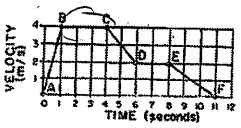
Name:
Regents Physics

Unit 6: Momentum Review

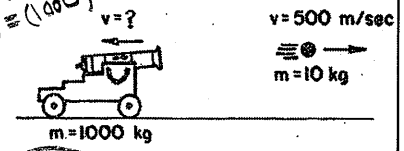
1. Base your answer to the following question on the graph below which represents the velocity-time relationship for a 2.0-kilogram mass moving along a horizontal frictionless surface.



The momentum of the mass during interval *BC* is
(1) 8.0 kg·m/s (3) 0 kg·m/s
(2) 12 kg·m/s (4) 4.0 kg·m/s

2. Two rocks weighing 5 Newtons and 10 Newtons, respectively, fall freely from rest near the Earth's surface. After 3 seconds of free-fall, compared to the 5-newton rock, the 10-newton rock has greater
(1) acceleration (3) momentum
(2) height (4) speed

3. In the diagram below, a 10-kilogram ball is fired with a velocity of 500 meters per second from a 1,000-kilogram cannon. What is the recoil velocity of the cannon?

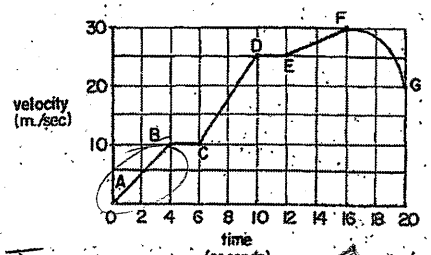


(1) 5 m/s (3) 10 m/s
(2) 2 m/s (4) 500 m/s

4. Which is a unit of momentum?
(1) N-m/s^2 (3) N-m/s
(2) kg-m/s^2 (4) kg-m/s

5. What is the momentum of a 1.5×10^3-kilogram car as it travels at 30. meters per second due east for 60. seconds?
(1) 4.5×10^4 kg·m/s, east (3) 4.5×10^6 kg·m, east
(2) 4.5×10^4 kg·m/s, west (4) 4.5×10^6 kg·m, west

6. Base your answer to the following question on the graph below, which shows the velocity of a 1,500-kilogram car during a 20-second-time interval.

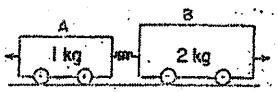


The impulse applied to the car during time interval *AB* is
(1) 9.0×10^2 N-sec. (3) 6.0×10^3 N-sec.
(2) 4.5×10^3 N-sec. (4) 1.5×10^4 N-sec.

7. An impulse of 30.0 Newton-seconds is applied to a 5.00-kilogram mass. If the mass had a speed of 100. meters per second before the impulse, its speed after the impulse could be
(1) 250. m/sec (3) 6.00 m/sec
(2) 106 m/sec (4) 0 m/sec

8. A force of 10. Newtons acts on an object for 0.010 second. What force, acting on the object for 0.050 second, would produce the same impulse?
(1) 1.0 N (3) 5.0 N
(2) 2.0 N (4) 10. N

Base your answers to questions 9 through 11 on the diagram below which represents carts *A* and *B* being pushed apart by a spring which exerts an average force of 50. Newtons for a period of 0.20 second. [Assume friction-less conditions.]



9. What is the magnitude of the impulse applied by the spring on cart *A*?
(1) 5.0 N-sec (3) 50. N-sec
(2) 10. N-sec (4) 100 N-sec

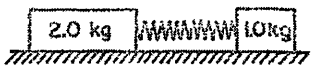
10. Compared to the magnitude of the impulse acting on cart *A*, the magnitude of the impulse acting on cart
(1) one-half as great (3) the same
(2) twice as great (4) four times as great

11. Compared to the total momentum of the carts before the spring is released, the total momentum of the carts after the spring is released is
(1) one-half as great (3) the same
(2) twice as great (4) four times as great

12. A 0.60-kilogram softball initially at rest is hit with a bat. The ball is in contact with the bat for 0.20 second and leaves the bat with a speed of 25 meters per second. What is the magnitude of the average force exerted by the ball on the bat?
(1) 8.3 N (3) 3.0 N
(2) 15 N (4) 75 N

13. A 2,400-kilogram car is traveling at a speed of 20. meters per second. Compared to the magnitude of the force required to stop the car in 12 seconds, the magnitude of the force required to stop the car in 6.0 seconds is
(1) half as great (3) the same
(2) twice as great (4) four times as great

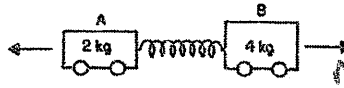
Base your answers to questions 14 and 15 on the diagram below which represents two objects at rest on a frictionless horizontal surface with a spring compressed between them. When the compressed spring is released, the two objects are pushed apart.



