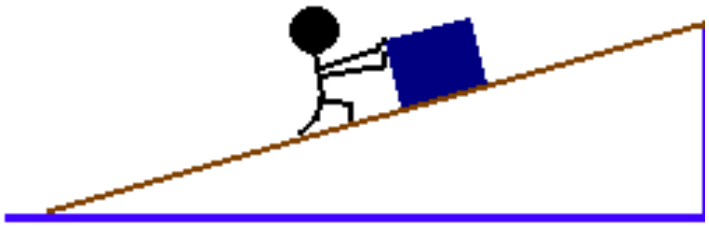
Physic² 121:
Phundament°ls of Phy²ics I

October 11, 2006

Bob and the Ramp

- Bob is pushing a crate up a ramp. He exerts a force of 100 N on the crate. The crate has a mass of 10 kg. The ramp is at an angle of 30°, and the coefficient of kinetic friction between the ramp and the box is 0.2.
- Q: What is the acceleration of the crate?



Momentum

Chapter 6

N2 and Acceleration Definition

- Remember Newton's 2nd Law?

$$\vec{a} = \frac{\vec{F}_{Net}}{m}$$

- And the definition of average acceleration?

$$\bar{a} = \frac{\Delta v}{\Delta t}$$

- Combining these two ideas we get:

$$F = ma$$
$$= m\frac{\Delta v}{\Delta t}$$

- Or:

$$F\Delta t = m\Delta v$$
$$= m\left(v_f - v_i\right)$$

Impulse and Momentum

- The things on the left and right side of the equal sign each have their own name in the world of physics:
  - $F\Delta t$ is called Impulse, I
  - mv is called momentum
  - Momentum usually denoted as p

$$\vec{I} = \vec{F}\Delta t$$

$$\vec{p} = m\vec{v}$$

- So, we can write the last equation from previous slide as:

$$\vec{I} = \Delta\vec{p}$$

- Note: This is really just N2 written in a different way

Units

- Units of momentum:
  - $p = mv$, so $[p] = M\ L\ /\ T$
  - In SI units, kg m / s
  - No special name
- Units of Impulse
  - $I = F\Delta t$, so $[I] = (M\ L\ /\ T^2)xT = M\ L\ /\ T$
  - In SI units, kg m / s (note: same dimensions as momentum!)
  - Again, no special name

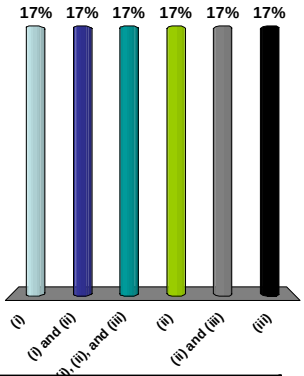
?

Consider these situations:

(i) a ball moving at speed v is brought to rest
(ii) the same ball is projected from rest so that it moves at speed v
(iii) the same ball moving at speed v is brought to rest and then projected backward to its original speed

In which case(s) does the ball undergo the largest change in momentum?

1. (i)
2. (i) and (ii)
3. (i), (ii), and (iii)
4. (ii)
5. (ii) and (iii)
6. (iii)



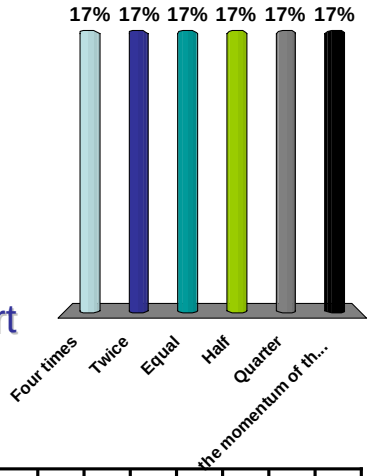
1	2	3	4	5														

?

Consider two carts, of masses m and 2m, at rest on an air track. If you push first one cart for 3s and then the other for the same length of time, exerting equal force on each, the momentum of the light cart is:

1. Four times
2. Twice
3. Equal
4. Half
5. Quarter

the momentum of the heavy cart



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