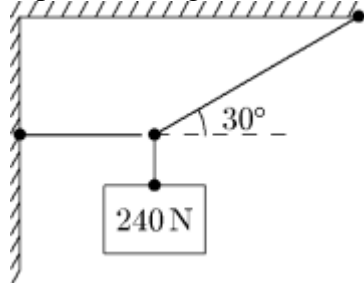Name: _____   Date: _____

1. A 240-N weight is hung from two ropes as shown. The tension force of the horizontal rope has a magnitude of:


A) 0
B) 656 N
C) 480 N
D) 416 N
E) 176 N

2. A cube with edges exactly 2 cm long is made of material with a bulk modulus of 3.5×10^9 N/m². When it is subjected to a pressure of 3.0×10^5 Pa its volume is:

A) 7.31 cm³
B) 7.99931 cm³
C) 8.00069 cm³
D) 8.69 cm³
E) none of these

3. Young's modulus can be correctly given in:

A) N · m
B) N/m²
C) N · m/s
D) N/m
E) joules

Write the letter for the correct answer on the answer sheet. Write clearly.

**4.** The bulk modulus is a proportionality constant that relates the pressure acting on an object to:

   A) the shear
   B) the fractional change in volume
   C) the fractional change in length
   D) Young's modulus
   E) the spring constant

5. A horizontal beam of weight W is supported by a hinge and cable as shown. The force exerted on the beam by the hinge has a vertical component that must be:
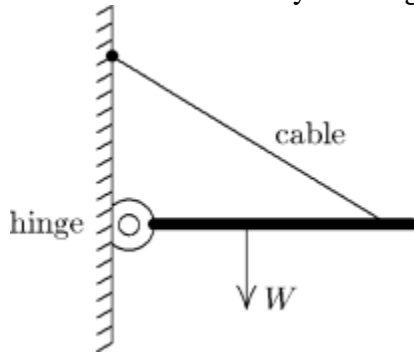

   A) nonzero and up
   B) nonzero and down
   C) nonzero but not enough information given to know whether up or down
   D) zero
   E) equal to W

6. A force of 5000 N is applied outwardly to each end of a 5.0-m long rod with a radius of 34.0 cm and a Young's modulus of 125×10^8 N/m². The elongation of the rod is:

   A) 0.0020 mm
   B) 0.0040 mm
   C) 0.14 mm
   D) 0.55 mm
   E) 1.42 mm

7. A meter stick on a horizontal frictionless table top is pivoted at the 80-cm mark. A force $\vec{F}_1$ is applied perpendicularly to the end of the stick at 0 cm, as shown. A second force $\vec{F}_2$ (not shown) is applied perpendicularly at the 60-cm mark. The forces are horizontal. If the stick does not move, the force exerted by the pivot on the stick:


0 cm   20 cm   40 cm   60 cm   80 cm   100 cm
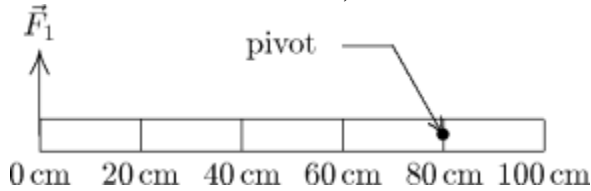
A) must be zero
B) must be in the same direction as $\vec{F}_1$ and have magnitude $|\vec{F}_2| - |\vec{F}_1|$
C) must be directed opposite to $\vec{F}_1$ and have magnitude $|\vec{F}_2| - |\vec{F}_1|$
D) must be in the same direction as $\vec{F}_1$ and have magnitude $|\vec{F}_2| + |\vec{F}_1|$
E) must be directed opposite to $\vec{F}_1$ and have magnitude $|\vec{F}_2| + |\vec{F}_1|$

8. Stress can be measured in:

A) N/m^2
B) $N \cdot m^2$
C) N/m
D) $N \cdot m$
E) none of these (it is unitless)

9. A ladder leans against a wall. If the ladder is not to slip, which one of the following must be true?
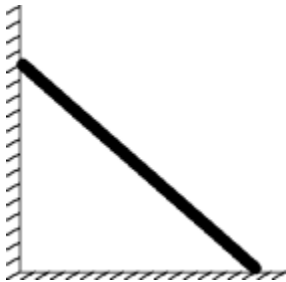

A) The coefficient of friction between the ladder and the wall must not be zero
B) The coefficient of friction between the ladder and the floor must not be zero
C) Both A and B
D) Either A or B
E) Neither A nor B

Write the letter for the correct answer on the answer sheet. Write clearly.

