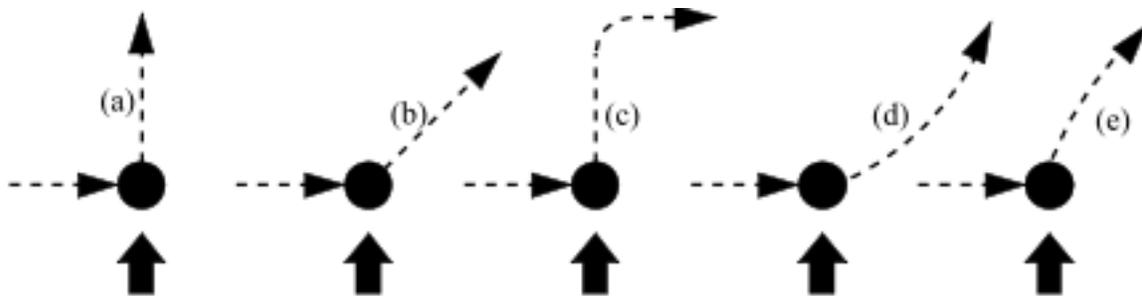**Conceptual Questions**

1. During baseball practice, a batter hits a very high fly ball and then runs in a straight line and catches it. Which had the greater displacement, the batter or the ball? Explain. [1]

2. Can the displacement vector for a particle moving in two dimensions ever be longer than the path-length travelled by the particle over the same time interval? Can it ever be less? Discuss. [2]

3. Can two vectors of unequal magnitude add up to give the zero vector? Can *three* unequal vectors? Under what conditions? [3]

4. The figure depicts a hockey puck sliding with constant speed v_0 in a straight line from point "**a**" to point "**b**" on a frictionless horizontal surface. Forces exerted by the air are negligible. You are looking down on the puck. When the puck reaches point "**b**", it receives a swift horizontal kick in the direction of the heavy print arrow. Had the puck been at rest at point "**b**", then the kick would have set the puck in horizontal motion with a speed v_k in the direction of the kick. [4]
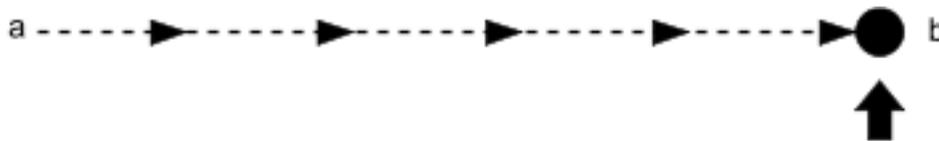
   a) Which of the paths below would the puck most closely follow after receiving the kick?

[1] Physics 6th Edition, Giancoli, Chapter 3 Questions, #4
[2] Physics 6th Edition, Giancoli, Chapter 3 Questions, #3
[3] Physics 6th Edition, Giancoli, Chapter 3 Questions, #7
[4] Force Concept Inventory, Hestenes, Halloun, Wells, and Swackhamer, #8, 9

b) The speed of the puck just after it receives the kick is:

(a) equal to the speed "v_0" it had before it received the kick.

(b) equal to the speed "v_k" resulting from the kick and independent of the speed "v_0".

(c) equal to the arithmetic sum of the speeds "v_0" and "v_k".

(d) smaller than either the speeds "v_0" or "v_k"

(e) greater than either of the speeds "v_0" or "v_k", but less than the arithmetic sum of these two speeds.

5. A rocket drifts sideways in outer space from point "**a**" to point "**b**" as shown below. The rocket is subject to no outside forces. Starting at position "**b**", the rocket's engine is turned on and produces a constant thrust (force on the rocket) at right angles to the line "**ab**". The constant thrust is maintained until the rocket reaches a point "**c**" in space. [5]
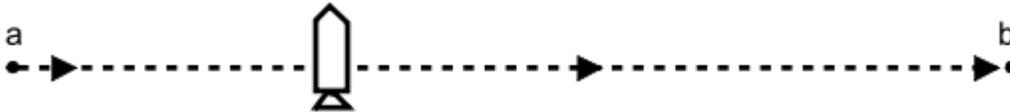

