Seating for PHYS 1020 Term Test, 2007
Tuesday, October 23, 7-9 pm

Student numbers		Room
From	To	
6504394	6842355	200 Fletcher-Argue
6842547	6852067	200 Armes
6852080	6852939	206 Tier
6852942	6855233	306 Tier
6855256	7607350	223 Wallace

GENERAL PHYSICS I: PHYS 10

Schedule - Fall 2007
(lecture schedule is approximate)

	W	3	12	Chapter 5	Uniform circular motion	(chapters 1, 2, 3)
	F	5	13			
6	M	8	Thanksgiving Day			Experiment 2: Measurement of g by free fall
	W	10	14	Chapter 5	Uniform circular motion	
	F	12	15	Chapter 6	Work and energy	
7	M	15	16			Tutorial and Test 2 (chapters 4, 5)
	W	17	17			
	F	19	18	Chapter 7	Impulse and momentum	
8	M	22	19			No lab or tutorial
	Tue	23	MID-TERM TEST, Ch 1-5, Tuesday, October 23, 7-9 pm			
	W	24	20	Chapter 7	Impulse and momentum	
	F	26	21	Chapter 8,		

Tuesday, October 23, 7-9 pm, midterm: ch. 1-5
(20 multiple-choice questions)

Monday, October 22

Review Lecture
Chapters 1 - 5

Email me your "favourite" problems
from old exams and textbook

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Mastering Physics Assignment 3

Assignment 3 is available on the Mastering Physics website

It is due Friday, October 26 at 11 pm

It covers material from chapters 4 and 5 as preparation for
the term test on Tuesday

There are 8 questions for practice and 6 for credit

OPUS Tutoring Schedule (room 105C Allen)

Monday	Tuesday	Wednesday	Thursday	Friday
8:30	8:30	8:30	8:30	8:30
9:30 Erica	10:00	9:30 Eric H	10:00	9:30 Charles
10:30	11:30	10:30	11:30 Liz	10:30 Andrei
11:30	1:00 Andrew	11:30 Nikki		11:30
12:30 Adam		12:30 Eric R	1:00 Ryan	12:30 Trevor
1:30	2:30 Kyle	1:30		1:30
2:30 Todd		2:30 Dan	2:30	2:30
3:30	4:00	3:30 Mitchell	3:30 Mike	3:30
4:30		4:30		4:30

Conservation of Mechanical Energy

Mechanical energy = KE + PE = $mv^2/2 + mgy$

In the absence of applied forces and friction:

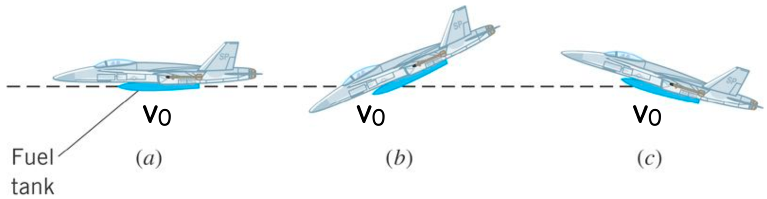
(change in KE) + (change in PE) = 0

so mechanical energy is conserved.

KE + PE = constant

Note: the weight mg is included in the PE so do not add in the work done by gravity, it's already there.

Clickers!

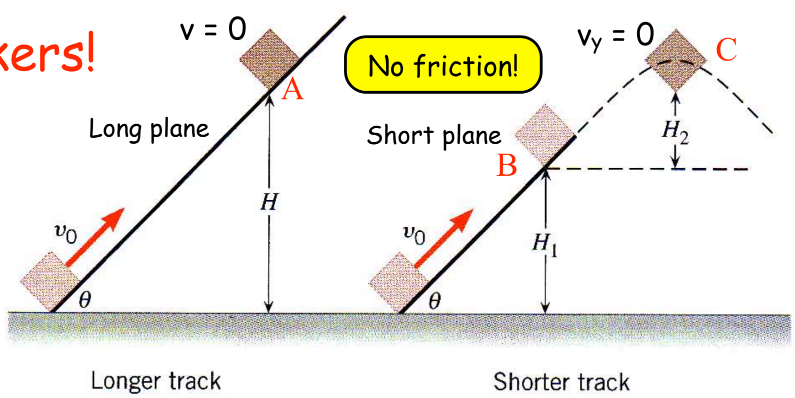


6.C17: An empty fuel tank is released by three different planes. At the moment of release, each plane has the same speed and each tank is at the same height above the ground.

