

Forces Review

1. Two groups of five men each are engaged in a tug-of-war, each man pulling with a force of 900 N. If the rope does not move, the tension in it is

- A) 18 kN
- B) 9.0 kN
- C) 44 kN
- D) 4.5 kN
- E) 0.46 kN

Explain why you choose your answer.

THE TENSION DOES NOT ADD → IF ONE END OF THE STRING PULLS WITH A FORCE OF 4500 N - THE TENSION IS 4500 N (5 MEN x 900N/MAN).

2. Complete the following statement: The term *net force* most accurately describes

- A) the mass of an object
- B) the inertia of an object.
- C) the quantity that causes displacement.
- D) the quantity that keeps an object moving.
- E) the quantity that changes the velocity of an object.

NET FORCE CAUSES ACCELERATION
AN ACCELERATION IS A CHANGE IN VELOCITY
→ NET FORCES CHANGE MOTION (VELOCITY)

3. Which one of the following terms is used to indicate the natural tendency of an object to remain at rest or in motion at a constant speed along a straight line?

- A) velocity
- B) force
- C) acceleration
- D) equilibrium
- E) inertia

4. When the net force that acts on a hockey puck is 10 N, the puck accelerates at a rate of 50 m/s². Determine the mass of the puck.

- A) 0.2 kg
- B) 1.0 kg
- C) 5 kg
- D) 10 kg
- E) 50 kg

$$\Sigma F = ma$$
$$m = \frac{\Sigma F}{a} = \frac{10N}{50m/s^2} = 0.2kg$$

5. A rock is thrown straight up from the earth's surface. Which one of the following statements concerning the *net force* acting on the rock at the top of its path is true?

- A) It is equal to the weight of the rock.
- B) It is instantaneously equal to zero newtons.
- C) Its direction changes from up to down.
- D) It is greater than the weight of the rock.
- E) It is less than the weight of the rock, but greater than zero newtons.

Explain why you choose your answer.

-IN ORDER TO BE A PROJECTILE, THE ONLY FORCE ACTING ON THE OBJECT IS ITS WEIGHT. THE NET FORCE DURING THE ENTIRE FLIGHT IS THE WEIGHT.

6. A force accelerates a body of mass *M*. The same force applied to a second body produces three times the acceleration. What is the mass of the second body?

- A) *M*
- B) 3*M*
- C) *M*/3
- D) 9*M*
- E) *M*/9

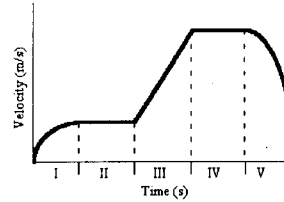
$$F = Ma$$

$$F = (?) (3a)$$

↑
 $\frac{1}{3} M$

Use the following to answer question 7:

A 2.0-kg object moves in a straight line on a horizontal frictionless surface. The graph shows the velocity of the object as a function of time. The equal time intervals are labeled using Roman numerals: I, II, III, IV, and V. The net force on the object always acts along the line of motion of the object.



surface. various and V. The object. force?

7. Which section(s) of the graph correspond to a condition of zero net force?
 A) V only B) III only **C) II and IV** D) II, III, and IV E) I, III, and V

Explain why you choose your answer.

THE SLOPE OF VELOCITY VS. TIME IS ACCELERATION. IF THE SLOPE IS ZERO (SECTIONS 2 & 4) THEN $a=0$. IF $a=0$, THEN $\Sigma F=0$.

8. A body moves with constant speed in a straight line. Which of the following statements must be true?

- A) No force acts on the body.
 B) A single constant force acts on the body in the direction of motion.
 C) A single constant force acts on the body in the direction opposite to the motion.
D) A net force of zero acts on the body.
 E) A constant net force acts on the body in the direction of motion.

CONSTANT SPEED $\Rightarrow a=0$
 $a=0 \Rightarrow \Sigma F=0$
 MULTIPLE FORCES COULD ACT, BUT ALL ADD TO ZERO

9. The weight of an object is

- A) the same as the mass of the object.
 B) the quantity of matter in the object.
 C) the mass of the object multiplied by the acceleration due to gravity at sea level, regardless of where the object is located.
D) the result of the gravitational force acting on the object.
 E) the reading on a spring scale attached to the object.

