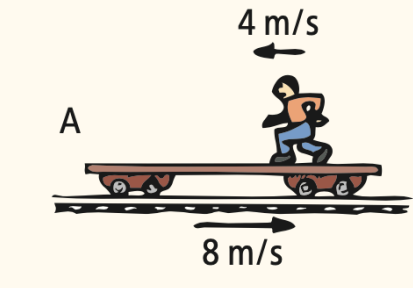
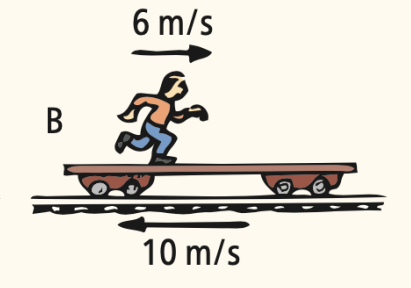
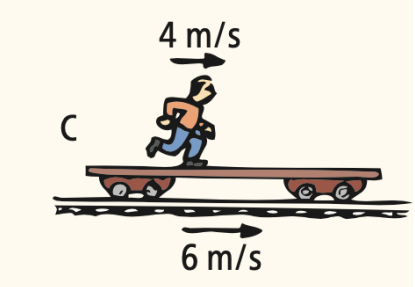
Ch. 3 HW Linear Motion

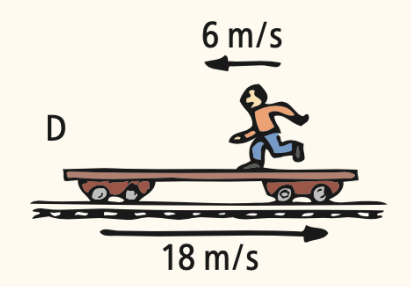
Extra Credit Option: Each student may obtain up to +5 points extra credit from this HW set to be added towards Exam I. (see Syllabus "Extra Credit' for details)

1) **(5 pts)** Jogging Jake runs along a train flatcar that moves at the velocities shown in positions A-D. Rank the velocity of Jake relative to a stationary observer on the ground from fastest to slowest. (Call the direction to the right positive.) *hint*: first draw the resultant velocity vector (magnitude + direction) at the top of each figure.





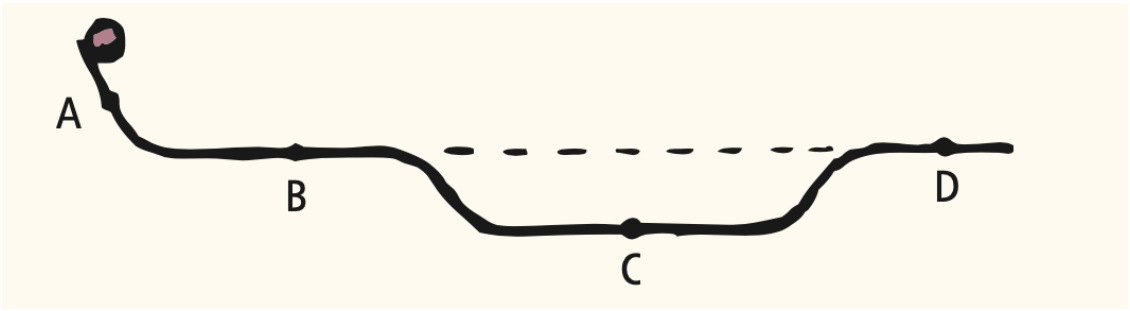




_____ _____ _____ _____

fastest slowest

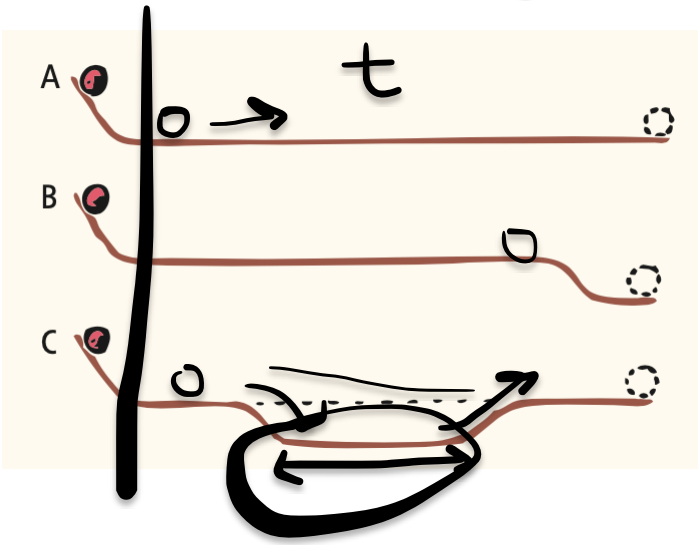
2) **(5 pts)** A ball released at the left end of the channel iron track continues past the various points as shown. Rank the *speed* of the ball at points A, B, C, and D, from *fastest* to *slowest*. (Watch for tie scores. If tie, put in same line)



