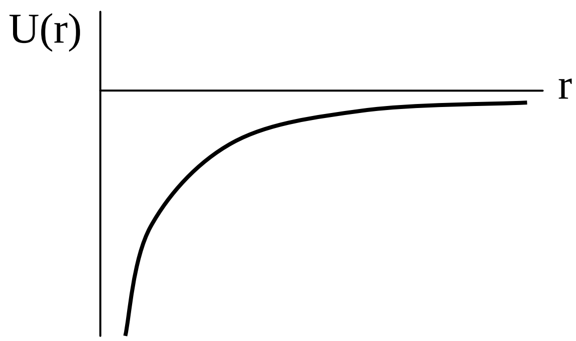
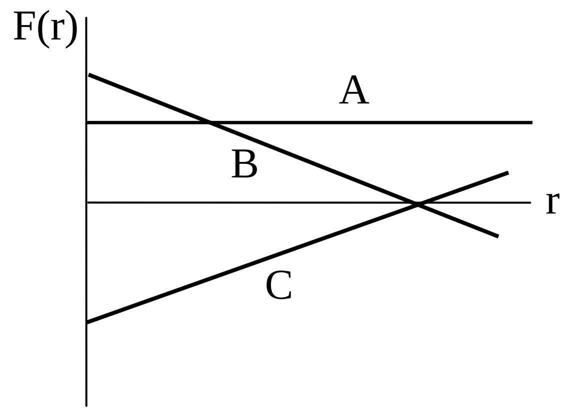
CTWeek12-1.
The potential energy of a test mass is shown as a function of distance from the origin U(r) ~ 1 / r. Which graph shows the corresponding force as a function of distance?





A) F(r) = constant

B) F(r) linearly decreasing with increasing r

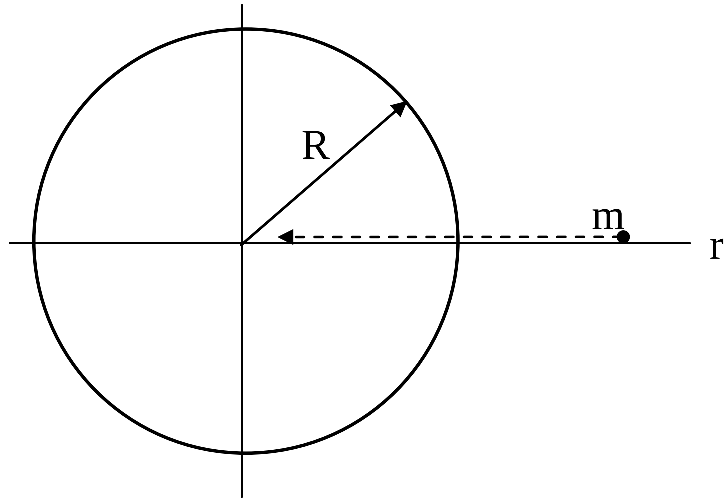
C) F(r) linearly increasing with increasing r

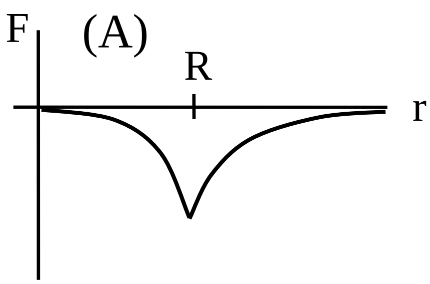
D) None of these.

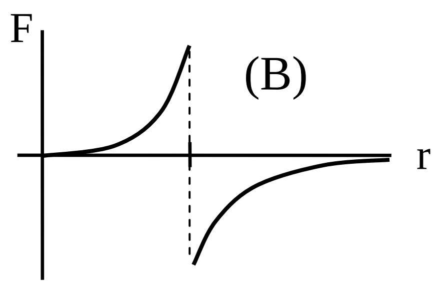
CTWeek12-2.

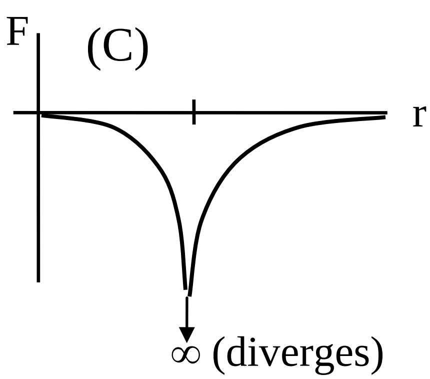
A test mass m moves along a straight line toward the origin, passing through a spherical mass shell of radius R, centered on the origin.

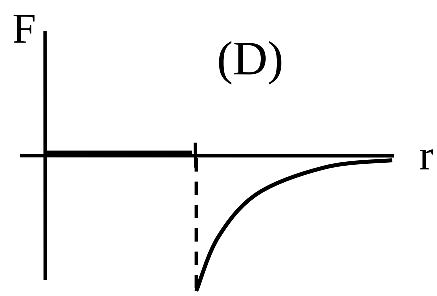
Which graph correctly shows the force F on the test mass vs. position r ?









