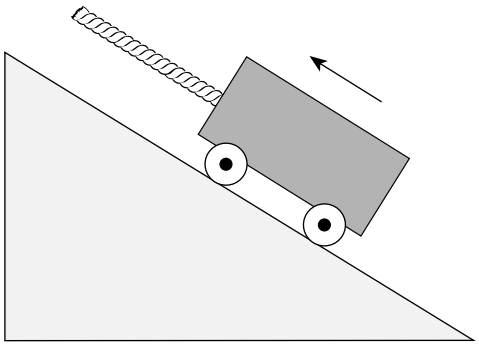
The resulting motion has

A. constant velocity.
B. constant momentum.
C. constant acceleration.
D. constant kinetic energy.

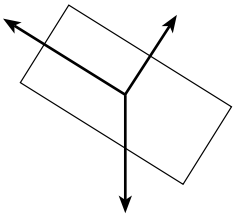
10. What is the frictional force due to air resistance on a 0.50 kg object falling vertically with an acceleration of $8.5\ m/s^2$?

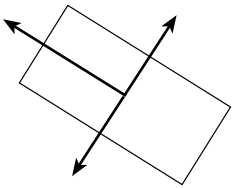
A. 0.65 N
B. 4.3 N
C. 4.9 N
D. 9.2 N

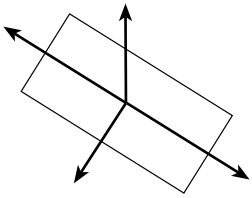
11. The diagram below shows a cart being pulled up a frictionless slope by a rope.

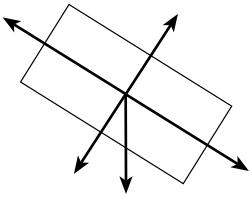


Which of the following best represents the free body diagram for the cart?

A. 

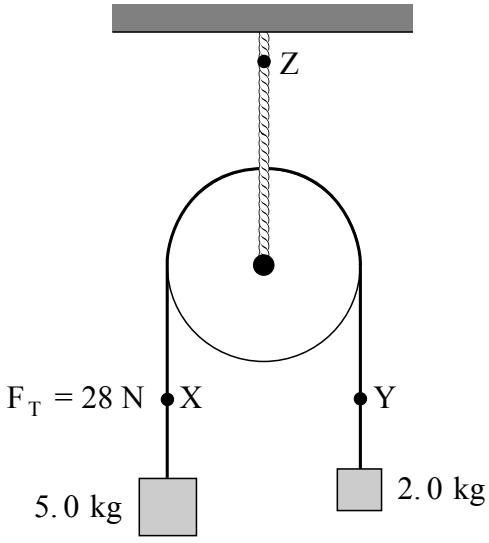
B. 

C. 

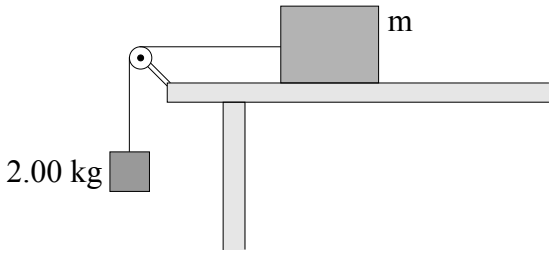
D. 

12. A massless, frictionless pulley is suspended by a rope. When the masses are allowed to accelerate, the tension in the string joining them is 28 N at X . What will the tension be at Y and at Z?

	TENSION AT Y	TENSION AT Z
A.	20 N	48 N
B.	20 N	69 N
C.	28 N	56 N
D.	28 N	69 N



13. The frictionless system shown below accelerates at $1.60\ m/s^2$ when released.



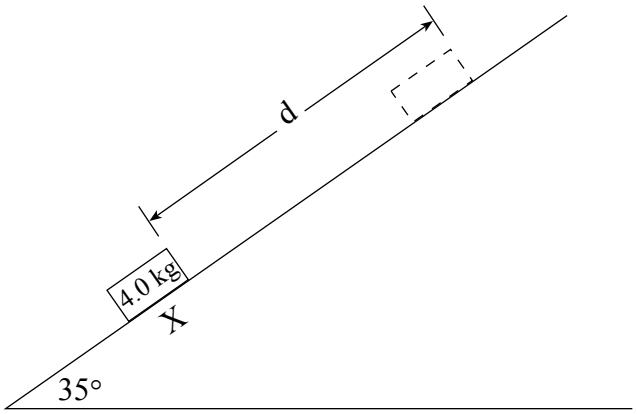
Find the tension in the string while the system is accelerating.

A. 3.20 N
B. 16.4 N
C. 19.6 N
D. 22.8 N

14. Force F gives mass m_1 an acceleration of $4.0\ m/s^2$. The same force F gives mass m_2 an acceleration of $2.0\ m/s^2$. What acceleration would force F give to the two masses m_1 and m_2 if they were glued together?

A. $1.0\ m/s^2$
B. $1.3\ m/s^2$
C. $3.0\ m/s^2$
D. $6.0\ m/s^2$

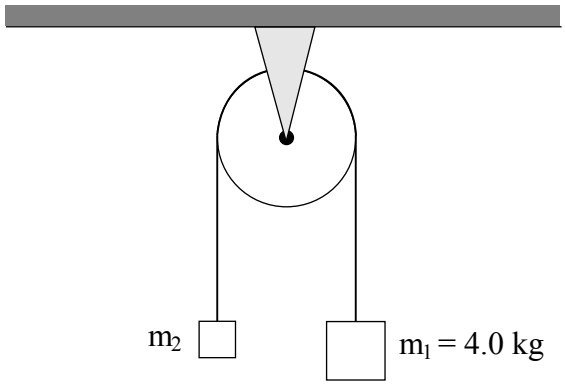
15. A 4.0 kg block has a speed of $9.0\ m/s$ at X.