In the absence of air resistance, do the tanks have different speeds when they hit the ground?

A) The tank in (b) has the highest speed when it hits the ground.
B) The tank in (c) has the highest speed as it reaches a greater height before falling.
C) All three tanks hit the ground at the same speed.

Clickers!



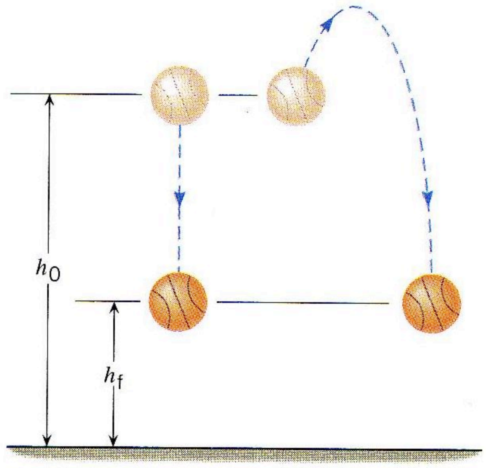
6.C87: Initial mechanical energy the same for the two blocks.

Block at left reaches highest point on plane at A, at y = H.

Block at right leaves shorter plane at B, at $y = H_1$
flies through air to highest point at C, at $y = H_1 + H_2$.

A) A is higher than C
B) A is lower than C
C) A and C are at the same height

Conservative Forces



Gravitational potential energy depends only on height

The difference in PE, $mg(h_o - h_f)$ is **independent of path taken**

→ Gravity is a "conservative force"

Conservative Forces

Alternative definitions of conservative forces:

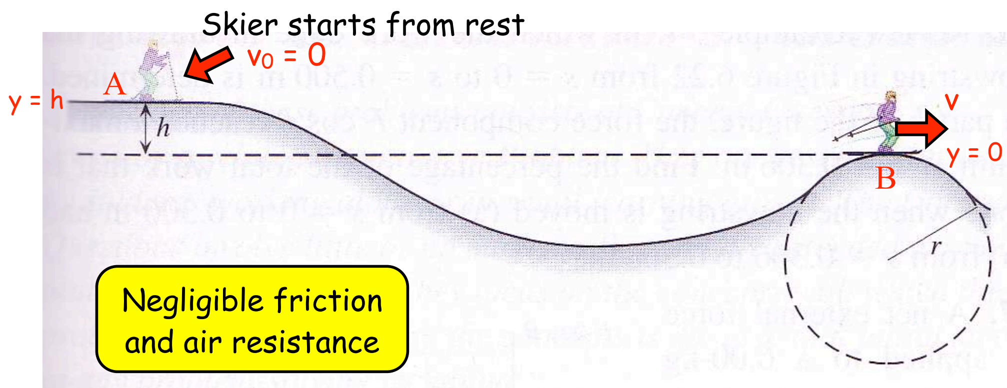
- The work done by a conservative force in moving an object is independent of the path taken.
  (Compare pushing a crate across the floor – the most direct path requires the least work. Friction is **not** a conservative force).

- A force is conservative when it does no net work in moving an object around a closed path, ending up where it started.

In either case, the potential energy due to a conservative force depends only on position.

Examples of conservative forces:

- Gravity, elastic spring force, electric force

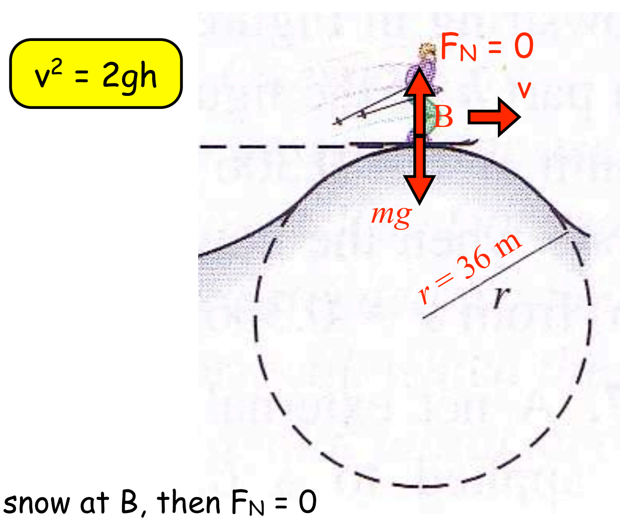


6.42: What must be the height h if the skier just loses contact with the snow at the crest of the second hill at B?