_____ _____ _____

fastest slowest

3) **(15 pts)** A ball is released at the left end of these different tracks bent from equal-length pieces of channel iron.



a) **(5 pts)** Rank the *speed* of the ball at the right end of the track from fastest to slowest

B _____ A/C _____ _____

fastest slowest

b) **(5 pts)** Rank the tracks in terms of the *time* for the ball to reach the end from longest to shortest

C _____ B _____ A _____

fastest slowest

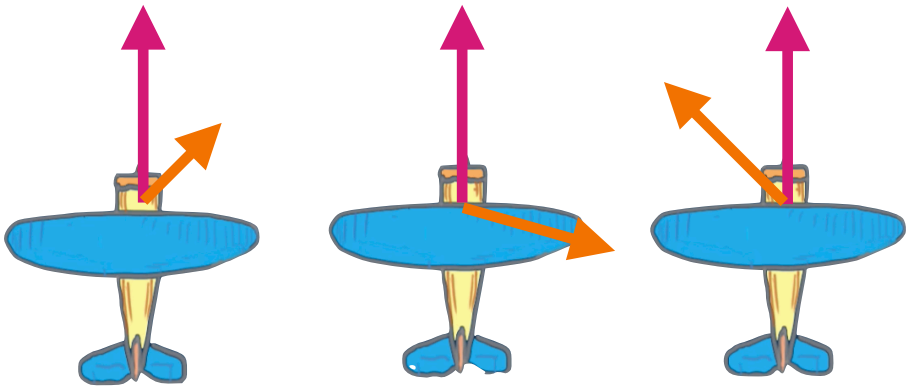
c) **(5 pts)** Rank the tracks in terms of the *average speed* of the ball from greatest to least

_____ _____ _____

fastest slowest

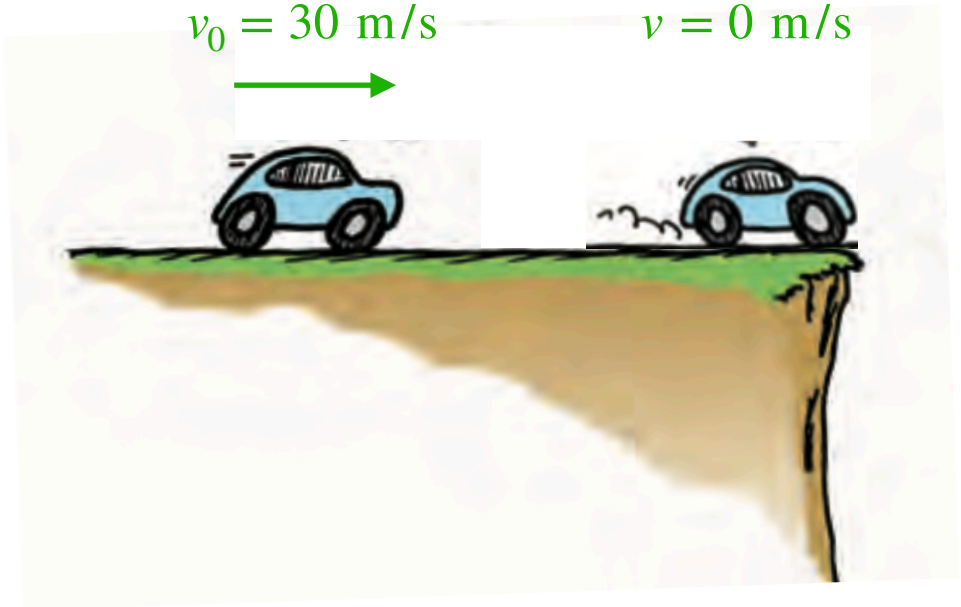
4) **(10 pts)** An airplane traveling north encounters strong winds from a hurricane throughout the course of the trip which causes it to divert course multiple times.

a) **(5 pts)** Draw the resultant velocity vector of the diverted plane for each case



b) **(5 pts)** If the plane has a landing speed of 30 m/s, and it takes 60 seconds to come to a *full stop*, determine the *average speed*, *acceleration* and the *distance* travelled.

5) **(15 pts)** A car moving at 30 m/s approaches a cliff and must come to a complete stop to avoid going over the cliff. The driver decides to press the brake at a distance of 60 m from the edge and manages to stop right at the edge.