What is the maximum distance, d, travelled by the block? Ignore friction.

A. 0.92 m
B. 1.6 m
C. 4.1 m
D. 7.2 m

16. The tension in the string shown is 12 N. Find the acceleration of mass m_1.



A. 3.0 m/s^2
B. 6.4 m/s^2
C. 6.8 m/s^2
D. 13 m/s^2

17. A 75 kg man stands on a scale while accelerating upwards in an elevator. If the scale reads 850 N, what is the magnitude of the acceleration of the elevator?

A. 1.2 m/s^2
B. 1.5 m/s^2
C. 9.8 m/s^2
D. 11 m/s^2

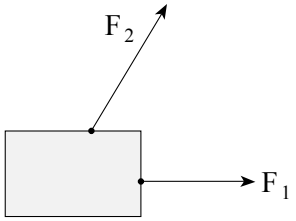
18. A 45 kg toboggan and rider decelerate on level snow at 0.53 m/s^2. What is the coefficient of friction between the toboggan and the snow?

A. 0.012
B. 0.054
C. 0.22
D. 0.53

19. The 2.0 kg head of an axe strikes a tree horizontally at 40 m/s. The blade penetrates 0.040 m into the tree. What is the average force exerted by the blade on this tree?

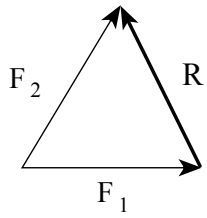
A. 2.0×10^1 N
B. 2.0×10^3 N
C. 2.0×10^4 N
D. 4.0×10^4 N

20. Two forces act on an object as shown in the diagram.

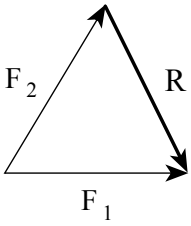


Which of the following best shows the resultant R of these forces?

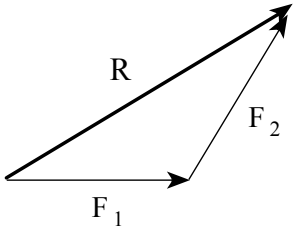
A.



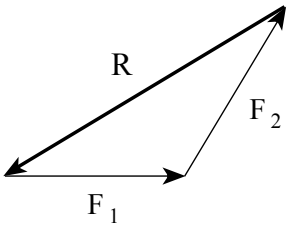
B.



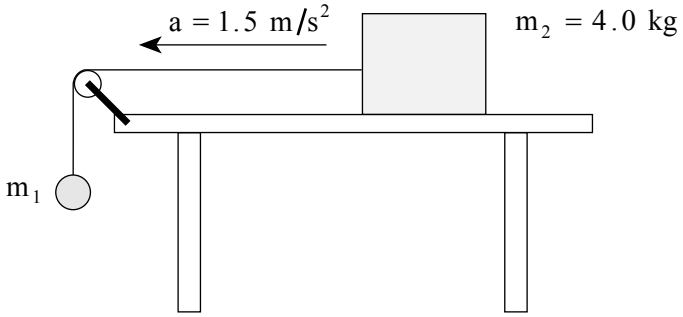
C.



D.



21. The 4.0 kg block shown accelerates across a frictionless horizontal table at 1.5 m/s^2.



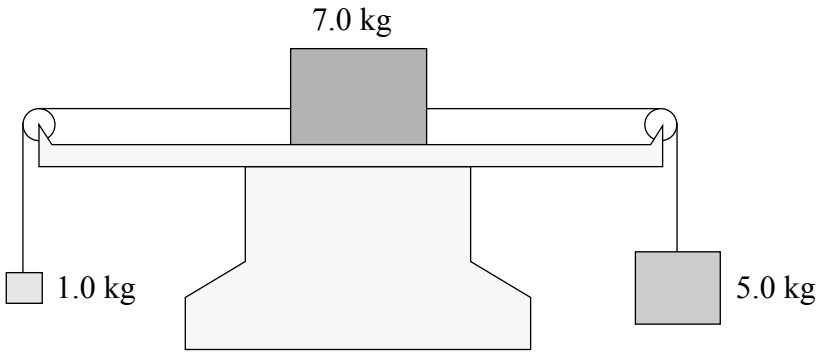
Find the mass of object m_1.

A. 0.61 kg
B. 0.72 kg
C. 6.0 kg
D. 26 kg

22. Which of the following is not a statement of one of Newton's laws of motion?

A. For every action force, there is an equal and opposite reaction force.
B. If no net force acts on an object, the object will remain at rest, or continue to move at a constant velocity.
C. The acceleration of freely falling objects is proportional to their mass.
D. If a net force does act on an object, the object will accelerate in the direction of the net force.

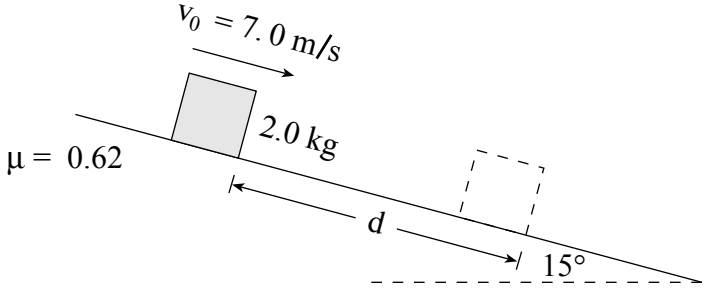
23. Three blocks have masses 1.0 kg, 7.0 kg and 5.0 kg as shown. The horizontal surface is frictionless.



What is the magnitude of the acceleration of the system?

