EQUILIBRIUM

PROVINCIAL EXAM ASSIGNMENT

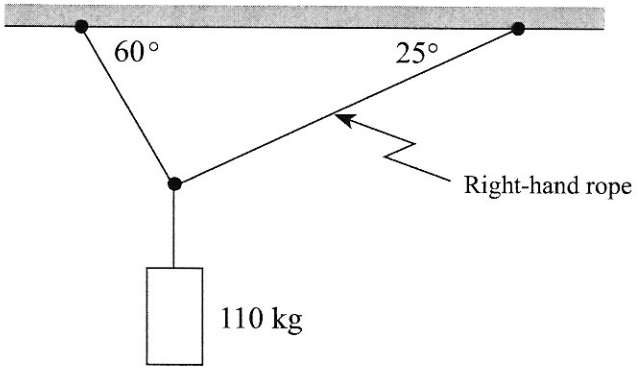
1. State the condition for translational equilibrium.

   A. $\Sigma F = 0$
   B. $\Sigma F \neq 0$
   C. $\Sigma \tau = 0$
   D. $\Sigma \tau \neq 0$

2. Two forces, 12 N west and 5.0 N north, act on an object. What is the direction of a third force that would produce static equilibrium?

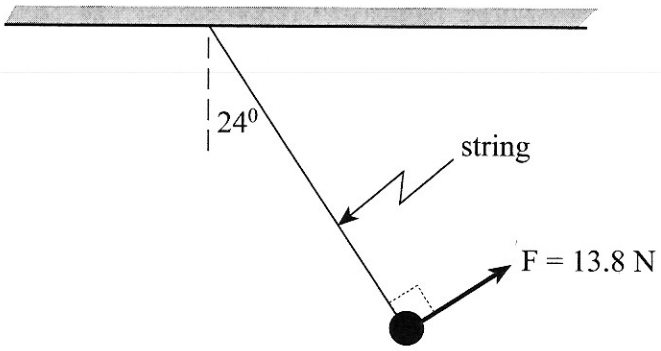
   A. 23° south of east
   B. 23° north of west
   C. 67° south of east
   D. 67° north of west

3. A 110 kg object is supported by two ropes attached to the ceiling. What is the tension T in the right-hand rope?



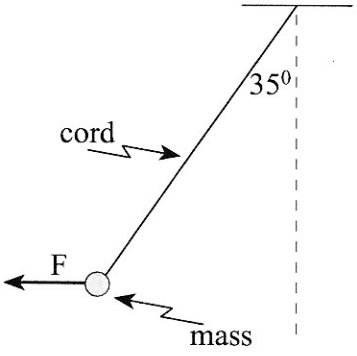
   A. 460 N
   B. 540 N
   C. 930 N
   D. 1 300 N

4. A mass suspended by a string is held 24° from vertical by a force of 13.8 N as shown. Find the mass.



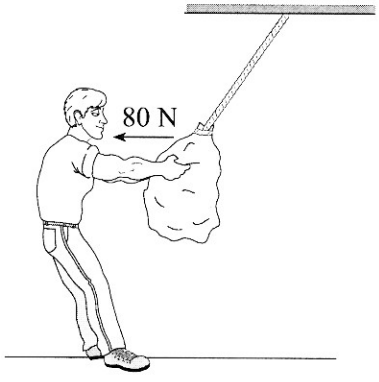
A. 0.57 kg
B. 1.5 kg
C. 3.2 kg
D. 3.5 kg

5. A mass of 5.0 kg is suspended from a cord as shown in the diagram below. What horizontal force F is necessary to hold the mass in the position shown?



A. 28 N
B. 34 N
C. 40 N
D. 70 N

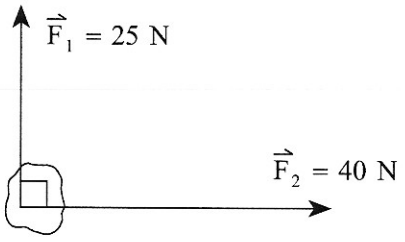
6. A 220 N bag of potatoes is suspended from a rope as shown in the diagram. A person pulls horizontally on the bag with a force of 80 N.



