ACCELERATION

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 WORKSHEET

- Objects do not change direction.
  - Omit #5

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/s^2. 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/s^2.

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