A. 3.0 m/s^2
B. 3.8 m/s^2
C. 6.5 m/s^2
D. 7.8 m/s^2

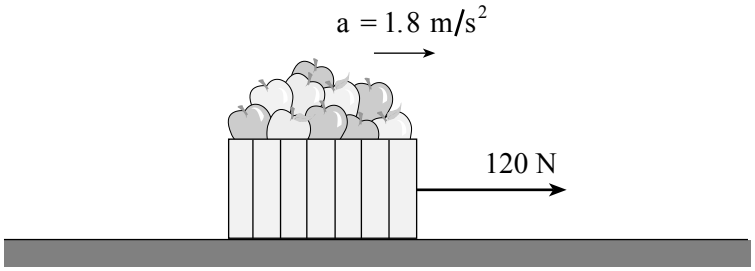
24. A 2.0 kg block is sliding down a 15° incline. The coefficient of friction is 0.62. At some position the block has a speed of 7.0 m/s.



What distance d will this block move before coming to rest?

A. 2.5 m
B. 4.0 m
C. 4.2 m
D. 7.4 m

25. A student exerts a $120\ \text{N}$ horizontal force on a $25\ \text{kg}$ carton of apples, causing it to accelerate over level ground at $1.8\ \text{m/s}^2$.



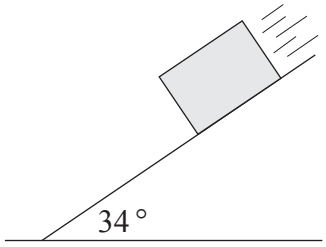
Find the coefficient of friction between the carton and the ground.

A. 0.31
B. 0.38
C. 0.49
D. 0.67

26. A net force F acts on an object of mass m, causing it to accelerate at $4.0\ \text{m/s}^2$. If the same net force F acts on an object of mass $2m$, its acceleration will be

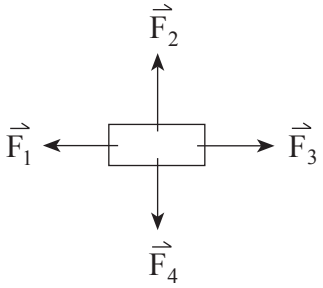
A. $1.0\ \text{m/s}^2$
B. $2.0\ \text{m/s}^2$
C. $4.0\ \text{m/s}^2$
D. $8.0\ \text{m/s}^2$

27. A $5.0\ \text{kg}$ concrete block accelerates down a $34°$ slope at $4.2\ \text{m/s}^2$. Find the coefficient of friction between the block and the slope.



A. 0.13
B. 0.16
C. 0.43
D. 0.67

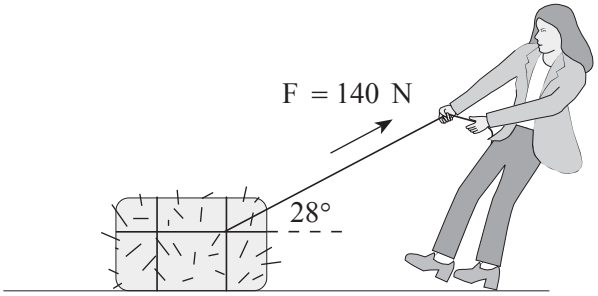
28. The free body diagram shown below represents a crate being dragged towards the left over a rough surface.



Which of the vectors represent the normal force and the friction force acting on the crate?

	NORMAL FORCE	FRICTION FORCE
A.	$\vec{F}_1$	$\vec{F}_2$
B.	$\vec{F}_2$	$\vec{F}_3$
C.	$\vec{F}_3$	$\vec{F}_4$
D.	$\vec{F}_4$	$\vec{F}_1$

29. A girl applies a 140 N force to a 35 kg bale of hay at an angle of 28° above horizontal. The friction force acting on the bale is 55 N. What will be the horizontal acceleration of the bale?



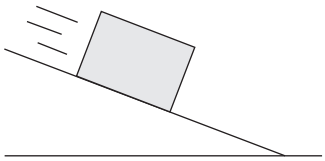
A. 0.31 m/s^2

B. 2.0 m/s^2

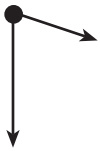
C. 2.4 m/s^2

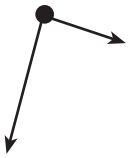
D. 2.6 m/s^2

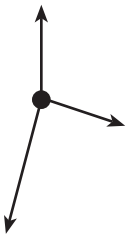
30. A block is on a frictionless incline.



Which of the following is a correct free body diagram for the block?

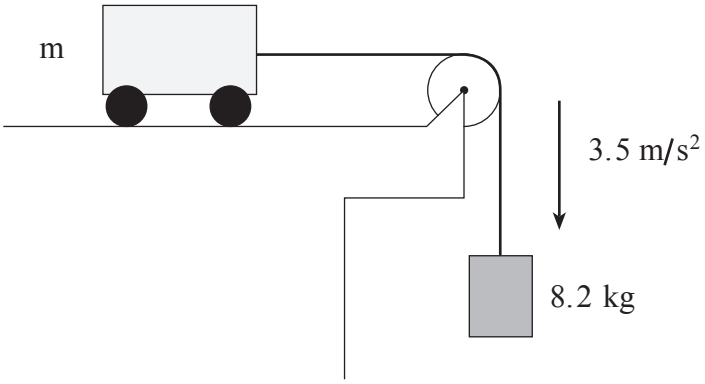
A. 

B. 

C. 

D. 

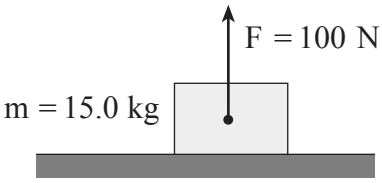
31. A cart on a frictionless surface is attached to a hanging mass of 8.2 kg.



If this system accelerates at 3.5 m/s^2, what is the mass m of the cart?

A. 6.0 kg
B. 15 kg
C. 23 kg
D. 31 kg

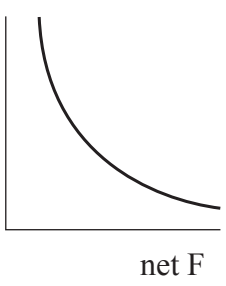
32. A 15 kg block on a horizontal surface has a 100 N force acting on it as shown.

