ACCELERATION

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MATHEMATICAL & GRAPHICAL ANALYSIS

ACCELERATION

•The change in velocity per unit time.

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_o}{t}$$

•Vector •Units = m/s^2

CONCEPTUAL UNDERSTANDING

- T/F Acceleration and velocity act in the same direction.
- T/F An object can have an instantaneous velocity of zero and an acceleration that is not zero.
 - T/F An object can accelerate while keeping a constant speed.
 - T/F If an object returns to the starting point, its average acceleration is zero.
 - T/F An object can experience a non-zero acceleration and keep a constant velocity.
 - T/F When an object changes direction from east to west, its acceleration is zero for an instant.

• MATHEMATICAL ACCELERATION PROBLEMS. • A car is initially traveling 20 m/s [E]. It then accelerates to 32 m/s [E] in 3.5 seconds. Calculate the acceleration of the car.

Step 1: Set up a coordinate system.
Step 2: Reread and list known & wanted quantities. Make quantities relative to the positive direction if necessary.
If given no initial position information, initial position is zero.

MATHEMATICAL ACCELERATION PROBLEMS.
 Step 3: Check for a formula using only the known and wanted quantities.

• If there are none, check if a different variable can be calculated with given values.

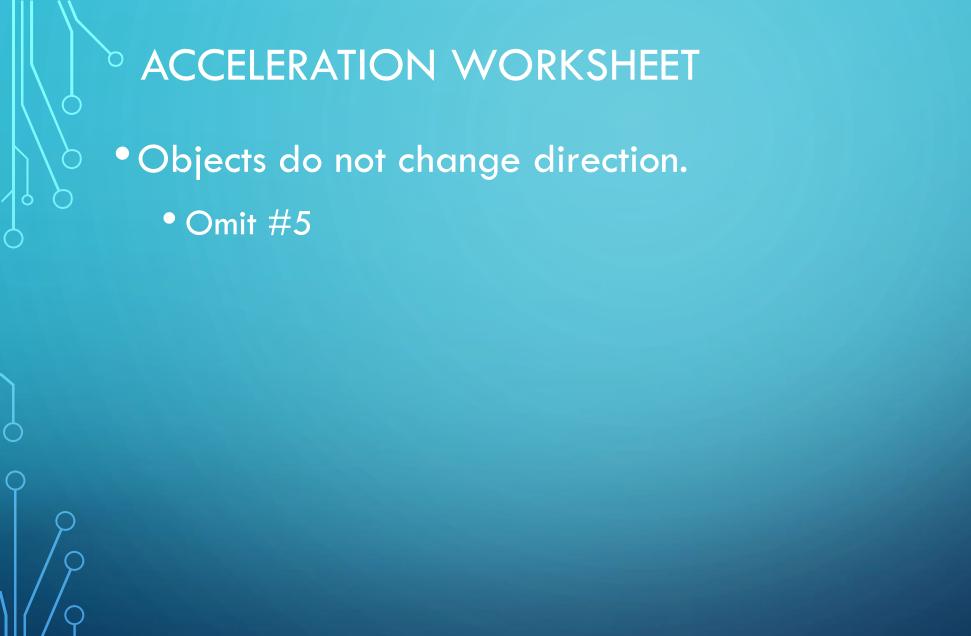
 Step 4: Plug 'n chug – place known values in to the equation and solve.

• Step 5: Check answer conceptually – does the value and direction make sense?

SOLVING FOR FINAL VELOCITY •A car is initially moving 15 m/s [E] and accelerates at 3.5 m/s^2 [E] for 9.2 seconds. Calculate the car's final velocity. • Check mentally first!

SOLVING FOR INITIAL VELOCITY •A plane accelerates to 175 m/s [E] under an acceleration of 15 m/s^2 in 10 seconds. Calculate the initial velocity of the plane. •Check mentally first!

THE DREADED SOLVING FOR TIME PROBLEM Calculate how long it would take a person to accelerate from 5.0 m/s [E] to 35 m/s [E] averaging an acceleration of 1.8 m/s^2 [E]. •Again, conceptually think about it first.



ACCELERATION: CHANGING DIRECTIONS A baseball is thrown 15 m/s [W] and 5.6 s later it is moving 21 m/s [E]. Calculate the average acceleration of the baseball.

ACCELERATION DUE TO GRAVITY

- Earth's gravity pulls everything towards its center. That pull is called the force of gravity, and forces cause accelerations.
- •All objects on Earth are subject to the acceleration due to gravity, 9.81 m/s². That number is the average for the entire Earth.
- Any problem that moves vertically from the Earth's surface uses the acceleration of 9.81 m/s².

ACCELERATION: THROWN OBJECT

•A coin is thrown upwards with a velocity of 35 m/s. Calculate the velocity of the coin 5.0 seconds later (no air resistance).

ACCELERATION ON EARTH •A ball is thrown upwards from the surface of the Earth. It takes 6.4 seconds for the ball to have a velocity of -12.5 m/s. Calculate the initial velocity of the ball.

ACCELERATION & POSITION •A car is initially traveling 20 m/s [E]. It then accelerates to 32 m/s [E] in 3.5 seconds. a) Calculate the average acceleration. b) Calculate the final position of the car at that time. > PROBLEMS WITH NO TIME

•An object is thrown from a 125 m high cliff with an upwards velocity of 24 m/s. Calculate the final velocity when the object is 50 m above the ground.

SO...MANY...QUESTIONS •An object initially moving 35 m/s [E] experiences an acceleration at 8.5 m/s^2 [W]. Calculate the time it will take the object to have a final position of 175 m [W] assuming an initial position of zero.

GRAPHICAL ANALYSIS OF VELOCITY - TIME

The Moving Man

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