What is the tension in the rope?

A. 1.4×10^2 N
B. 2.2×10^2 N
C. 2.3×10^2 N
D. 3.0×10^2 N

7. Two forces act on an object as shown. Find the magnitude of the third force required to achieve translational equilibrium.

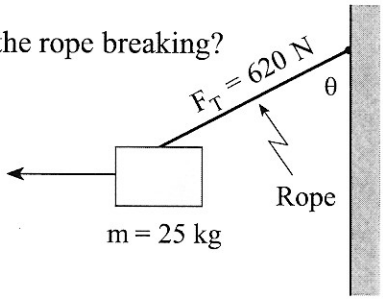


A. 15 N
B. 33 N
C. 47 N
D. 65 N

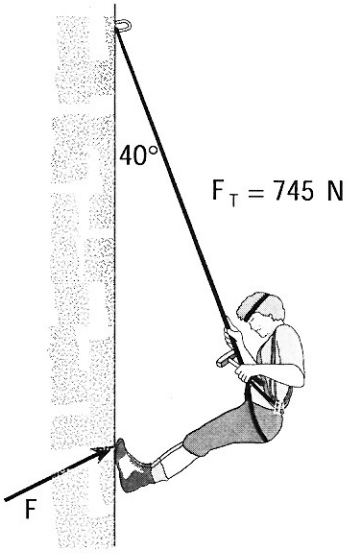
8. A 25 kg block is pulled by a horizontal force. The supporting rope can withstand a maximum tension force of 620 N.

To what maximum angle, θ, can the block be pulled without the rope breaking?

A. 22°
B. 23°
C. 67°
D. 88°



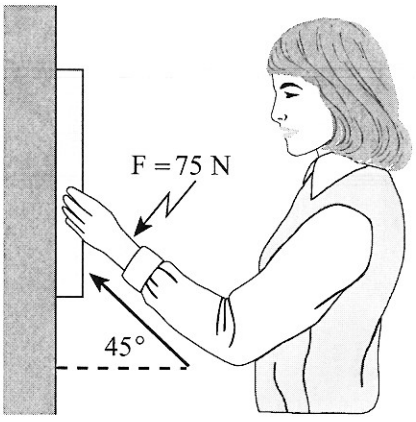
9. An 85.0 kg mountaineer remains in equilibrium while climbing a vertical cliff. The tension force in the supporting rope is 745 N.



Find the magnitude of the reaction force, F, which the cliff exerts on the mountaineer's feet.

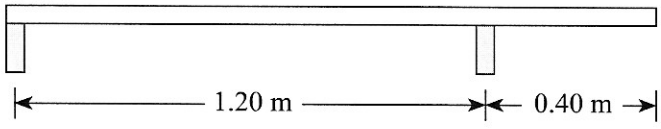
A. 88.0 N
B. 373 N
C. 479 N
D. 546 N

10. An artist must push with a minimum force of 75 N at an angle of 45° to a picture to hold it in equilibrium. The coefficient of friction between the wall and the picture frame is 0.30. What is the mass of the picture?



A. 1.6 kg
B. 2.3 kg
C. 3.8 kg
D. 7.0 kg

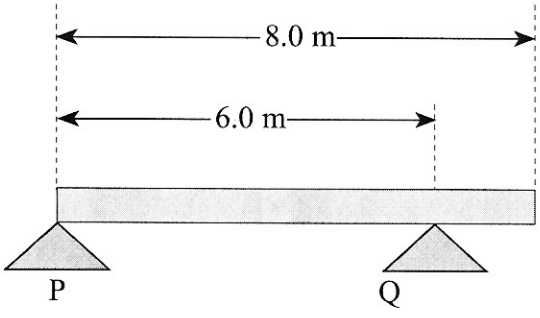
11. A uniform 1.60 m board rests on two bricks as shown below. The left brick exerts an upward force of 12 N on the board.