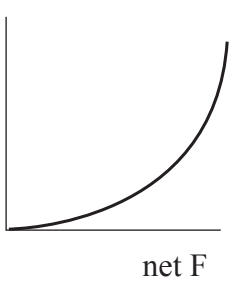


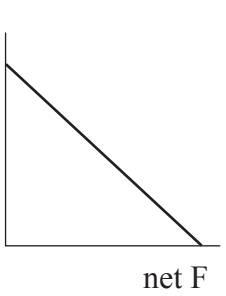
What is the normal force?

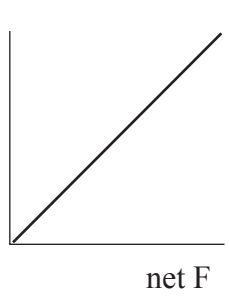
A. 47 N
B. 100 N
C. 147 N
D. 247 N

33. Which of the following graphs shows the relationship between acceleration and net force?

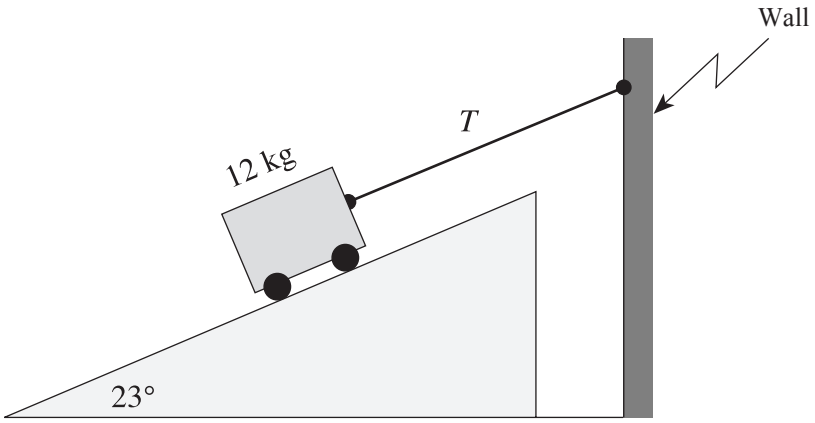
A. 

B. 

C. 

D. 

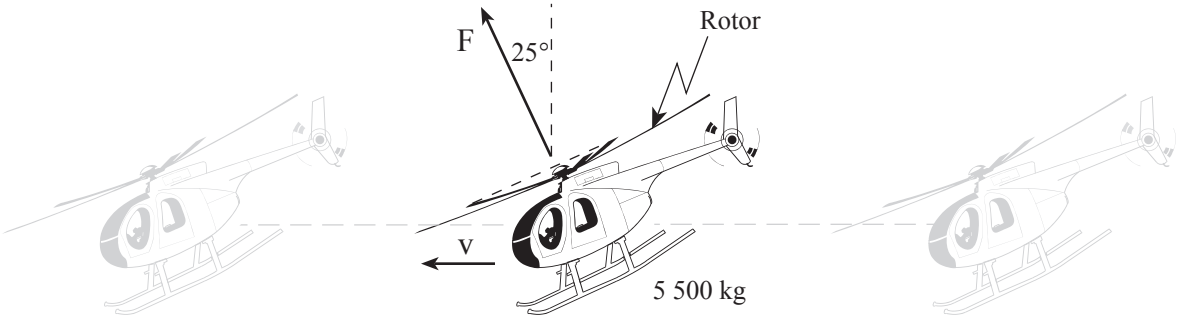
34. A 12 kg cart on a 23° frictionless incline is connected to a wall as shown.



What is the tension T in the cord?

A. 46 N
B. 50 N
C. 110 N
D. 120 N

35. A 5500 kg helicopter is travelling at constant speed in level flight.



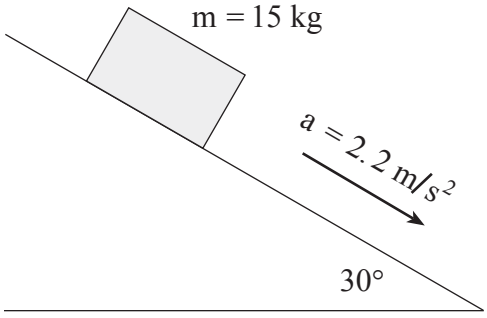
What is the force F provided by the rotor?

A. 4.9×10^4 N
B. 5.4×10^4 N
C. 5.9×10^4 N
D. 1.2×10^5 N

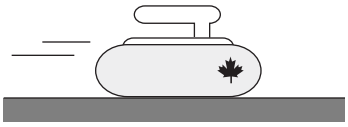
36. A 15 kg block has a constant acceleration of $2.2\ \text{m/s}^2$ down a 30° incline.

What is the magnitude of the friction force on the block?

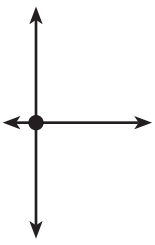
A. 33 N
B. 41 N
C. 74 N
D. 130 N

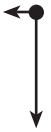


37. A curling rock is travelling to the right across the ice as shown in the diagram.



Which of the following best represents the forces acting on the curling rock?

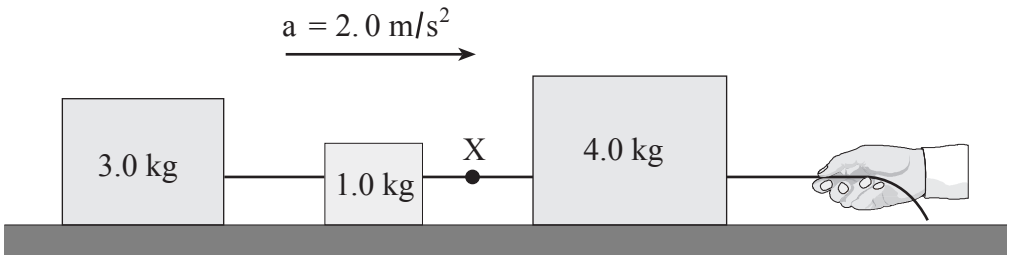
A. 