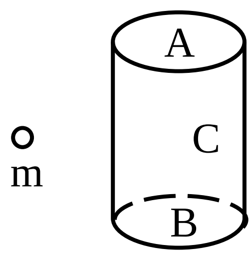


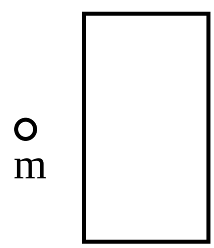
CTWeek12-3. A point mass m is near a closed cylindrical gaussian surface. The closed surface consists of the flat end caps (labeled A and B) and the curved barrel surface (C). What is the sign of the flux through surface C? (Hint: Recall that for closed surfaces, the direction of the surface vector is the direction of the *outward* normal.)

$$\int_C \vec{g} \cdot d\vec{A} \text{ is ...}$$

(A) positive (B) negative (C) zero

(D) not enough information given to decide





(side view)

CTWeek12-4. Which of the following is a good approximation when Δx is small?

$$g_x(x_o + \Delta x) - g_x(x_o) \approx ?$$

A) $\left.\dfrac{\partial^2 g_x}{\partial x^2}\right|_{x_o} \Delta x^2$

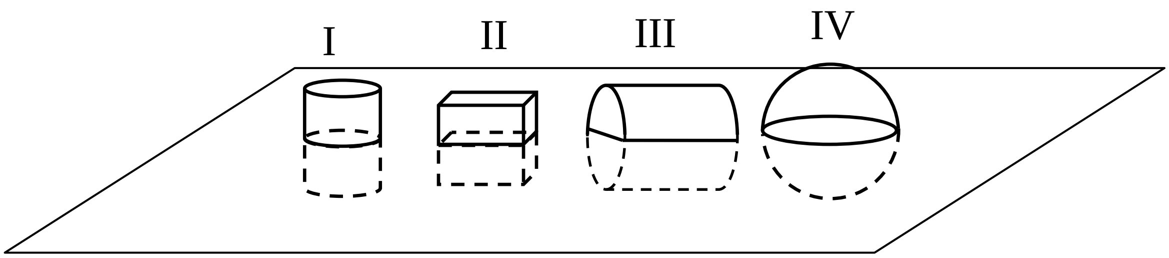
B) $2g_x\left(x_o + \dfrac{\Delta x}{2}\right)$

C) $\dfrac{g_x\left(\dfrac{\Delta x}{2}\right)}{2}$

D) $\dfrac{\Delta x}{g_x\left(x_o + \dfrac{\Delta x}{2}\right)}$

E) $\left.\dfrac{\partial g_x}{\partial x}\right|_{x_o} \Delta x$

CTWeek12-5. Consider these four closed gaussian surfaces, each of which straddles an infinite sheet of constant areal mass density. The four shapes are I: cylinder II: cube III: cylinder IV: sphere



For which of these surfaces does gauss's law ($\oint \vec{g} \cdot d\vec{A} = 4\pi G M_{enclosed}$) hold ?

A) All B) I and II only C) I, II, and IV only

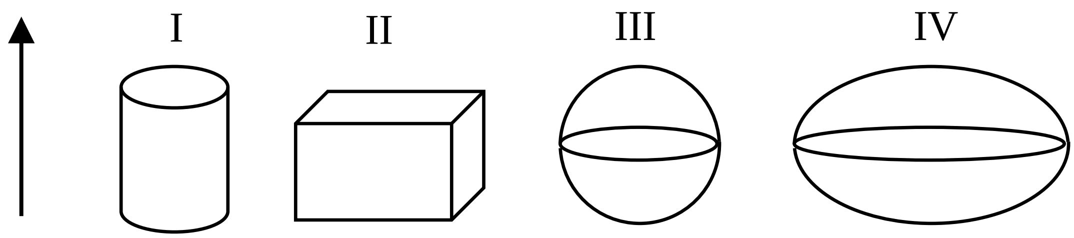
D) I and IV only E) Some other combination

For which of these surface does gauss's law allow easy computation of the field near the sheet?

A) All B) I and II only C) IV only

D) I and IV only E) Some other combination

CTWeek12-6. Which of these shapes is azimuthally symmetric (about the vertical axis) but not spherically symmetric?



A) All
B) I and II only
C) I, III, and IV only
D) I and IV only
E) Some other combination

CTWeek12-7. Assume that $f(r)$ depends on r only, and $g(\theta)$ depends on θ only, and

$$f(r)+g(\theta)=0$$

for all r and θ. What does this tell you about the functions f and g?

A) $f=g=0$

B) $f=g=\text{constant}$

C) $-f=g=\text{constant}$

D) $f=\text{constant}_1$, $g=\text{constant}_2$

E) Nothing.

CTWeek12-8. Review of solutions to ODEs. Which is the correct general solution to the ODE ?

$$2r\frac{dG}{dr}+r^2\frac{d^2G}{dr^2}=\ell(\ell+1)G$$

A) $G(r)=Ar^{\ell}$

B) $G(r)=Ar^{\ell+1}+\frac{B}{r^{\ell}}$

C) $G(r)=\frac{A}{r^{\ell+1}}$

D) $G(r)=Ar^{\ell}+\frac{B}{r^{\ell+1}}$

CTWeek12-9. What can you say about the integral of the Legendre polynomial

$$\int_{-1}^{1} P_\ell(x)\,dx$$

when ℓ is odd?

A) The integral is positive.

B) The integral is exactly zero.

C) The integral is negative.

D) The answer depends on ℓ.