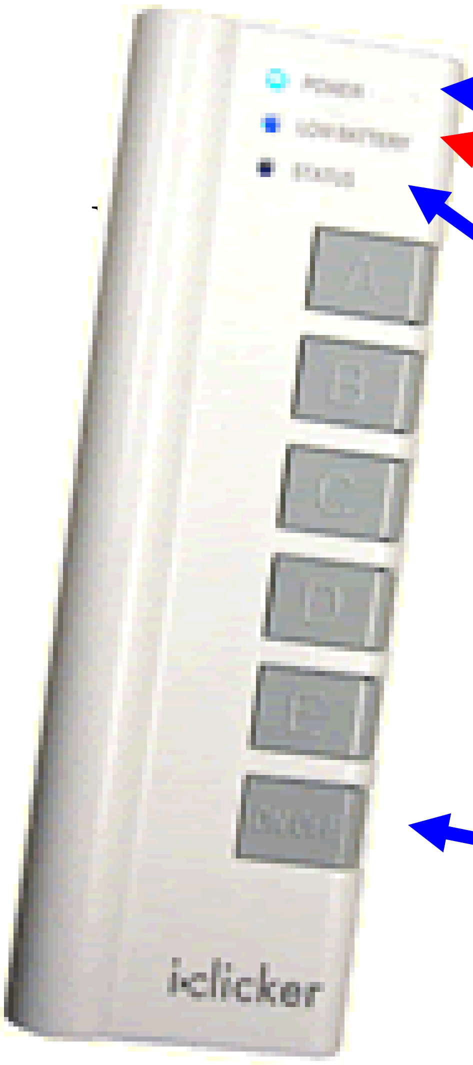
Physics 3210

Week 1 clicker questions



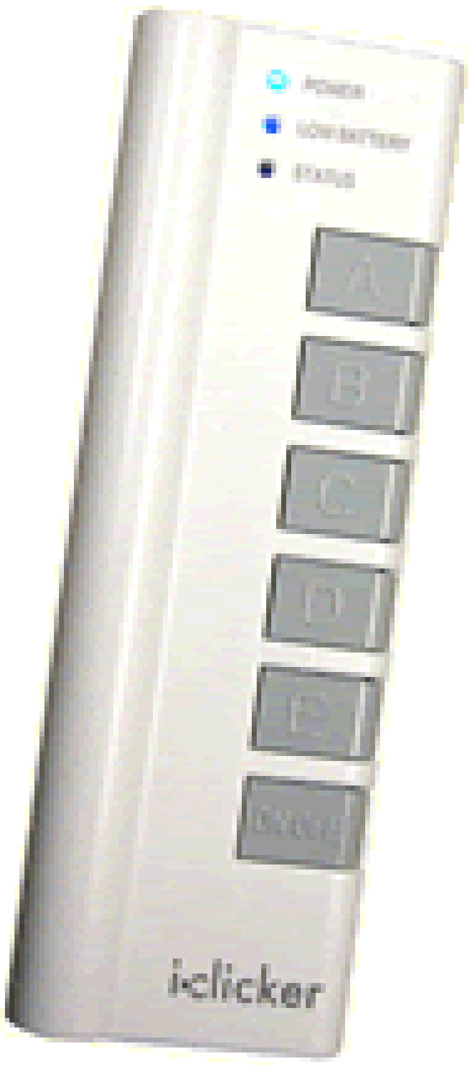
Power Indicator (lighted when on)

Low Battery Indicator (<10 h left)
replace 3 AAA batteries before next class

Vote Status
Green on for 0.5 sec to
indicates vote received
Flashing Red – not received

On-Off Button (keep on during class)

Change freq-not needed for this class



The iClicker is becoming the University of Colorado Standard for Clickers. You will use the iClicker in some of your future classes.

Are you using i clickers in any of your other classes?

A. Yes
B. No

When is the first homework due in this class?