B. 

C. 

D. 

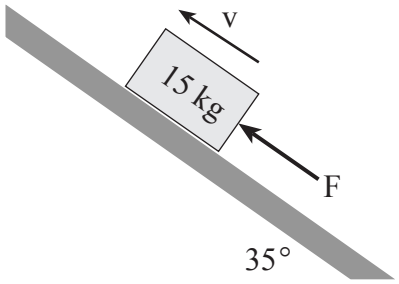
38. The system of blocks on a frictionless surface in the diagram below is accelerating at $2.0\ m/s^2$.



What is the tension in the cord at X?

A. 2.0 N
B. 6.0 N
C. 8.0 N
D. 16 N

39 A 15 kg block is pushed up a 35° incline. A friction force of 110 N exists between the block and the incline.

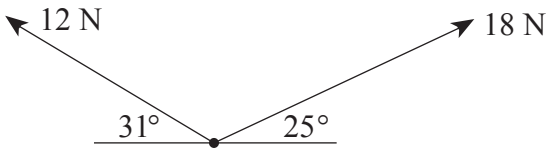


What minimum force F, would be necessary to move the block up the incline at a constant speed?

A. 26 N
B. 84 N
C. 150 N
D. 190 N

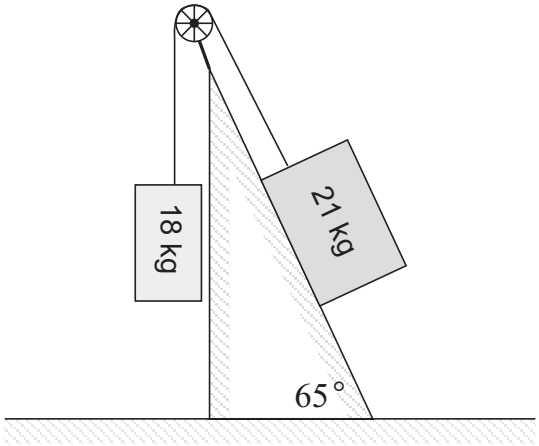
40. Two forces act at a single point as shown.

What is the magnitude of the resulting force?



A. 15 N
B. 22 N
C. 27 N
D. 30 N

41. Two masses are connected together by a rope and pulley on a frictionless inclined plane as shown.



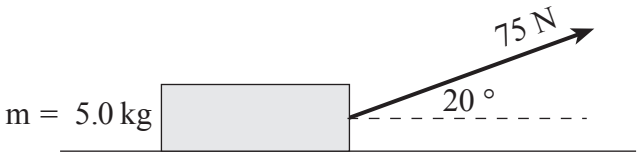
When the system is released, what is the initial acceleration of the 21 kg mass?

	MAGNITUDE OF THE ACCELERATION	DIRECTION THE MASS WILL TRAVEL
A.	0.26 m/s^2	up the incline
B.	0.26 m/s^2	down the incline
C.	0.48 m/s^2	up the incline
D.	0.48 m/s^2	down the incline

42. A 5.0 kg block is being pulled to the right by a 75 N force.

What is the normal force on this block?

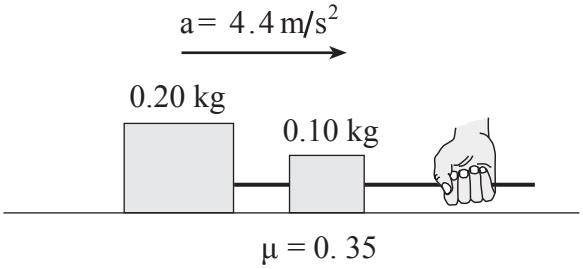
A. 23 N
B. 26 N
C. 49 N
D. 75 N



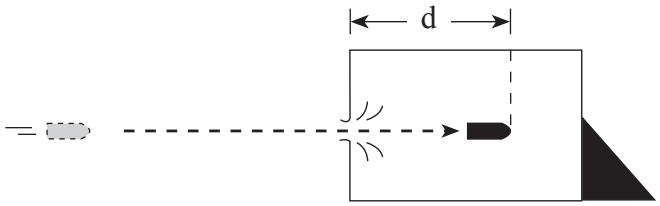
43. The system of blocks shown in the diagram below is being accelerated to the right at 4.4 m/s^2.

What pulling force is applied by the hand?

A. 0.3 N
B. 1.0 N
C. 1.3 N
D. 2.3 N



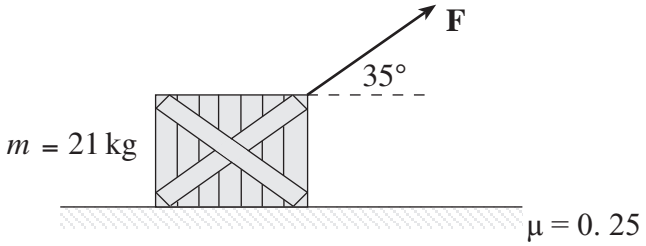
44. A 0.055 kg bullet was fired at 250 m/s into a block of wood as shown in the diagram below.



Assuming an average force of 9500 N brings the bullet to rest in the wood, what distance d did the bullet penetrate the block?