NOT TRUE \rightarrow THE VALUE OF g DEPENDS ON LOCATION

10. The acceleration due to gravity on the moon is only about 1/6 of that on earth. An astronaut whose weight on earth is 600 N travels to the lunar surface. His mass as measured on the moon is

- A) 600 kg B) 100 kg **C) 61.2 kg** D) 10.0 kg E) 360 kg

$m = \frac{600N}{9.8m/s^2}$

MASS DOES NOT DEPEND ON LOCATION

11. A boy holds a bird in his hand. The reaction force to the weight of the bird is the force of the

- A) earth on the bird.
B) bird on the earth.
 C) hand on the bird.
 D) bird on the hand.
 E) earth on the hand.

Explain why you choose your answer.

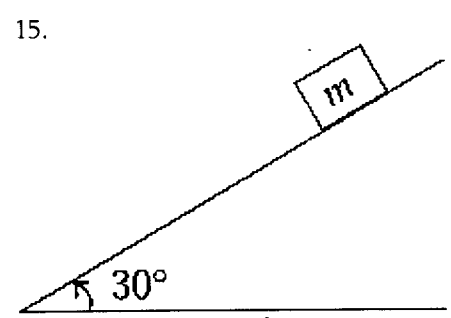
ACTION REACTION FORCES MUST OCCUR BETWEEN THE SAME PAIR OF OBJECTS. THE WEIGHT OF THE BIRD INVOLVES THE BIRD & THE EARTH, SO THE REACTION FORCE MUST ALSO INCLUDE THE BIRD & THE EARTH. WEIGHT IS THE EARTH PULLING ON THE BIRD - THE REACTION IS THE BIRD PULLING ON THE EARTH.

12. A body of weight w is in free fall near the surface of the earth. What force does the body exert on the earth?
 (A) w B) greater than w C) less than w D) $9.81w$ E) zero **EQUAL & OPPOSITE REACTION**

13. A cricket batsman hits a ball with a bat. If the force with which the bat hits the ball is considered the action force, what is the reaction force?
 A) the force the bat exerts on the batsman's hands **ACTION: BAT HITS BALL**
 B) the force on the ball exerted by the hand of the person who catches it **REACTION: BALL HITS BAT**
 (C) the force the ball exerts on the bat
 D) the force the bowler exerts on the ball in throwing it
 E) friction as the ball rolls to a stop

14. A block of wood is pulled by a horizontal string across a rough surface at a constant velocity by a force of 20 N. The coefficient of kinetic friction between the surfaces is 0.3. The force of friction is
 A) impossible to determine without knowing the mass of the block.
 B) impossible to determine without knowing the speed of the block.
 C) 0.3 N
 D) 6 N
 (E) 20 N

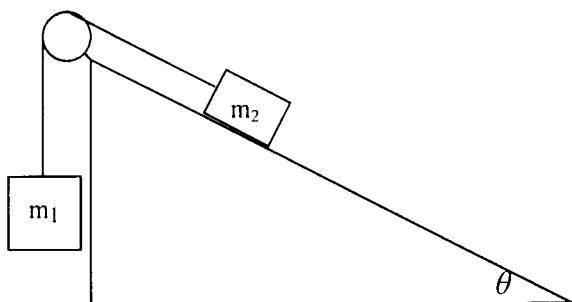
Explain why you choose your answer.
 IF THE BLOCK TRAVELS @ A CONSTANT VELOCITY, THE PULLING FORCE (20N) MUST EQUAL THE FRICTIONAL FORCE [$a=0, \Sigma F=0$]



A block of mass m is at rest on an inclined plane that makes an angle of 30° with the horizontal, as shown in the figure. Which of the following statements about the force of static friction is true?

a. Is the normal force acting on the block greater than, less than, or equal to its weight Justify your answer.
LESS THAN THE WEIGHT. THE WEIGHT OF THE BLOCK PULLS STRAIGHT DOWN, THE NORMAL FORCE PUSHES UP AT AN ANGLE \rightarrow ONLY PART OF THE WEIGHT IS OPPOSITE THE NORMAL FORCE. PUT ANOTHER WAY, THE NORMAL FORCE ONLY HAS TO SUPPORT THE PART OF THE WEIGHT THAT POINTS IN THE DIRECTION OF THE NORMAL FORCE.

