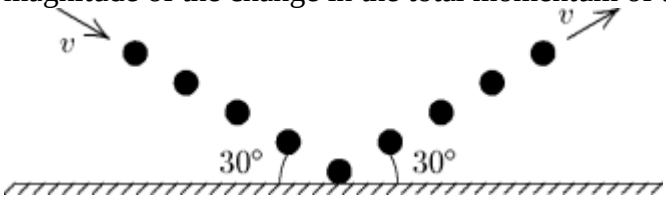
Name: _____ Date: _____

1. A stream of gas consists of n molecules. Each molecule has mass *m* and speed *v*. Each molecule is reflected without change in speed from a rigid surface as shown. The magnitude of the change in the total momentum of the stream is:



A) 2*mnv*
B) 2*mnv* sin 30º
C) *mnv* sin 30º
D) *mnv* cos 30º
E) *mnv*

2. A golf ball of mass *m* is hit by a golf club so that the ball leaves the tee with speed *v*. The club is in contact with the ball for time *T*. The magnitude of the average force on the club on the ball during the time *T* is:

A) *mvT*
B) *mv*/*T*
C) (1/2)mv^2T
D) $mv^2/(2T)$
E) $mT^2/(2v)$

3. A 0.2-kg rubber ball is dropped from the window of a building. It strikes the sidewalk below at 30 m/s and rebounds up at 20 m/s. The impulse on the ball during the collision is:

A) 10 N · s upward
B) 10 N · s downward
C) 2.0 N · s upward
D) 2.0 N · s downward
E) 9.8 N · s upward

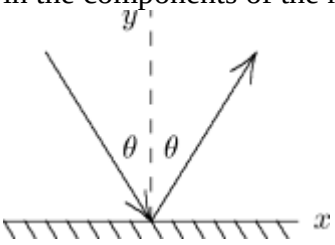
4. The thrust of a rocket is:

A) a gravitational force acting on the rocket
B) the force of the exiting fuel gases on the rocket
C) any force that is external to the rocket-fuel system
D) a force that arises from the reduction in mass of the rocket-fuel system
E) none of the above

5. A 64-kg woman stands on frictionless level ice, with a 0.10-kg stone at her feet. She kicks the stone with her foot so that she acquires a velocity of 0.0017 m/s in the forward direction. The velocity acquired by the stone is:

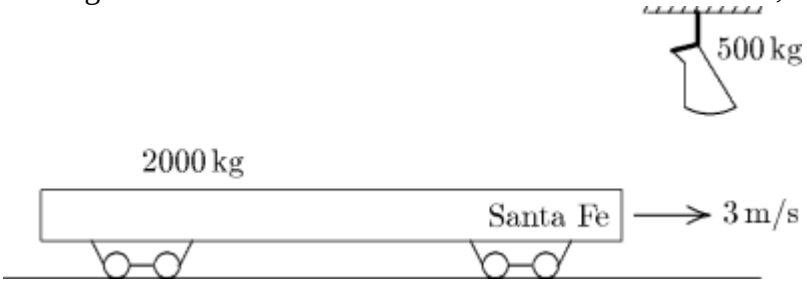
A) 1.1 m/s forward
B) 1.1 m/s backward
C) 0.0017 m/s forward
D) 0.0017 m/s backward
E) none of these

6. A ball hits a wall and rebounds with the same speed, as diagramed below. The changes in the components of the momentum of the ball are:



A) $\Delta p_x > 0, \Delta p_y > 0$
B) $\Delta p_x < 0, \Delta p_y > 0$
C) $\Delta p_x = 0, \Delta p_y > 0$
D) $\Delta p_x = 0, \Delta p_y < 0$
E) $\Delta p_x > 0, \Delta p_y < 0$

7. A 500-kg sack of coal is dropped on a 2000-kg railroad flatcar which was initially moving at 3 m/s as shown. After the sack rests on the flatcar, the speed of the flatcar is:



A) 0.6 m/s
B) 1.2 m/s
C) 1.8 m/s
D) 2.4 m/s
E) 3.6 m/s

8. Bullets from two revolvers are fired with the same velocity. The bullet from gun #1 is twice as heavy as the bullet from gun #2. Gun #1 weighs three times as much as gun #2. The ratio of the momentum imparted to gun #1 to that imparted to gun #2 is:

A) 2:3
B) 3:2
C) 2:1
D) 3:1
E) 6:1

9. What impulse will give a 2.0-kg object a momentum change of $+ (50\,\text{kg}\cdot\text{m/s})\,\hat{\text{i}}$?

A) $+(25\,\text{N}\cdot\text{s})\,\hat{\text{i}}$
B) $-(25\,\text{N}\cdot\text{s})\,\hat{\text{i}}$
C) $+(50\,\text{N}\cdot\text{s})\,\hat{\text{i}}$
D) $-(50\,\text{N}\cdot\text{s})\,\hat{\text{i}}$
E) $+(100\,\text{N}\cdot\text{s})\,\hat{\text{i}}$