10. A picture P of weight W is hung by two strings as shown. The tension force of each string is T. The total upward pull of the strings on the picture is:
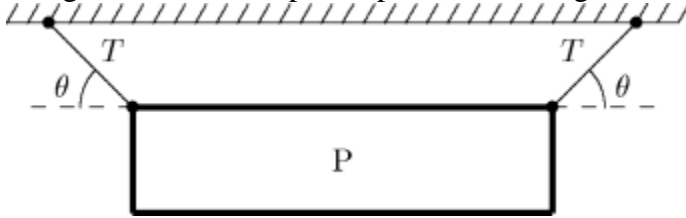

A) $2W \cos \theta$
B) $T \sin \theta$
C) $T \cos \theta$
D) $2T \sin \theta$
E) $2T \cos \theta$

11. A cube with 2.0-cm sides is made of material with a bulk modulus of $4.7 \times 10^5 \text{ N/m}^2$. When it is subjected to a pressure of 2.0×10^5 Pa the length of its any of its sides is:

A) 0.85 cm
B) 1.15 cm
C) 1.66 cm
D) 2.0 cm
E) none of these

12. A certain wire stretches 0.90 cm when certain outward forces are applied to each end. The same forces are applied to a wire of the same material but with three times the diameter and three times the length. The second wire stretches:

A) 0.01 cm
B) 0.30 cm
C) 0.90 cm
D) 2.7 cm
E) 8.1 cm

Write the letter for the correct answer on the answer sheet. Write clearly.

13. A picture is to be hung from the ceiling by means of two wires. Order the following arrangements of the wires according to the magnitude of the tension force of wire B, from least to greatest.
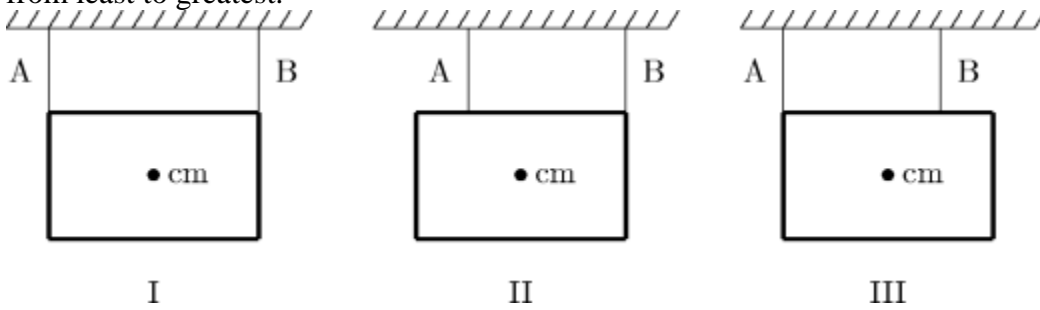

A) I, II, III
B) III, II, I
C) I and II tie, then III
D) II, I, III
E) all tie

14. The center of gravity coincides with the center of mass:

A) always
B) never
C) if the center of mass is at the geometrical center of the body
D) if the gravitational field strength uniform over the body
E) if the body has a uniform distribution of mass