A. 1.4×10^{-3} m
B. 1.4×10^{-2} m
C. 1.8×10^{-1} m
D. 3.6×10^{-1} m

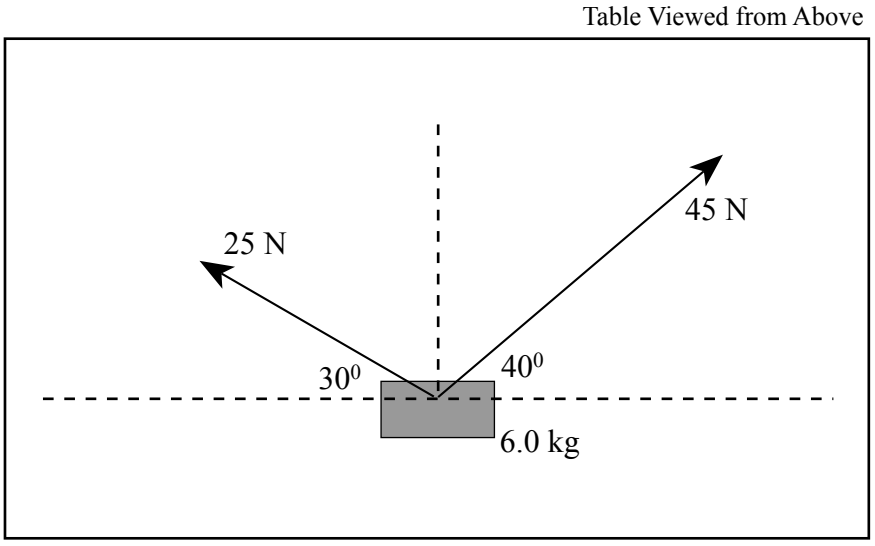
45. A force **F** is applied at an angle of 35° above the horizontal to pull a 21 kg crate across a rough floor as shown below.



If the acceleration is 4.2 m/s^2, what is the magnitude of F?

A. 100 N
B. 145 N
C. 170 N
D. 207 N

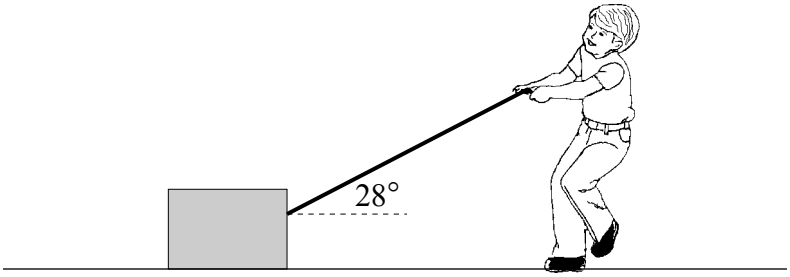
1. A 6.0 kg block is held at rest on a horizontal, frictionless air table. Two forces are pulling on this block in the directions shown in the diagram below.



What will be the magnitude of the acceleration on the 6.0 kg block at the moment it is released?

(7 marks)

2. A 60 kg block rests on the ground. A student exerts a 320 N force on the block by pulling on a rope, but friction prevents the block from moving.



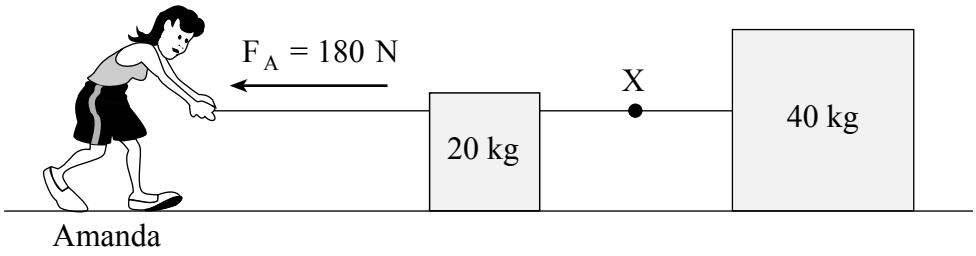
a) Draw and label a free body diagram showing all forces acting on the block. **(2 marks)**

b) Calculate the force of friction on the block. **(2 marks)**

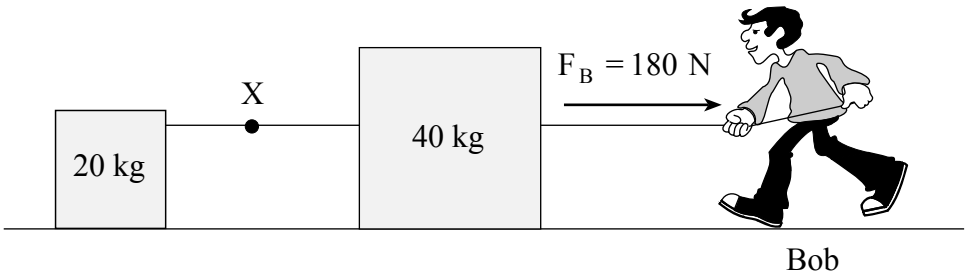
c) Calculate the normal force exerted by the ground on the block. **(2 marks)**

d) Calculate the minimum coefficient of friction between the block and the ground. **(1 mark)**

3. a) Amanda exerts a horizontal force of 180 N on a piece of rope causing two blocks of mass 20 kg and 40 kg to accelerate. Friction on the blocks is negligible. Find the tension force at X in the rope joining the two blocks together. **(3 marks)**



b) Bob exerts a force of equal magnitude in the opposite direction on an identical pair of blocks.



How does the tension force at X compare to the value in part a)? (Circle one.) **(1 mark)**

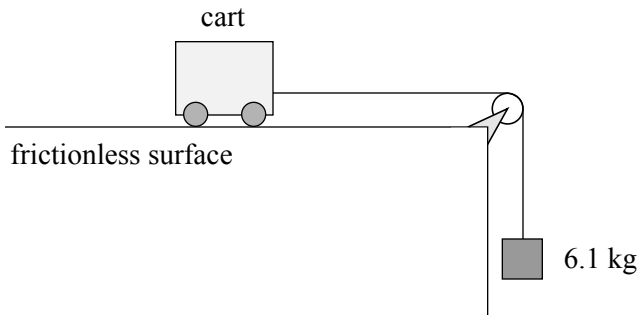
i) The tension force is the same.

ii) The tension force is greater than in a).

iii) The tension force is smaller than in a).

