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Conservation of momentum in one dimension

Mech HW-65

Name \_\_\_\_\_

5. This problem concerns three collision experiments performed on a frictionless surface with gliders A and B, with masses  $m_A$  and  $m_B$ , respectively. In all three experiments, the instantaneous speeds of gliders A and B are initially  $v_A$  and 0, respectively.

If not given enough information is given to answer any of the parts, state so explicitly.

a. In experiment 1, the track is level, and the gliders are repelled by magnets, so they do not come into contact. At time  $t_0$ , glider A moves to the left and glider B to the right, both with speed  $v/2$ , as shown at right.

1. Is  $|\vec{p}_{tot}|$ , the magnitude of the momentum of the system of both gliders at time  $t_0$ , greater than, less than, or equal to  $m_A v_0$ ? Explain.

$F_{net} = \frac{dp}{dt}$   
 No net external forces,  $\frac{dp}{dt} = 0$ ,  
 thus  $|\vec{p}_{tot}| = |\vec{p}_{i}|$   
 greater, or rather to preserve the initial momentum to the right,  $|\vec{p}_{tot}| = m_A v_0 + m_B v_0/h = \frac{3}{2} m_A v_0 > m_A v_0$

2. Is  $|\vec{p}_{tot}|$ , the magnitude of the momentum of glider B at time  $t_0$ , greater than, less than, or equal to  $|\vec{p}_{tot}|$ , the magnitude of the momentum of glider A at time  $t_0$ ? Explain.

$F_{net} = \frac{dp}{dt}$  of gravity  $F_{net} = m_A g \sin \theta$   
 thus  $|\vec{p}_{tot}| > |\vec{p}_{i}|$

b. In experiment 2, the track is inclined, as shown. At time  $t_0$ , glider A has an instantaneous speed of 0.

1. Is  $|\vec{p}_{tot}|$ , the magnitude of the momentum of the system of the two gliders at time  $t_0$  in experiment 2, greater than, less than, or equal to  $m_A v_0$ ? Explain.

$F_{net} = \frac{dp}{dt}$  of gravity  $F_{net} = m_A g \sin \theta$   
 thus  $|\vec{p}_{tot}| > |\vec{p}_{i}|$

2. In experiment 3, the track is again level, and glider B's magnet is replaced by a spring-loaded plunger. (The mass of glider B is unchanged.) The plunger is initially compressed, and it is released when the gliders come into contact. At time  $t_0$ , glider A moves to the left with speed greater than  $v_A$ .

1. Is  $|\vec{p}_{tot}|$ , the magnitude of the momentum of the system of the two gliders at time  $t_0$  in experiment 3, greater than, less than, or equal to  $m_A v_0$ ? Explain.

$F_{net} = \frac{dp}{dt}$   $< 0$  because of spring force acting opposite of velocity  
 thus, final momentum of system  $< 100\%$

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