What upward force does the right brick exert?

A. 3.0 N
B. 12 N
C. 24 N
D. 36 N

12. A uniform beam of mass 25 kg rests on supports P and Q, as shown in the diagram below.



What force is exerted by support Q on the beam?

A. 1.2×10^2 N
B. 1.6×10^2 N
C. 3.3×10^2 N
D. 4.9×10^2 N

13. What are the units of torque?

A. $N \times m$
B. N/m
C. $N \times s$
D. N/s

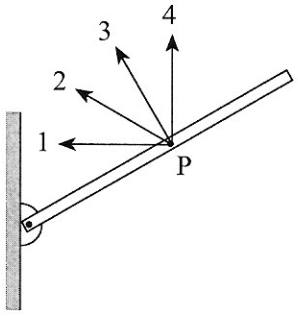
14. A body is in static equilibrium when

A. $\Sigma\tau = 0$ only.
B. $\Sigma F = 0$ only.
C. $\Sigma F = 0$ and $\Sigma\tau = 0$.
D. $\Sigma F = 0$ and $\Sigma\tau \neq 0$.

15. A body is in rotational equilibrium when

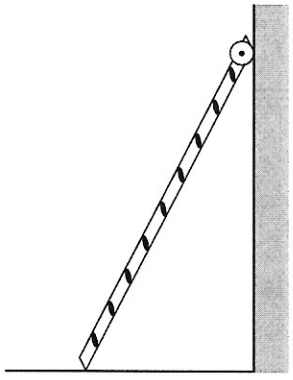
A. $\Sigma\tau = 0$
B. $\Sigma F = 0$
C. $\Sigma p = 0$
D. $\Sigma E_k = 0$

16. In which direction should a force act at point P to hold the boom in equilibrium so that the force will be a minimum?

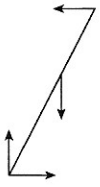


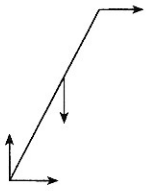
A. 1
B. 2
C. 3
D. 4

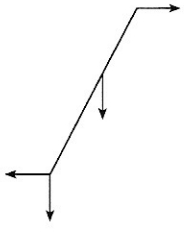
17. A uniform ladder leans against a frictionless wall as shown.



Which of the following diagrams best shows the forces acting on the ladder?

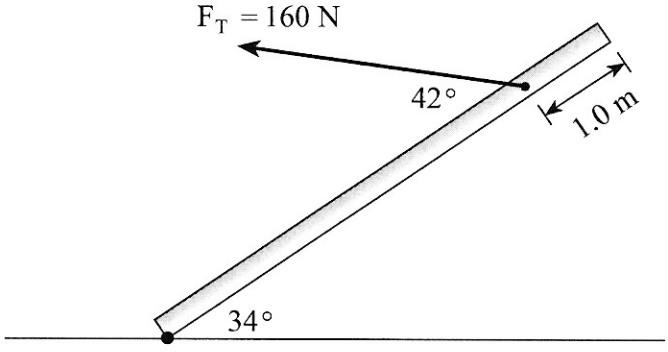
A. 

B. 

C. 

D. 

18. A uniform 15 kg pipe of length 5.0 m has a 160 N force applied 4.0 m from its lower end as shown.

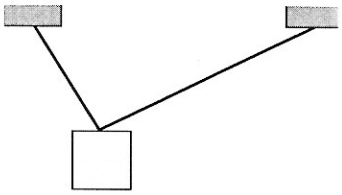


Using the point where the pipe touches the ground as a pivot, calculate the sum of the torques acting on the pipe.

A. 180 N×m in a clockwise direction.
B. 270 N×m in a clockwise direction.
C. 120 N×m in a counter-clockwise direction.
D. 270 N×m in a counter-clockwise direction.