A. Friday 1/19
B. Monday 1/22
C. Wednesday 1/24
D. Friday 1/26
E. Monday 1/29

What is the date of the first exam in this class?

A. 1/31
B. 2/7
C. 2/14
D. 2/21
E. 2/28

Which of these problems must be solved using the calculus of variations?

1. Find the period of small oscillations for a particle sliding (without friction) on the inside of a sphere.
2. Find the surface with fixed area that encloses the maximum volume.
3. Find the path between two points that minimizes the time for a particle to slide (without friction) between the points.
4. Find the path of a projectile (with no air resistance) that leads to the maximum range.

A. None

B. Only one

C. Exactly two

D. Exactly three

E. All four

A calculus of variations problem requires minimizing

$$J[y(x)] = \int_{x_1}^{x_2} f[y(x);y'(x);x]dx$$

When we solve Euler's equation

$$\frac{\partial f}{\partial y} - \frac{d}{dx}\frac{\partial f}{\partial y'} = 0$$

what do we learn?

A. The value of J[y(x)] at the minimum/maximum.
B. The path y(x) that minimizes J[y(x)].
C. The functional f[y(x);y'(x);,x] that minimizes J[y(x)].
D. All A-C.
E. None of A-C.

Soap films form **minimal surfaces** (surfaces with minimum surface area). Suppose a surface is described by a curve from (x_1,y_1) to (x_2,y_2) revolved about the y axis. Which is the correct expression for the area of the surface?

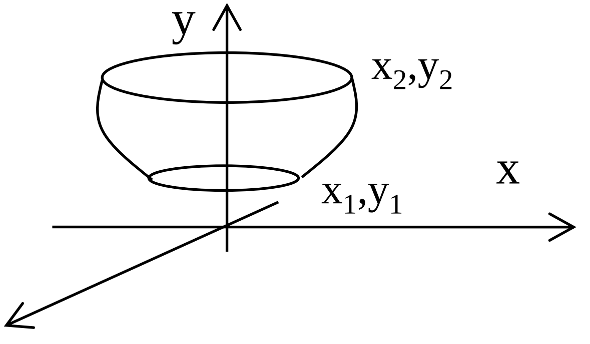
A. $A = 2\pi\int_{x_1}^{x_2} y'\sqrt{1+x^2}\,dx$

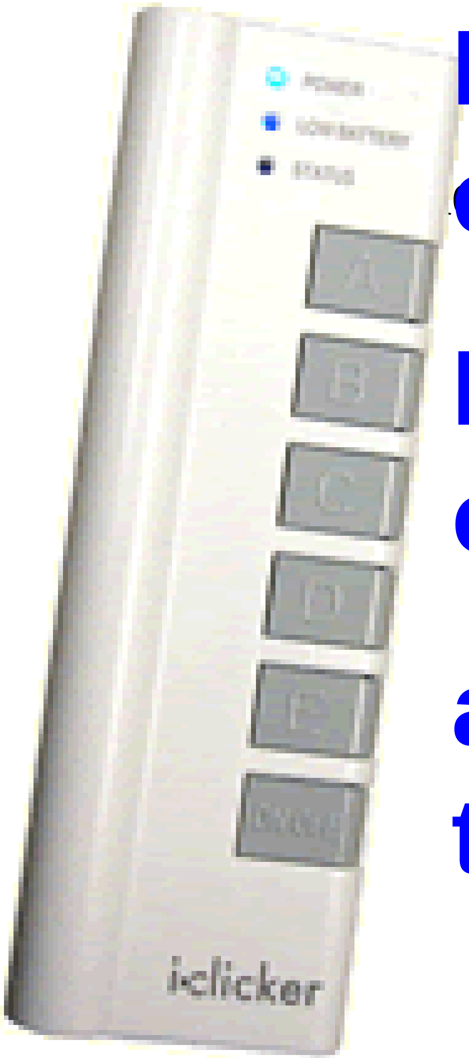
B. $A = \pi\int_{x_1}^{x_2} y'^2\sqrt{1+x^2}\,dx$

C. $A = 2\pi\int_{x_1}^{x_2} y\sqrt{1+y'^2}\,dx$

D. $A = \pi\int_{x_1}^{x_2} x^2\sqrt{1+y'^2}\,dx$

E. $A = 2\pi\int_{x_1}^{x_2} x\sqrt{1+y'^2}\,dx$





Pick up the same clicker every class session!