15. The pull *P* is just sufficient to keep the 14-N block and the weightless pulleys in equilibrium as shown. The tension force *T* of the upper cable has a magnitude of:
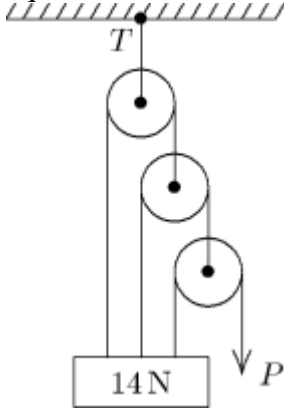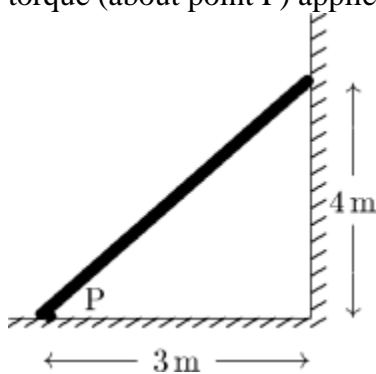

A) 14 N
B) 28 N
C) 16 N
D) 9.33 N
E) 18.7 N

16. For a body to be in equilibrium under the combined action of several forces:

A) all the forces must be applied at the same point
B) all of the forces form pairs of equal and opposite forces
C) any two of these forces must be balanced by a third force
D) the sum of the torques about any point must equal zero
E) the lines of action of all the forces must pass through the center of gravity of the body

17. A meter stick on a horizontal frictionless table top is pivoted at the 80-cm mark. A force $\vec{F}_1$ is applied perpendicularly to the end of the stick at 0 cm, as shown. A second force $\vec{F}_2$ (not shown) is applied perpendicularly at the 100-cm end of the stick. The forces are horizontal. If the stick does not move, the force exerted by the pivot on the stick:
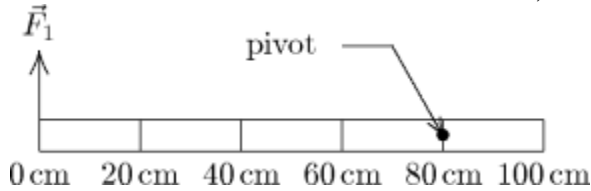
A) must be zero
B) must be in the same direction as $\vec{F}_1$ and have magnitude $|\vec{F}_2| - |\vec{F}_1|$
C) must be directed opposite to $\vec{F}_1$ and have magnitude $|\vec{F}_2| - |\vec{F}_1|$
D) must be in the same direction as $\vec{F}_1$ and have magnitude $|\vec{F}_2| + |\vec{F}_1|$
E) must be directed opposite to $\vec{F}_1$ and have magnitude $|\vec{F}_2| + |\vec{F}_1|$

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


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

Write the letter for the correct answer on the answer sheet. Write clearly.

19. Two supports, made of the same material and initially of equal length, are 2.0 m apart. A stiff board with a length of 4.0 m and a mass of 10 kg is placed on the supports, with one support at the left end and the other at the midpoint. A block is placed on the board a distance of 0.50 m from the left end. As a result the board is horizontal. The mass of the block is:

A) zero
B) 2.3 kg
C) 6.6 kg
D) 10 kg
E) 20 kg

20. A 960-N block is suspended as shown. The beam AB is weightless and is hinged to the wall at A. The magnitude of the tension force of the cable BC is:
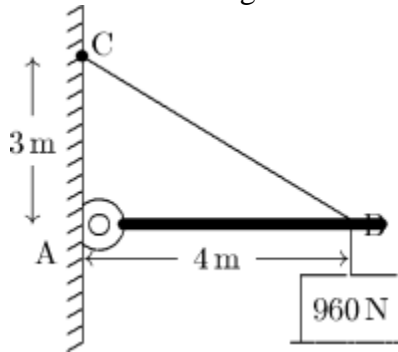
A) 720 N
B) 1200 N
C) 1280 N
D) 1600 N
E) none of these

Write the letter for the correct answer on the answer sheet. Write clearly.

Answer Key

  1. D
  2. B
  3. B
  4. B
  5. A
  6. D
  7. B
  8. A
  9. B
10. D
11. C
12. B
13. D
14. D
15. C
16. D
17. E
18. C
19. E
20. D

Write the letter for the correct answer on the answer sheet. Write clearly.