c) Using principles of physics, explain your answer to part b). **(3 marks)**

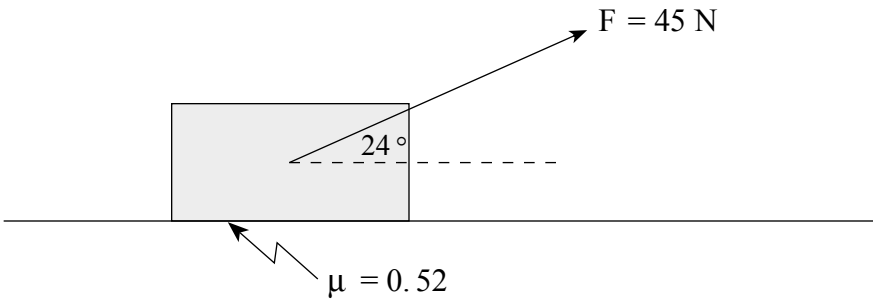
4. In the diagram shown, the tension in the cord connecting the hanging mass and cart is 43 N.



a) Draw and label a free body diagram for the cart and the hanging mass. **(2 marks)**

b) Determine the mass of the cart. **(5 marks)**

5. A student drags a $7.0\ \text{kg}$ carton of apples across the floor by exerting a 45 N force in the direction shown. The coefficient of friction between the carton and the floor is 0.52.

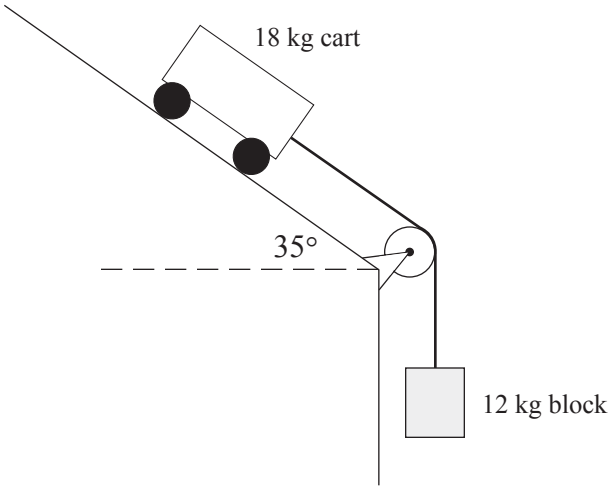


a) What is the magnitude of the normal force acting on the carton? **(2 marks)**

b) What friction force acts on the carton? **(2 marks)**

c) What is the acceleration of the carton? **(3 marks)**

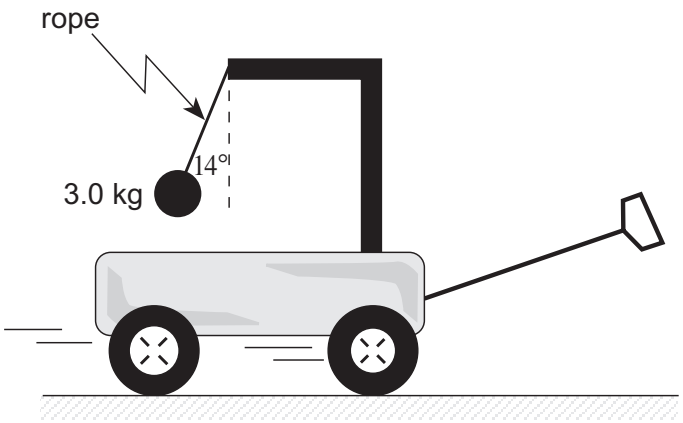
6. An 18 kg cart is connected to a 12 kg hanging block as shown. (Ignore friction.)



a) Draw and label a free body diagram for the 18 kg cart. **(2 marks)**

b) What is the magnitude of the acceleration of the cart? **(5 marks)**

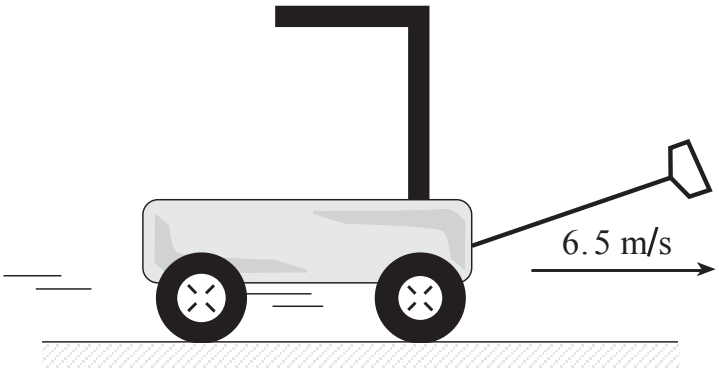
7. A 3.0 kg mass hangs at one end of a rope that is attached to a support on a child's wagon as shown in the diagram. The wagon is pulled to the right. (You may ignore air resistance.)



a) Draw and label a free body diagram showing the forces acting on the mass. **(2 marks)**

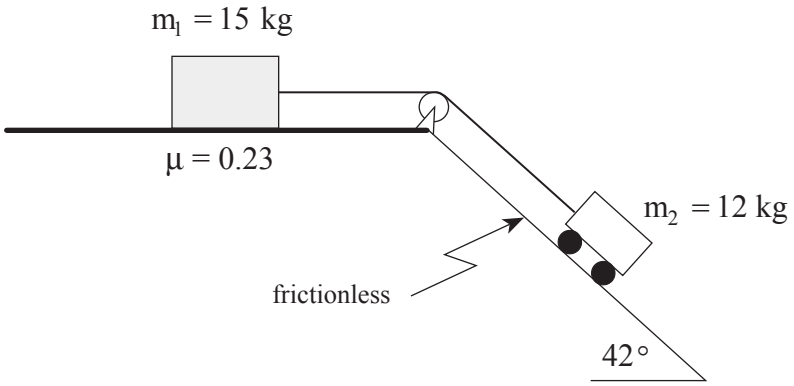
b) What is the acceleration of the wagon? **(3 marks)**

c) On the diagram below, sketch the position of the mass when the cart reaches a constant velocity of 6.5 m/s. **(1 mark)**