a) Which of the following best represents the path of the rocket between points "**b**" and "**c**"?
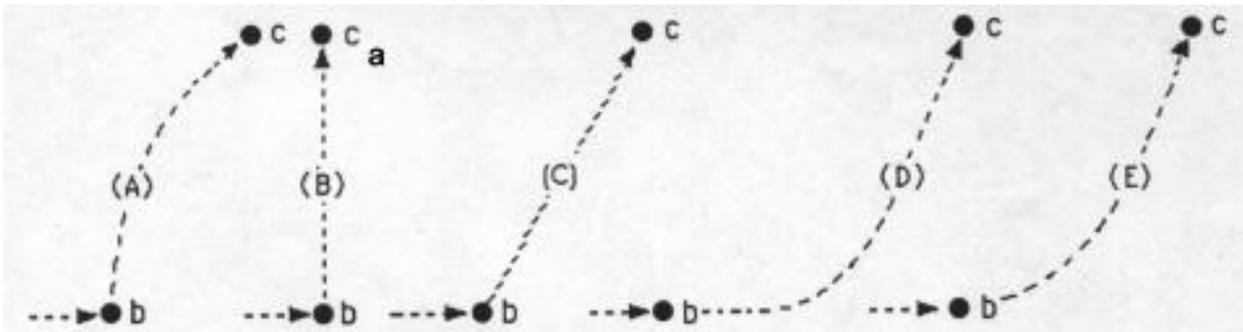
b) As the rocket moves from position "**b**" to position "**c**" its speed is:

(a) constant.

(b) continuously increasing.

(c) continuously decreasing.

(d) increasing for a while and constant thereafter.

(e) constant for a while and decreasing thereafter.

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[5] Force Concept Inventory, Hestenes, Halloun, Wells, and Swackhamer, #21, 22, 23, 24

c) At point "**c**" the rocket's engine is turned off and the thrust immediately drops to zero. Which of the paths below will the rocket follow beyond point "**c**"?
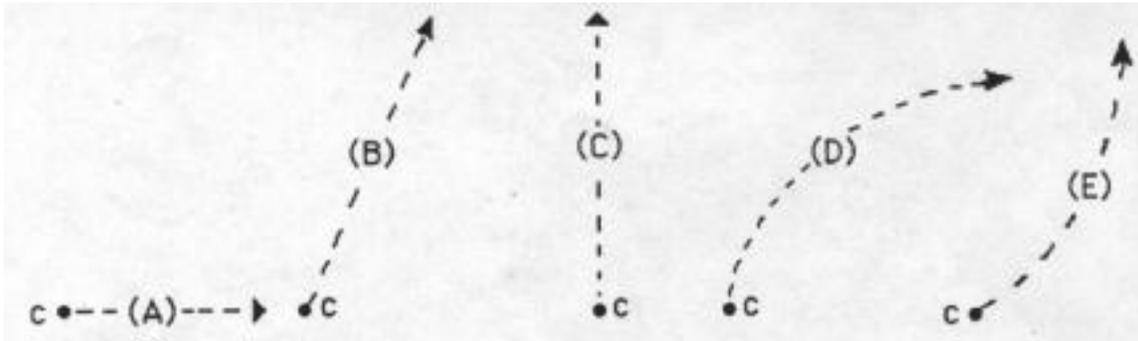
d) Beyond position "**c**" the speed of the rocket is:
   (a) constant.
   (b) continuously increasing.
   (c) continuously decreasing.
   (d) increasing for a while and constant thereafter.
   (e) constant for a while and decreasing thereafter.

Problems

6. Three vectors are shown to the right. Their magnitudes are given in arbitrary units. [6]
   a) Determine the sum if the three vectors. Give the resultant in terms of (a) components and (b) magnitude and angle with the x-axis.

   b) Determine the vector $\vec{A} - \vec{C}$.

   c) Determine the vector (a) $\vec{B} - 2\vec{A}$ and (b) $2\vec{A} - 3\vec{B} + 2\vec{C}$.