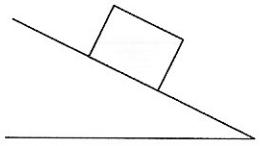
19. Which of the four problems shown requires the application of torque?

A.



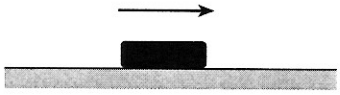
What is the tension in the supporting cables?

B.



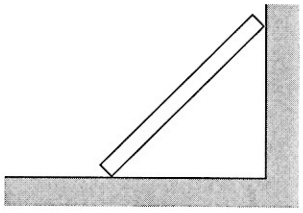
What is the friction force acting on the block?

C.



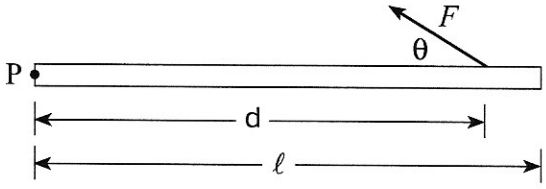
What is the acceleration of the puck?

D.



What force does the wall exert on the board?

20. A force F is applied to a uniform horizontal beam as shown in the diagram below.

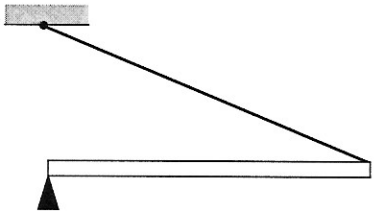


Which of the following is a correct expression for the torque on the beam about pivot point P due to this force?

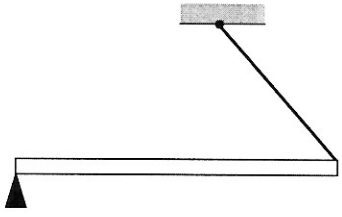
A. $F \sin\theta \cdot d$
B. $F \sin\theta \cdot d/$
C. $F \cos\theta \cdot d$
D. $F \cos\theta \cdot d/$

21. A beam is to be kept horizontal by a cord. In which of the four situations shown below will the tension in the cord be least?

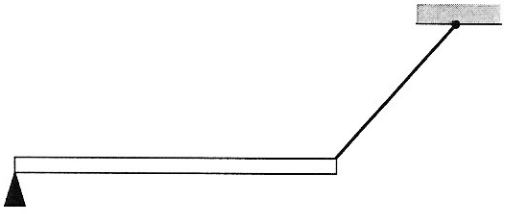
A.



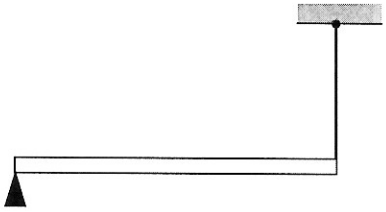
B.



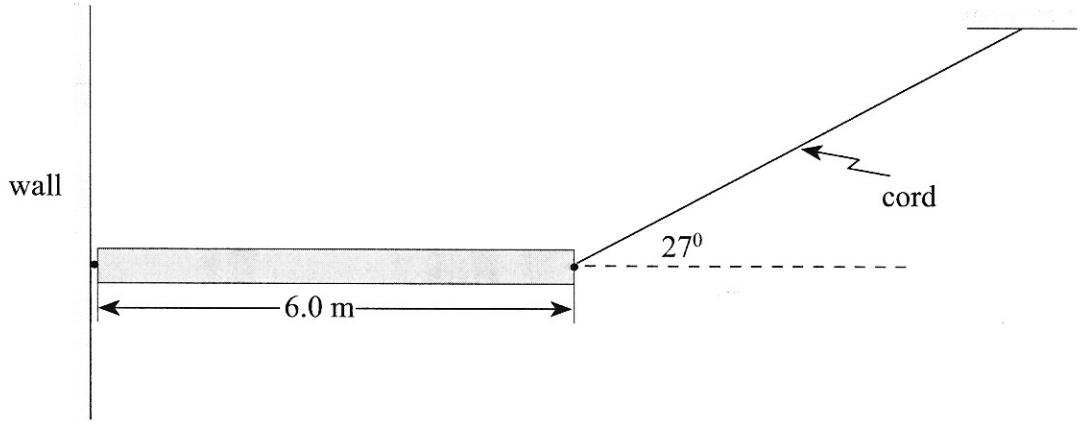
C.



