Average and Instantaneous Velocity

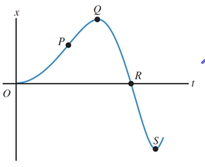
QUIZ Check your understanding:

Five cars, A, B, C, D, and E, each take a trip that lasts one hour. The positive *x*-direction is to the east. (i) A travels 50 km due east. (ii) B travels 50 km due west. (iii) C travels 60 km due east, then turns around and travels 10 km due west. (iv) D travels 70 km due east. (v) E travels 20 km due west, then turns around and travels 20 km due east. (a) Rank the five trips in order of average x-velocity from most positive to most negative. (b) Which trips, if any, have the same average x-velocity? (c) For which trip, if any, is the average x-velocity equal to zero?

(a) D; A&C (same); E; B
(b) A&C (same)
(c) E

QUIZ Check your understanding:

Figure shows an *x*-*t* graph of the motion of a particle. (a) Rank the values of the particle's x-velocity v_x at points P, Q, R, and S from most positive to most negative. (b) At which points is v_x positive? (c) At which points is v_x negative? (d) At which points is v_x zero? (e) Rank the values of the particle's speed at points P, Q, R, and S from fastest to slowest.

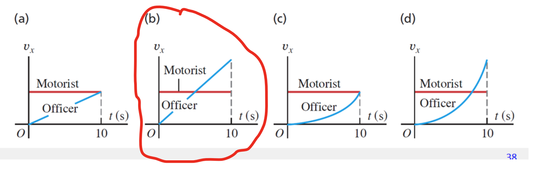


(a) P; Q&S (same); R
(b) P
(c) R
(d) Q&S (same)
(e) R; P; Q&S (same)

1-D Motion with Constant Acceleration

QUIZ Check your understanding:

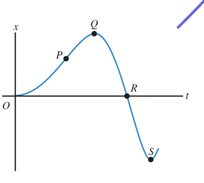
Four possible v_x-*t* graphs are shown for the two vehicles in Task #5. Which graph is correct?



1-D Motion with Constant Acceleration

QUIZ Check your understanding:

Figure shows an *x*-*t* graph of the motion of a particle. (a) At which points P, Q, R, and S is the acceleration a_x positive. (b) At which points is the acceleration negative? (c) At which points does the acceleration appear to be zero? (d) At each point state whether the velocity is increasing, decreasing, or not changing.

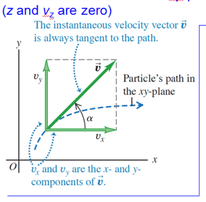


(a) S
(b) Q
(c) P&R
(d) P - not changing
Q - decreasing
R - not changing
S - increasing

Instantaneous Velocity Vector

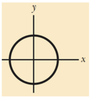
In case of motion within the *xy*-plane: (*z* and v_z are zero)

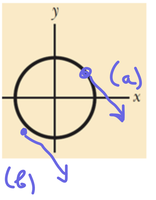
$$v = \sqrt{v_x^2 + v_y^2} \qquad \tan\alpha = \frac{v_y}{v_x}$$



QUIZ Check your understanding:

The figure shows a circular path taken by a particle. If the instantaneous velocity of the particle is $\boldsymbol{v} = 2\,\boldsymbol{i} - 2\boldsymbol{j}$ (m/s), through which quadrant is the particle moving at that instant if it is traveling (a) clockwise and (b) counterclockwise around the circle? For both cases, draw $\boldsymbol{v}$ on the figure.





QUIZ Check your understanding:

In which of these situations would the average velocity $\boldsymbol{v}_{\text{av}}$ over an interval be equal to the instantaneous velocity $\boldsymbol{v}$ at the end of the interval? (i) an object moving along a curved path at constant speed; (ii) an object moving along a curved path and speeding up; (iii) an object moving along a straight line at constant speed; (iv) an object moving along a straight line and speeding up

(iii)

Alternative Expansion of Acceleration Vector

motion along a curved path is ALWAYS accelerated

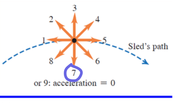
$$\vec{a} = \vec{a}_{\perp} + \vec{a}_{\parallel}$$

Later

QUIZ Check your understanding:

A sled travels over the crest of a snow-covered hill. The sled slows down as it climbs up one side of the hill and gains speed as it descends on the other side.

Which of the vectors in the figure correctly shows the direction of the sled's acceleration at the crest?



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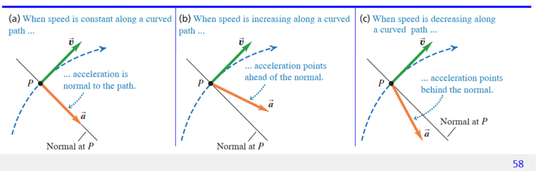
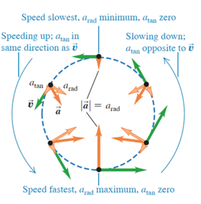


(Nonuniform) Circular Motion

QUIZ Check your understanding:

Suppose that the particle shown in the figure experiences four times the acceleration at the bottom of the loop as it does at the top of the loop. Compared to its speed at the top of the loop, is its speed at the bottom of the loop: (i) $\sqrt{2}$ times as great; (ii) 2 times as great; (iii) $2\sqrt{2}$ as great; (iv) 4 times as great; or (v) 16 times as great?



2 times as great