14. What is the total momentum of the two-object system after the expansion of the spring?
(1) 20. kg-m/s (3) 5.0 kg-m/s
(2) 10. kg-m/s (4) 0 kg-m/s

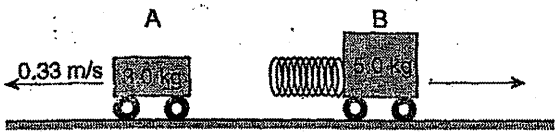
15. If the 1.0-kilogram object receives an impulse of +20.-newton-seconds, what impulse does the 2.0-kilogram object receive?
(1) 0 N-s (3) -10. N-s
(2) -5.0 N-s (4) -20. N-s

16. Lab carts *A* and *B* are initially at rest with a compressed spring between them as shown in the diagram below.



Which statement best describes the motion of the carts after the spring is released?
(1) Cart *A* has twice the momentum of cart *B*.
(2) Cart *B* has twice the momentum of cart *A*.
(3) Cart *A* has twice the velocity of cart *B*.
(4) Cart *B* has twice the velocity of cart *A*.

17. The diagram below shows two carts on a horizontal, frictionless surface being pushed apart when a compressed spring attached to one of the carts is released. Cart *A* has a mass of 3.0 kilograms and cart *B* has a mass of 5.0 kilograms. The speed of cart *A* is 0.33 meter per second after the spring is released.



$p_A = -p_B$

$m_A v_A = -m_B v_B$

$(3\text{kg})(-.33\frac{\text{m}}{\text{s}}) = (5\text{kg})(v_B)$

If the carts are initially at rest, what is the approximate speed of cart *B* after the spring is released?

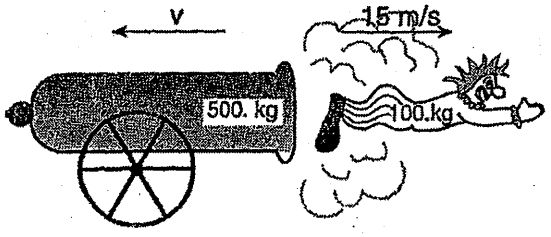
(1) 0.12 m/s (3) 0.33 m/s

(2) 0.20 m/s (4) 0.55 m/s

18) $m_A v_A = -m_B v_B$

$(500)(v_A) = -(100)(15)$

18. In the diagram below, a 100.-kilogram clown is fired from a 500.-kilogram cannon.



If the clown's speed is 15 meters per second after the firing, the recoil speed (*v*) of the cannon is

(1) 75 m/s (3) 3.0 m/s

(2) 15 m/s (4) 0 m/s

Free Response Problems

1. A ball of mass 3.0 kg, moving at 2 m/s eastward, strikes head-on a ball of mass 1.0 kg that is moving at 2 m/s westward. The balls stick together after the impact. What are the magnitude and direction of the velocity of the combined mass after the collision? What is the magnitude and

2. A tennis player returns a 30. m/s serve straight back at 25. m/s (keep in mind of direction), after making contact with the ball for 0.50 s. If the ball has a mass of 0.20 kg, what is the force she exerted on the ball?

3. Two girls with masses of 50.0 kg and 70.0 kg are at rest on frictionless in-line skates. The larger girl pushes the smaller girl so that the 50 kg girl rolls away at a speed of 10.0 m/s. Calculate the final speed of the 70 kg girl?

4. A 0.5 kg collision cart traveling 5 m/s collides with a 0.7 kg cart initially at rest. After the collision the large mass cart travels with a speed of 3 m/s. Calculate the speed of the 0.5 kg cart.

(.7kg)

FREE RESPONSE

1) $m_A v_{Ai} + m_B v_{Bi} = (m_A + m_B) v_f$

$(3kg)(2\frac{m}{s}) + (1kg)(-2m/s) = (3kg + 1kg) v_f$

$v_f = 1 m/s$ EAST

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2) $J = Ft = mv_f - mv_i$

$F = \frac{mv_f - mv_i}{t} = \frac{(.20kg)(-25m/s) - (.20kg)(30m/s)}{0.50s}$

$v_i = 30 m/s$

$v_f = -25 m/s$ ↑ GOES BACK

$F = 22N$

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3) $m_A v_{AF} = -m_B v_{BF}$

$(50kg)(10m/s) = -(70kg) v_{BF}$

$v_{BF} = -7.14 m/s$

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4) $m_A v_{Ai} + m_B \cancel{v_{Bi}}^{0} = m_A v_{AF} + m_B v_{BF}$

$(0.5kg)(5m/s) = (0.5kg) v_{AF} + (0.7kg)(3m/s)$

$v_{AF} = 0.8 m/s$