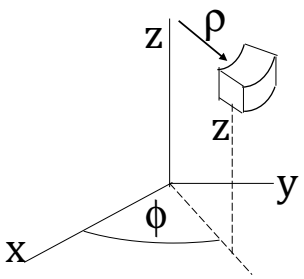
In cylindrical coordinates, what is the correct volume element, dV = ?

A) dρ dΦ dz
B) ρ dρ dΦ dz
C) ρ^2 dρ dΦ dz
D) sinΦ dρ dΦ dz
E) ρ sinΦ dρ dΦ dz



1

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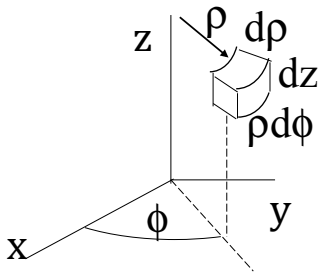
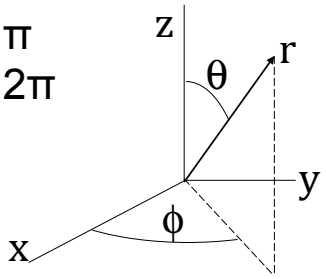


2

In spherical coordinates, to integrate over a sphere (radius R, centered at origin) what are the correct limits of integration?
(note the physics convention for θ and ϕ)

A) r: 0 to R, θ: 0 to π, φ: 0 to 2π
B) r: 0 to R, θ: 0 to 2π, φ: 0 to 2π
C) r:-R to R, θ: 0 to 2π, φ: 0 to π
D) r: -R to R, θ: 0 to 2π, φ: 0 to 2π
E) None of these!

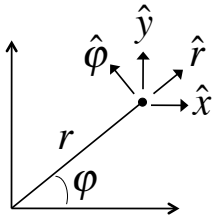


3

A ball is moving around in a plane.
Which of the following unit vectors might vary with time?

I: $\hat{x}$ II: $\hat{\varphi}$ III: $\hat{r}$

A) All
B) none
C) II only
D) III only
E) II and III



4

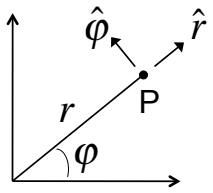
Which gives the position vector "**r**" of the point P at (x,y)=(1,1)?

A) $\vec{\mathbf{r}} = \sqrt{2}\,\hat{r}$

B) $\vec{\mathbf{r}} = \sqrt{2}\,\hat{r} + \frac{\pi}{4}\hat{\phi}$

C) $\vec{\mathbf{r}} = \sqrt{2}\,\hat{r} - \frac{\pi}{4}\hat{\phi}$

D) $\vec{\mathbf{r}} = \frac{\pi}{4}\hat{\phi}$ E) Other



5

$$\hat{\mathbf{r}} = \cos\phi\,\hat{\mathbf{x}} + \sin\phi\,\hat{\mathbf{y}}$$

What is $\hat{\phi}$?

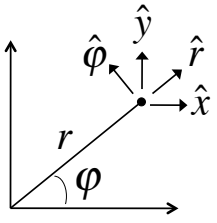
A) $\hat{\phi} = -\cos\phi\,\hat{\mathbf{x}} + \sin\phi\,\hat{\mathbf{y}}$

B) $\hat{\phi} = \sin\phi\,\hat{\mathbf{x}} + \cos\phi\,\hat{\mathbf{y}}$

C) $\hat{\phi} = -\sin\phi\,\hat{\mathbf{x}} + \cos\phi\,\hat{\mathbf{y}}$

D) $\hat{\phi} = -\sin\phi\,\hat{\mathbf{x}} - \cos\phi\,\hat{\mathbf{y}}$

E) Other!



6

In Phys 1110, centripetal acceleration was usually written $a = v^2/R$, or else (in terms of angular speed $\omega = v/R$), $a = \omega^2 R$.

Which term is the "centripetal force"?

$$F_r = \overset{A}{m\ddot{r}} - \overset{B}{mr\dot{\varphi}^2}$$

$$F_\varphi = \overset{C}{mr\ddot{\varphi}} + \overset{D}{2m\dot{r}\dot{\varphi}}$$

E) None, or *more* than 1 of these!

8

In Phys 1110, angular acceleration was $\alpha = a_{tangent}/R$. Which term involves "α"?

$$F_r = \overset{A}{m\ddot{r}} - \overset{B}{mr\dot{\varphi}^2}$$

$$F_\varphi = \overset{C}{mr\ddot{\varphi}} + \overset{D}{2m\dot{r}\dot{\varphi}}$$

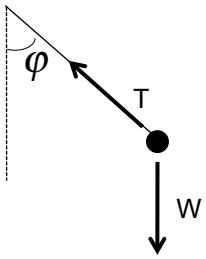
E) None, or *more* than 1 of these!

9

$$F_r = m\ddot{r} - mr\dot{\varphi}^2$$

$$F_\varphi = mr\ddot{\varphi} + 2m\dot{r}\dot{\varphi}$$

What is T_φ?



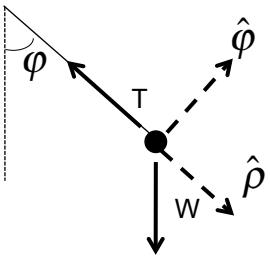
A) T
B) Tcosφ
C) Tsinφ
D) 0
E) Something else (signs!)

10

$$F_r = m\ddot{r} - mr\dot{\varphi}^2$$

$$F_\varphi = mr\ddot{\varphi} + 2m\dot{r}\dot{\varphi}$$

What is T_φ?



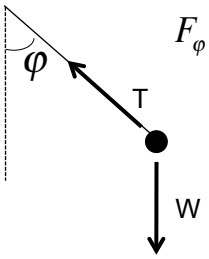
A) T
B) Tcosφ
C) Tsinφ
D) 0
E) Something else (signs!)

11

What is W_φ?

$$F_r = m\ddot{r} - mr\dot{\varphi}^2$$

$$F_\varphi = mr\ddot{\varphi} + 2m\dot{r}\dot{\varphi}$$



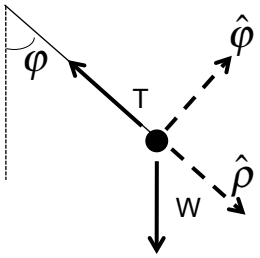
A) mg
B) mg cosφ
C) mg sinφ
D) 0
E) Something else (signs!)

12

What is W_φ?

$$F_r = m\ddot{r} - mr\dot{\varphi}^2$$

$$F_\varphi = mr\ddot{\varphi} + 2m\dot{r}\dot{\varphi}$$



A) mg
B) mg cosφ
C) mg sinφ
D) 0
E) Something else (signs!)

13

For a pendulum, we found

$$mR\ddot{\varphi} = -(mg)\sin\varphi$$

For small angle oscillations, which is the best statement about the period, T?

A) Larger mass means smaller T
B) Longer pendulum means longer T
C) Smaller starting angle means smaller T
D) On Jupiter, the period would be larger
E) None of these, or *more than one*, is correct

14

The position of a moving particle is given by

$$\mathbf{r}(t) = b\cos\omega t\hat{\mathbf{x}} + c\sin\omega t\hat{\mathbf{y}}$$

Describe this orbit:

A) circular, uniform motion
B) circular, non-uniform motion
C) helical
D) elliptical
E) Other!!

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