b. Assuming the block is at rest on the incline, what kind of friction acts on the block, static or kinetic? What **STATIC** would increasing the ramp angle do to the force?
2 POSSIBLE THINGS HAPPEN - IF THE BLOCK DOES NOT SLIP, THE FORCE OF FRICTION WILL INCREASE BECAUSE THE PART OF WEIGHT THAT PULLS IT DOWN THE PLANE INCREASES. & IF THE BLOCK DOES NOT MOVE, FRICTION MUST INCREASE AS WELL. THE FORCE PULLING DOWN THE PLANE MAY EXCEED STATIC FRICTION. IN THAT CASE, THE BLOCK WILL MOVE AND EXPERIENCE KINETIC FRICTION. AS THE ANGLE INCREASES, THE PART OF WEIGHT THAT PULLS AGAINST F_n DECREASES & SO DOES F_n . THIS DECREASES THE FRICTION

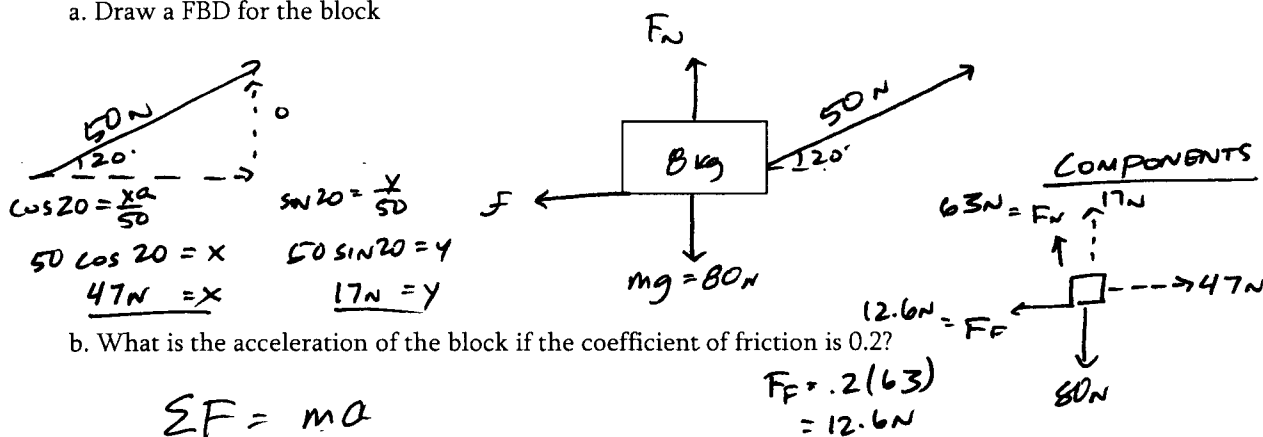


16. The system above is frictionless and at rest. Is mass 1 greater than, less than, or equal to mass 2? Justify your answer.

MASS 1 IS LESS THAN MASS 2. THE FORCE PULLING DOWN ON MASS 1 IS ITS ENTIRE WEIGHT. THE FORCE PULLING MASS 2 DOWN THE PLANE IS ONLY A PART OF ITS WEIGHT. IN ORDER FOR THE SYSTEM TO BE IN EQUILIBRIUM ($a=0$), THE WEIGHT OF MASS 1 MUST EQUAL PART OF THE WEIGHT OF MASS 2. MASS 2 MUST BE GREATER THAN MASS 1.

17. A block of mass 8 kg is being pulled by a string with a force of 50 N that makes an angle of 20 degrees above the horizontal.

a. Draw a FBD for the block



b. What is the acceleration of the block if the coefficient of friction is 0.2?

$$\Sigma F = ma$$

$$47\text{N} - 12.6\text{N} = 8\text{kg}(a)$$

$$34.4\text{N} = 8\text{kg}(a)$$

$$4.3\text{m/s}^2 = a$$

$$F_f = .2(63)$$

$$= 12.6\text{N}$$