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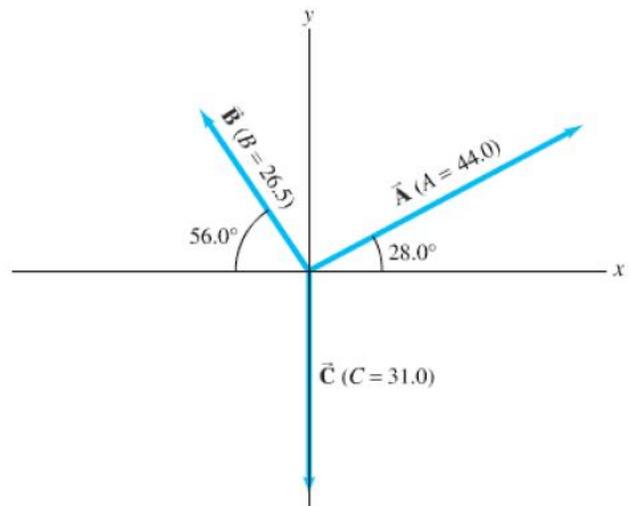
[6] Physics 6th Edition, Giancoli, Chapter 3 Problems, #10,11,14

7. A skier accelerates at a rate of 4.0 m/s^2 down a ski hill inclined at 35°. What are the vertical and horizontal components of her acceleration?[7]

8. A projectile is launched with a horizontal velocity of 10 m/s and a vertical velocity of 20 m/s. What is the magnitude and direction of the projectile's initial velocity?[8]

9. A pizza delivery truck drives 2.0 km [W], followed by 3.0 km [W20°N]. What is the total displacement of the delivery truck?[9]

10. In a mall, a shopper rides up an escalator between floors. At the top of the escalator, the shopper turns right and walks 9.00 m to a store. The magnitude of the shopper's displacement from the bottom of the escalator is 16.0 m. The vertical distance between the floors is 6.00 m. At what angle is the escalator inclined above the horizontal?[10]

11. A tennis ball's initial velocity is 30 m/s [S]. When struck by a tennis racquet, its velocity becomes 28 m/s [N30°W]. Determine the ball's change in velocity.[11]

12. A billiard ball with an initial velocity of 2.0 m/s [S30°E] strikes the bumper of a billiard table and reflects off it with a velocity of 1.8 m/s [N30°E]. If the interaction with the bumper takes 0.10 s, determine the vector acceleration of the billiard ball.[12]

13. A hockey puck rebounds from a board as shown below. The puck is in contact with the board for 2.5 ms. Determine the average acceleration of the puck over the interval.[13]

$|\vec{v_i}| = 26$ m/s   N $|\vec{v_f}| = 21$ m/s

22°   22°
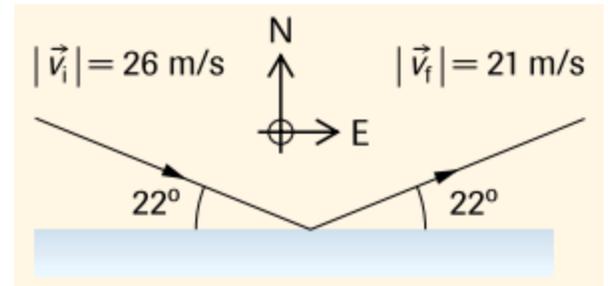
14. A bird takes 8.5 s to fly from position A to position B along the path shown in the diagram. Determine the bird's average acceleration.[14]

$\vec{v_B} = 7.8$ m/s [25° N of E]

A   B

N

$\vec{v_A} = 4.4$ m/s [31° S of E]

E
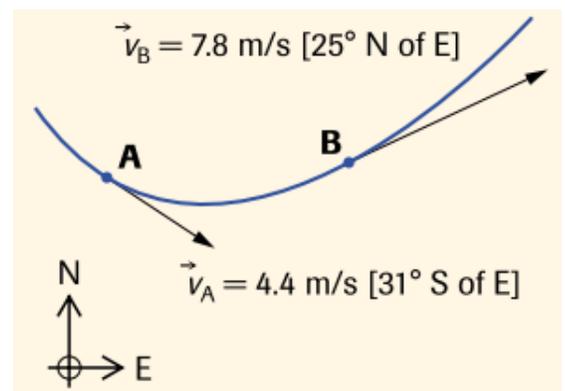
[7] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #16
[8] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #18
[9] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #17
[10] Physics, 7th Edition, Cutnell & Johnson, Chapter 3 Problems, #9
[11] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #20
[12] Physics Book Two, Irwin Publishing, Chapter 2 Problems, #21
[13] Physics 12, Nelson Education, Section 1.2 Practice, #27
[14] Physics 12, Nelson Education, Section 1.2 Questions, #15