Name: _____ Period: _____ Assigned on Wednesday, January 08, 2025

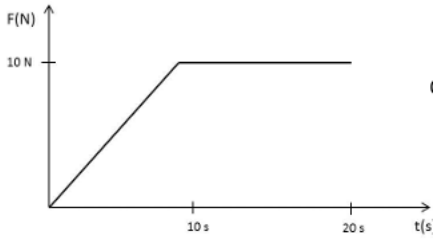
1.3 Impulse and Momentum Practice **Due Friday, January 10, 2025**

1. A golfer strikes a golf ball of mass 0.05 kg, and the time of impact between the golf club and the ball is 1.0 ms. If the ball acquires a velocity of magnitude 70 m/s, calculate the average force exerted on the ball.

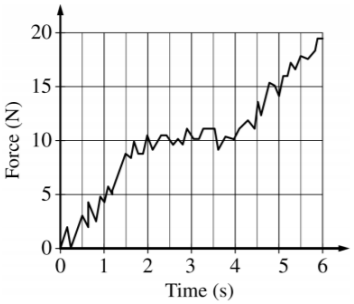
2. A football team's kicker punts the ball (mass = 0.4 kg) and gives it a launch speed of 30 m/s. Find the impulse delivered to the football by the kicker's foot and the average force exerted by the kicker on the ball, given that the impact time was 8 ms.

3. An 80 kg stuntman jumps out of a window that is 45 m above the ground. (a) How fast is he falling when he reaches the ground? (b) He lands on a large, air-filled target coming to rest in 1.5 s. What average force does he feel while coming to rest? (c) What if he had instead landed on the hard ground with an impact time of 10 ms?

4. A 1-kg box accelerates from rest in a straight line across a frictionless surface for 20 s as depicted in the force vs. time graph to the right. (a) What is the total impulse delivered to the box during the 20 s? (b) Find the time taken for the box to reach a speed of 5 m/s. (c) Determine the box's speed after 15 s. (d) What is the minimum amount of time a force of magnitude 20 N could be applied to return the box to rest after its 20 s acceleration?



5. During an experiment a student records the net horizontal force exerted on an object moving in a straight line along a horizontal frictionless track. The graph to the right shows the force as a function of time. Of the following, approximate the magnitude of the change in momentum of the object between 0 s and 5 s?



6. A race car of mass m is moving with speed v_0 on a straight road. It then accelerates in the direction of its motion at a constant rate a for an amount of time Δt. Which of the following expressions is equal to the magnitude of the impulse delivered to the car during this time?
A) ma B) $ma\Delta t$ C) $m(v_0 + a\Delta t)$ D) $v_0\Delta t + \frac{1}{2} a(\Delta t)^2$

7. A brick is dropped from the top of a building and falls toward the ground. In Case A, the brick lands on concrete and breaks into many pieces. In Case B, the brick lands on a thin foam pad and does not break. Why does the brick not break in Case B but breaks in Case A?
A) Because the foam pad reduces the impulse applied to the brick to stop it.
B) Because the foam pad reduces the work done on the brick to stop it.
C) Because the foam pad increases the magnitude of the force applied on the brick to stop it.
D) Because the foam pad increases the time that the force is applied to the brick to stop it.

8. A student catches a water balloon of mass m that has speed v just before the balloon reaches the student. The student brings the balloon to a complete stop by exerting an average force F_{avg} over a time t. The student then catches a second water balloon that has mass $4m$, also traveling at speed v, by exerting a force over a time $2t$. What is the average force the student exerted on the second balloon?
A) $F_{avg}/8$ B) $F_{avg}/2$ C) $2F_{avg}$ D) $8F_{avg}$

9. A student in a physics lab drops a ball of mass 0.50 kg from a height of 1.5 m onto a force plate. The ball hits the force plate and rebounds upward. The student records the maximum height of the ball after it rebounds to be 1.1 m. Calculate the impulse exerted on the ball by the force plate.

10. A 2-kg object accelerates as a net external force is applied to it. During the 5-second interval that the force is applied, the object's velocity changes from 3 m/s east to 7 m/s west. A student states: "The change in momentum of this object during these 5 seconds was 8 kg·m/s so the impulse applied to this object during these 5 seconds was 8/5 kg·m/s." What, if anything, is wrong with this statement? If something is wrong, identify and explain how to correct it. If this statement is correct, explain why.

Answers

1. 3500 N
2. 12 N·s; 1,500 N
3. 30 m/s, 1600N, 240000 N
4. 150 N·s, 3.16 s, 100 m/s, 7.5 s
5. 42.5 N·s
6. B
7. D
8. C
9. 5.1 N·s
10. This statement is incorrect because (1) momentum is a vector so a direction should be specified for the change in momentum, (2) impulse = change in momentum so the time does not enter into the problem, and (3) the actual change in momentum (taking east as positive) is (2kg)(-7m/s) – (2kg)(+3m/s) = - 20 kg•m/s which means 20 kg•m/s in the west (negative-x) direction.