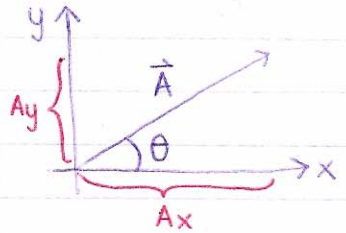
Q5-1: $v_0^2 + 2a\Delta x = 0$

$$\Delta x = \frac{v_0^2}{2a} = \frac{(20m/s)^2}{2 \cdot 10m/s^2} = \frac{400}{20} = 20m$$

10 September 2009

Lecture 6

2-D and Vectors



$\tan\theta = A_y/A_x$

A_x, A_y are scalars

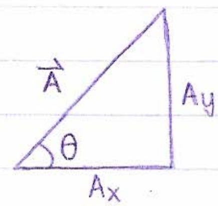
Vector Components

trig. functions = dimensionless

X component along x-axis

$A_x = A\cos\theta$

$\vec{A_x} = A\cos\theta\,\vec{x}$



$\sin\theta = \frac{A_y}{A}$

y component along y-axis

$A_y = A\sin\theta$

$\vec{A_y} = A\sin\theta\,\vec{y}$

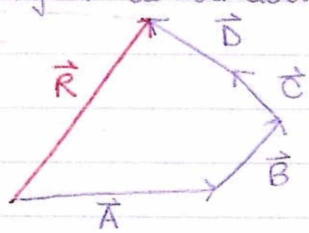
Therefore: $\vec{A} = \vec{A_x} + \vec{A_y}$ (only if θ is measured w/ respect to x-axis)

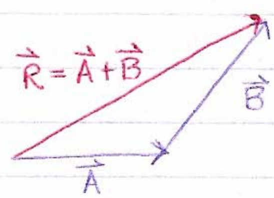
Graphically Adding Vectors

Put tail of second on head of first

Resultant $\vec{R}$ from origin of first vector to end of last vector

Vectors obey the commutative law of addition: the order in which they are added doesn't affect the result $\vec{A} + \vec{B} = \vec{B} + \vec{A}$



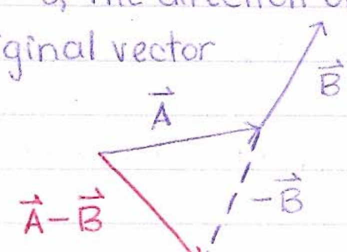


Vector Subtraction & Scalar Multiplication

Special case of vector addition $\vec{A} - \vec{B} = \vec{A} + (-\vec{B})$

If the scalar is >0, the direction of the result is the same as the original vector

If the scalar is <0, the direction of the result is opposite that of the original vector



Q5-2: $\theta = \tan^{-1}(y/x)$

$A_x = 2$ $A_y = 4$ $\theta = \tan^{-1}(6/6)$

$B_x = 4$ $B_y = 2$ $= 45°$

$R_x = 6$ $R_y = 6$

Adding Vectors Algebraically

Choose a coordinate system (Ihas suggests an x, y system)

Find x, y components of all vectors

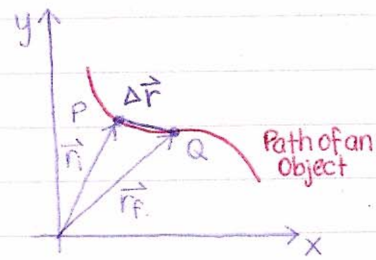
Add all x: $R_x = \Sigma A_x$

Add all y: $R_y = \Sigma A_y$

Pythagorean Theorem — Find magnitude of resultant: $R = \sqrt{R_x^2 + R_y^2}$

Find direction of resultant: $\theta = \tan^{-1}(R_y / R_x)$

Displacement, Velocity, Acceleration



The position of an object is described by its position vector

The displacement of the object is defined as $\vec{r}$

Change in position (meters) $\Delta\vec{r} = \vec{r_f} - \vec{r_i}$

Velocity (m/sec) $\vec{v}_{avg} = \Delta\vec{r}/\Delta t$

$\vec{a}_{avg}$ can change speed, direction, or both — Acceleration (m/s^2) $\vec{a}_{avg} = \Delta\vec{v}/\Delta t$

Projectile Motion

Treat x and y components independently

Ignore: air friction, earth's rotation

Object in projectile motion follows parabolic path

Q5-3: T, angles must be <90° — Rules: x direction is uniform motion $a_x = 0$

y direction is free fall $a_y = -g$

At Various Initial Angles: complementary values of the initial angle result in the same range (heights different), max range at 45°

Special Cases: object fired horizontally