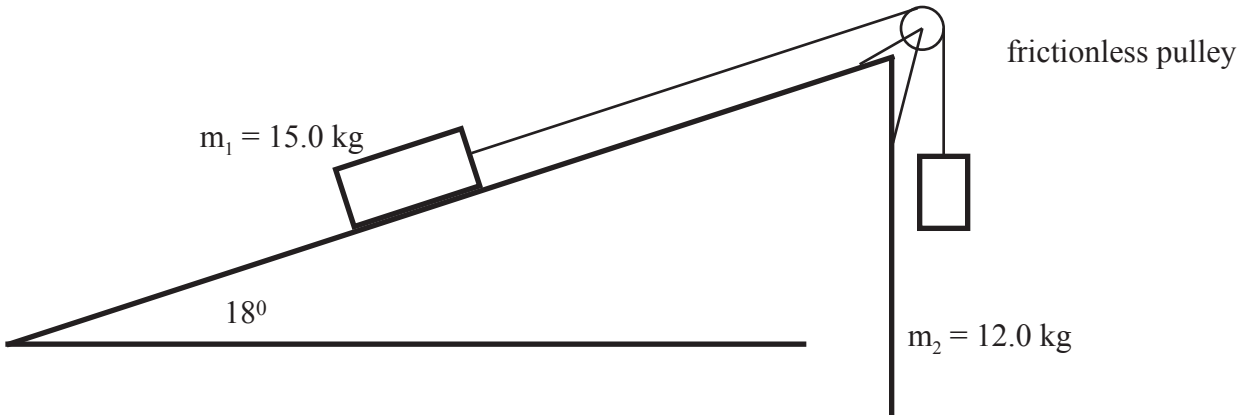
d) Using principles of physics, explain why the mass will be in this position. **(3 marks)**

8. Two objects are connected as shown. The 12 kg cart is on a frictionless 42° incline while the 15 kg block is on a horizontal surface having a coefficient of friction $\mu = 0.23$.



Determine the acceleration of the system of masses. **(7 marks)**

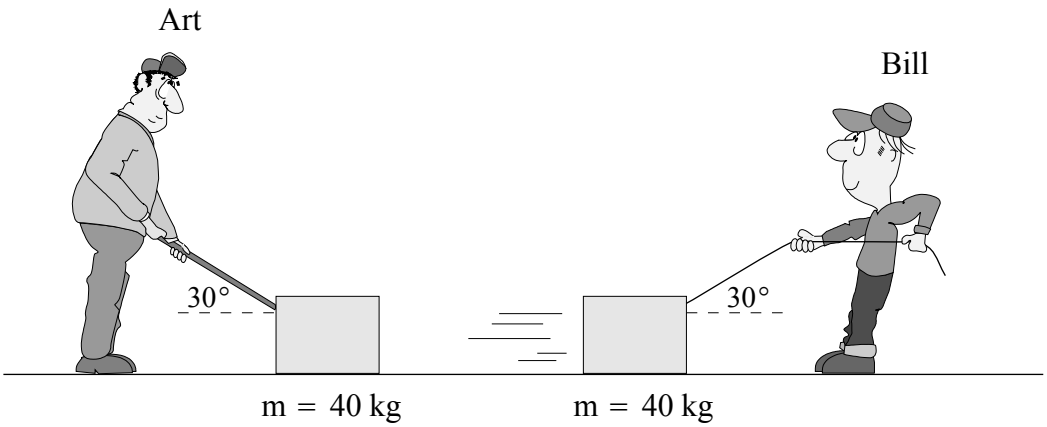
9. As shown in the diagram below, a 15.0 kg block m_1 on an 18^0 inclined plane is connected by a light cord over a frictionless pulley to a hanging 12.0 kg block m_2. The 12.0 kg block accelerates down at 0.97 m/s^2.



a) Draw the free-body diagram for the 15.0 kg block and label all the forces on the diagram. **(2 marks)**

b) What is the coefficient of friction between the block and the inclined plane? **(7 marks)**

10. Art and Bill both attempt to move identical 40 kg crates across identical rough surfaces. Art exerts an 80 N force by pushing with a stick. Bill exerts an 80 N force by pulling on a cord. Bill's crate slides across the ground, but Art's will not move.



Explain this observation, using principles of physics. **(4 marks)**

11. A classmate insists a book cannot be held against a wall by pushing horizontally as shown in Diagram A. He insists that there must be a vertical force component provided by pushing against the book from below, as shown in Diagram B.

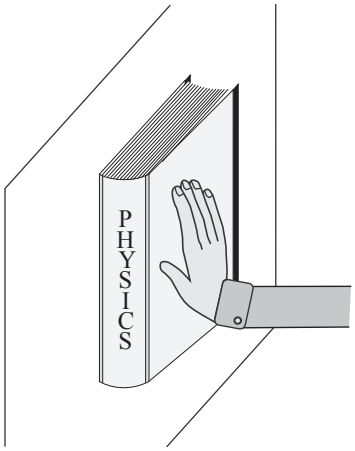


Diagram A

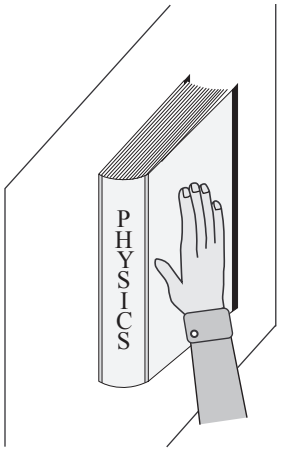


Diagram B

Using principles of physics, show that the situation in Diagram A is reasonable. **(4 marks)**