Record the number (1-30) on the front...

and the 8-digit hex code on the back.

Would it be useful to you if the course website had an RSS feed?

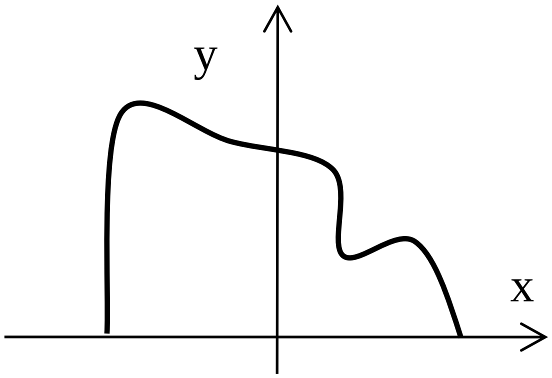
A. Yes.
B. No.
C. Don’t know/don’t care.

Which of these problems must be solved using the calculus of variations with constraints?

1. Find the shortest path between two points on the surface of a cylinder.
2. Find the surface with fixed area that encloses the maximum volume.
3. Find the path between two points that minimizes the time for a particle to slide (without friction) between the points.
4. Find the path between two points that minimizes the area of the surface of revolution (formed by rotating the path around an axis).

A. None
B. Only one
C. Exactly two
D. Exactly three
E. All four

Set up Dido’s problem: what are J[y] and K[y]?



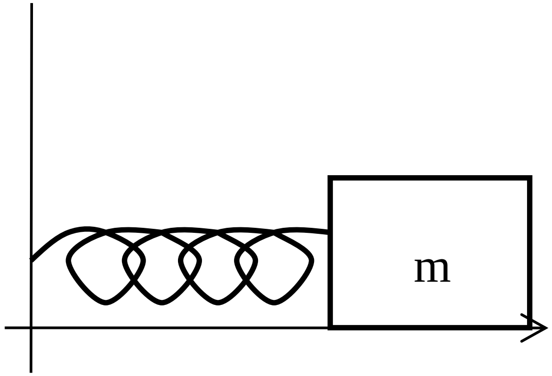
A. $J[y]=\int_{-a}^{a} y\,dx \qquad K[y]=\int_{-a}^{a}\sqrt{1+y'^2}\,dx$

B. $J[y]=\int_{-a}^{a} y^2\,dx \qquad K[y]=\int_{-a}^{a} y'^2\,dx$

C. $J[y]=\int_{-a}^{a} y^2\,dx \qquad K[y]=\int_{-a}^{a} 1+y'^2\,dx$

D. $J[y]=\int_{-a}^{a}\sqrt{1+y'^2}\,dx \qquad K[y]=\int_{-a}^{a} y\,dx$

What is the Lagrangian of a particle (mass m) attached to a spring (spring constant k)?



A. $\mathcal{L}(x,\dot{x},t)=\frac{1}{2}k\dot{x}^2-\frac{1}{2}mx^2$

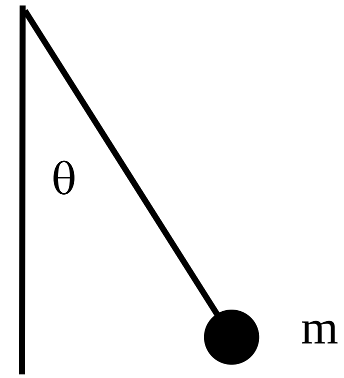
B. $\mathcal{L}(x,\dot{x},t)=m\dot{x}^2-kx^2$

C. $\mathcal{L}(x,\dot{x},t)=m\dot{x}^2+kx^2$

D. $\mathcal{L}(x,\dot{x},t)=\frac{1}{2}m\dot{x}^2+\frac{1}{2}kx^2$

E. $\mathcal{L}(x,\dot{x},t)=\frac{1}{2}m\dot{x}^2-\frac{1}{2}kx^2$

What is the Lagrangian of a pendulum (mass m, length l)? Assume the potential energy is zero when θ is zero.



A. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}m\ell^2\dot{\theta}^2-mg\ell(1-\cos\theta)$

B. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}m\ell^2\dot{\theta}^2+mg\ell(1-\cos\theta)$

C. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}m\dot{\theta}^2+mg\ell(1-\cos\theta)$

D. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}m\dot{\theta}^2-mg\ell(1-\cos\theta)$

Which of these constraints is holonomic?

1. A particle is constrained to slide on the inside of a sphere.
2. A cylinder rolls down an inclined plane.
3. Two moving particles are connected by a rod of length l.
4. A moving car is constrained to obey the speed limit.

A. None

B. Only one

C. Exactly two

D. Exactly three

E. All four

For which of these systems could you use Lagrange's equations of motion?

1. A double pendulum: a pendulum (mass m, length l) has a second pendulum (mass m, length l) connected to its bob.
2. A projectile moves in two dimensions with gravity and air resistance.
3. A bead slides without friction on a circular, rotating wire.

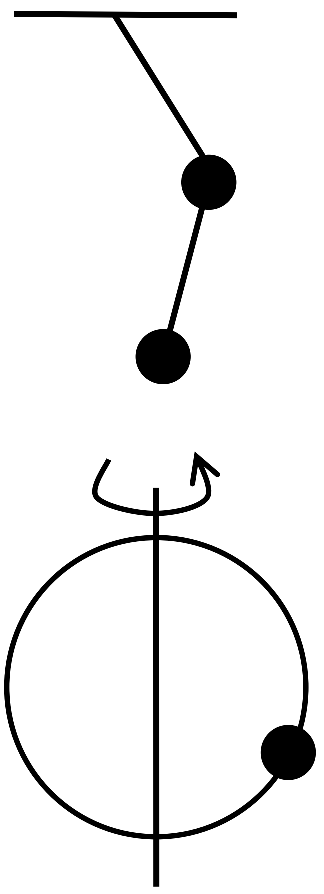
A. 1 only

B. 2 only

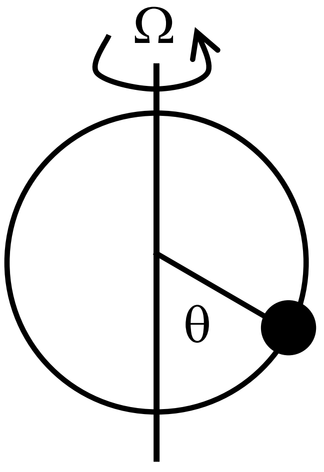
C. 3 only

D. 1 and 2

E. 1 and 3



A bead of mass m slides on a circular wire of radius R. The wire rotates about a vertical axis with angular velocity W. What is the Lagrangian of the system?



A. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}mR^2\dot{\theta}^2+\frac{1}{2}mR^2\Omega^2-mgR\cos\theta$

B. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}mR^2\dot{\theta}^2+\frac{1}{2}mR^2\sin^2\theta\Omega^2-mgR(1-\cos\theta)$

C. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}mR^2\dot{\theta}^2+\frac{1}{2}mR^2\cos^2\theta\Omega^2-mgR\cos\theta$

D. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}mR^2\dot{\theta}^2+\frac{1}{2}mR^2\sin^2\theta\Omega^2-mgR(1-\sin\theta)$

E. $\mathcal{L}(\theta,\dot{\theta},t)=\frac{1}{2}mR^2\left(\dot{\theta}+\Omega\right)^2-mgR(1-\cos\theta)$