10. A 3.00-g bullet traveling horizontally at 400 m/s hits a 3.00-kg wooden block, which is initially at rest on a smooth horizontal table. The bullet buries itself in the block without passing through. The speed of the block after the collision is:

A) 1.33 m/s
B) 0.40 m/s
C) 12.0 m/s
D) 40.0 m/s
E) 160 m/s

11. A rifle of mass M is initially at rest but free to recoil. It fires a bullet of mass m and velocity v (relative to the ground). After firing, the velocity of the rifle (relative to the ground) is:

A) $-mv$
B) $-Mv/m$
C) $-mv/M$
D) $-v$
E) mv/M

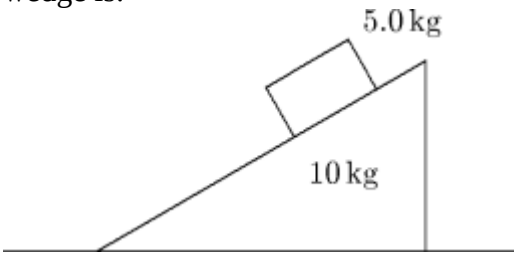
12. A 75-kg man is riding in a 30-kg cart at 2.0 m/s. He jumps off in such a way as to land on the ground with no horizontal velocity. The resulting change in speed of the cart is:

A) zero
B) 2.0 m/s
C) 3.0 m/s
D) 5.0 m/s
E) 7.0 m/s

13. A man is marooned at rest on level frictionless ice. In desperation, he hurls his shoe to the right at 15 m/s. If the man weighs 720 N and the shoe weighs 4.0 N, the man moves to the left with a speed of:

A) 0
B) 2.1×10^{-2} m/s
C) 8.3×10^{-2} m/s
D) 15 m/s
E) 2.7×10^{3} m/s

14. A large wedge with a mass of 10 kg rests on a horizontal frictionless surface, as shown. A block with a mass of 5.0 kg starts from rest and slides down the inclined surface of the wedge, which is rough. At one instant the vertical component of the block's velocity is 3.0 m/s and the horizontal component is 6.0 m/s. At that instant the velocity of the wedge is:



A) 3.0 m/s to the left
B) 3.0 m/s to the right
C) 6.0 m/s to the right
D) 6.0 m/s to the left
E) 17 m/s to the right

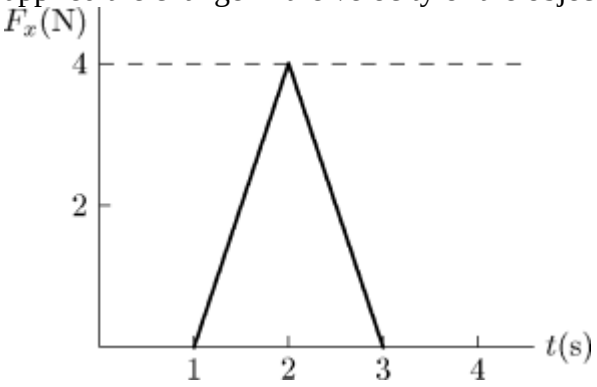
15. A 640-N acrobat falls 5.0 m from rest into a net. The net tosses him back up with the same speed he had just before he hit the net. The magnitude of the average upward force exerted on him by the net during this collision is:

A) 32 N
B) 64 N
C) 320 N
D) 640 N
E) impossible to determine from the given data

16. When you step on the accelerator to increase the speed of your car, the force that accelerates the car is:

A) the force of your foot on the accelerator
B) the force of friction of the road on the tires
C) the force of the engine on the drive shaft
D) the normal force of the road on the tires
E) none of the above

17. A 5-kg object can move along the *x* axis. It is subjected to a force $\vec{F}$ in the positive *x* direction; a graph of F_x as a function of time *t* is shown below. Over the time the force is applied the change in the velocity of the object is:



A) 0.8 m/s
B) 1.1 m/s
C) 1.6 m/s
D) 2.3 m/s
E) 4.0 m/s

18. At one instant of time a rocket is traveling in outer space at 2500 m/s and is exhausting fuel at a rate of 100 kg/s. If the speed of the fuel as it leaves the rocket is 1500 m/s, relative to the rocket, the thrust is:

A) 0
B) 1.0×10^5 N
C) 1.5×10^5 N
D) 2.9×10^5 N
E) 2.5×10^5 N

19. The momentum of an object at a given instant is independent of its:

A) inertia
B) mass
C) speed
D) velocity
E) acceleration

20. The physical quantity “impulse” has the same dimensions as that of:

A) force
B) power
C) energy
D) momentum
E) work

Answer Key

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