Mechanical energy is conserved, so $E_A = E_B$.

That is, $\underbrace{0 + mgh}_{\text{At A}} = \underbrace{mv^2/2 + 0}_{\text{At B}}$

So, $v^2 = 2gh$



If skier loses contact with snow at B, then $F_N = 0$

So, centripetal acceleration toward centre of curved slope is provided only by the skier's weight, mg.

That is, $mg = mv^2/r$ and $v^2 = rg$

So $v^2 = rg = 2gh$, and $h = r/2 = 18$ m

Non-conservative Forces

The work done by a non-conservative force depends on the path taken (as in pushing a crate across the floor...).

The longer the path taken, the more the (negative) work is done by the friction force.

A potential can be defined only for a conservative force.

Examples of non-conservative forces

- Static and kinetic friction forces
- Air resistance
- Tension, or any applied force
- Normal force
- Propulsion force in a rocket

Work-energy theorem revisited

From earlier, work done by an **applied force** is:

$$W = \Delta KE + \Delta PE$$

Identify this applied force as an example of a non-conservative force, and state that, for any non-conservative force:

$$W_{nc} = \Delta KE + \Delta PE$$

This is the work-energy theorem in terms of non-conservative forces

The important point is that a non-conservative force does not conserve mechanical energy

6.-/46: A 0.6 kg ball is pitched from a height of 2 m above the ground at 7.2 m/s. The ball travels at 4.2 m/s when it is 3.1 m above the ground.

How much work is done by air resistance, a non-conservative force?

$$\begin{aligned} W_{nc} &= \Delta KE + \Delta PE \qquad \text{(work-energy theorem)} \\ &= \frac{m(v_f^2 - v_0^2)}{2} + mg(y_f - y_0) \\ &= \frac{0.6(4.2^2 - 7.2^2)}{2} + 0.6g(3.1 - 2) = -14.1 \text{ J} \end{aligned}$$

Air resistance does -14.1 J of work

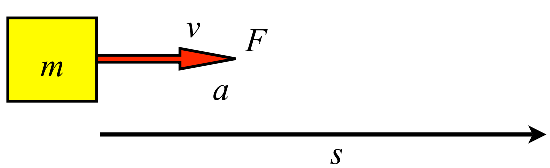
Power

Power is the rate of doing work, or the rate at which energy is generated or delivered.

Unit: 1 watt (W) = 1 J/s

$$\text{Power, } P = \frac{W}{t} = \frac{Fs}{t} = F \times \frac{s}{t} = Fv \qquad \text{(speed = distance/time)}$$

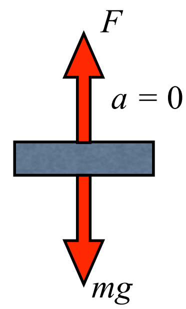
P = Fv



Kilowatt-hour (kWh): the energy generated or work done when 1 kW of power is supplied for 1 hour.
1 kWh = (1000 J/s)×(3600 s) = 3,600,000 J = 3.6 MJ

6.-/58: A 300 kg piano is being lifted by a crane at a steady speed to a height of 10 m. The crane produces a steady power of 400 W.

How much time does it take to lift the piano?



Power $P = Fv$ (F = mg, force to lift piano at constant speed)

So $P = mgv$ and $v = P/(mg)$

$$v = \frac{(400\ \text{W})}{(300\ \text{kg}) \times g} = 0.136\ \text{m/s}$$

$$\text{Takes time } \frac{h}{v} = \frac{10\ \text{m}}{0.136\ \text{m/s}} = 73.5\ \text{s}$$

6.59/74: The cheetah can accelerate from rest to 27 m/s (97 km/h) in 4 s. If its mass is 110 kg, determine the average power developed by the cheetah while it is accelerating.

Power = rate of doing work

Work done = ΔKE = $KE_{final} - KE_{initial}$

= $m(v_f^2 - v_i^2)/2$

= $110 \times (27^2 - 0^2)/2$ = 40,095 J

This work is done in 4 s, so the average power developed is:

P = 40,095/4 = 10,000 W = 10 kW (13.4 hp)