D.



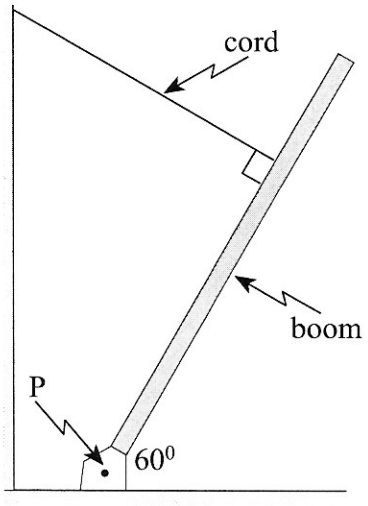
22. A uniform 25 kg bar, 6.0 m long, is suspended by a cord as shown.



What is the tension in the cord?

A. 1.2×10^2 N
B. 2.7×10^2 N
C. 3.7×10^2 N
D. 5.4×10^2 N

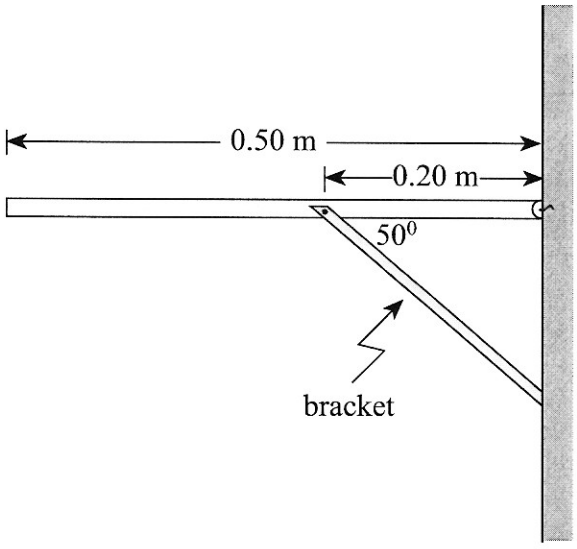
23. A boom hinged at P is held stationary, as shown in the diagram below.



If the tension in the supporting cord, attached three-quarters of the way along the boom from P, is 720 N, what is the weight of the boom?

A. 720 N
B. 1 080 N
C. 1 440 N
D. 2 160 N

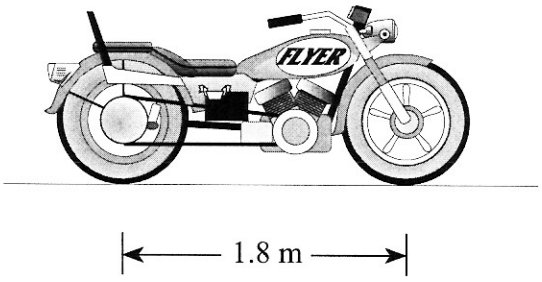
24. A uniform 3.0 kg shelf of width 0.50 m is supported by a bracket, as shown in the diagram below.



What force does the bracket exert on the shelf?

A. 7.4 N
B. 38 N
C. 48 N
D. 57 N

25. The motorcycle shown has a mass of 200 kg and a wheel base of 1.8 m.



If the rear wheel exerts a 1200 N force on the ground, find how far the motorcycle's centre of gravity is located from the front wheel.

A. 0.70 m
B. 0.90 m
C. 1.1 m
D. 1.2 m