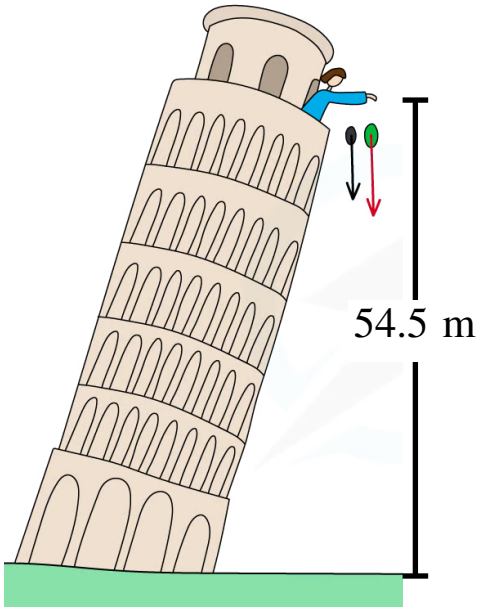


a) **(5 pts)** What is the average speed of the car ?

b) **(5 pts)** How long does it take for the car to stop ?

c) **(5 pts)** What is the acceleration (magnitude+direction) of the car ?

6) **(20 pts)** In his famous experiment, Galileo Galilei *dropped* a light and heavy object (*at rest*) from the Leaning Tower of Pisa at approximately an *initial height* of 54.5 m and showed that given *negligible air resistance* the objects in *free fall* hit the ground at the same time.



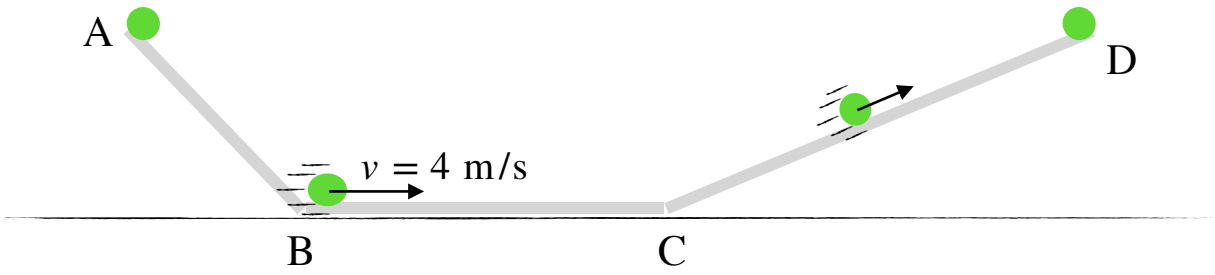
a) **(5pts)** What is the *acceleration* of the objects right after they are dropped ? Right before they hit the ground ? At any point in between free fall ?

b) **(5pts)** *How fast* are the objects falling 3 seconds after they are dropped ?

c) **(5pts)** *How long* does it take for the objects to hit the ground ?

d) **(5pts)** *How fast* do the objects hit the ground ?

7) **(25 pts)** A ball released from *rest* rolls down a frictionless incline plane (take the right direction as "+" positive)



a) **(5 pts)** If the ball takes 1 second to roll from A to B and reaches a speed of $v = 4$ m/s at point B, what is the *acceleration* as it rolls down the incline ?

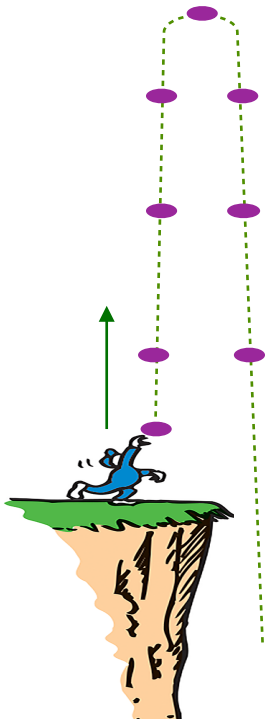
b) **(5 pts)** What *distance* does the ball travel from A to B ?

c) **(5 pts)** If the ball travels a distance of 8 meters from B to C, *how long* (time) does it take to roll from B to C ?

d) **(5 pts)** If the ball takes 2 seconds to travel from C to D and comes to rest at point D, what is the *acceleration* of the ball as it rolls uphill ? (specify magnitude and acceleration)

e) **(5 pts)** What distance does the ball travel as it rolls uphill from C to D?

8) **(25 pts)** You toss a ball straight up with an initial speed of $v_0 = 40$ m/s (take the upward direction as "+" positive)



a) **(5 pts)** Calculate the *speed* of the ball at its highest point

b) **(5 pts)** Calculate the *acceleration* of the ball at its highest point (specify its magnitude and direction)

c) **(5 pts)** *How long* did it take the ball to reach its highest point?

d) **(5 pts)** Calculate the *distance* the ball travelled from the moment it was released up until reaching its highest point?

e) **(5 pts)** What is the *velocity* of the ball 1 sec after reaching its highest point?