Assignment 11

The due date for submitting this assignment has passed.

As per our records you have not submitted this assignment.

1) A spheroidal surface $P$ is given parametrically by the position vector $r(\theta, \phi)$ as

$$ r(\theta, \phi) = (b \cos \theta \sin \phi, b \sin \theta \sin \phi, c \cos \phi) $$

where $-\pi < \theta \leq \pi$, and $0 \leq \phi \leq \pi$ and the constant $b$ is the minor semi-axis length and $c$ is the major semi-axis length. Which of the following expresses the scalar surface element $dA$ for $P$?

- $\Delta A = b^2 \sin \phi \left(1 - c^2 \sin^2 \phi\right) \, d\theta \, d\phi$
- $\Delta A = b^2 \sin \phi \left(1 + c^2 \sin^2 \phi\right) \, d\theta \, d\phi$
- $\Delta A = b^2 \sin \phi \left(1 + c^2 \sin^2 \phi\right) \, d\theta \, d\phi$
- $\Delta A = b^2 \sin \phi \left(1 + c^2 \sin^2 \phi\right) \, d\theta \, d\phi$

No, the answer is incorrect. Score: 0

Accepted Answers:

$\Delta A = b^2 \sin \phi \left(1 + c^2 \sin^2 \phi\right) \, d\theta \, d\phi$

2) Consider calculating the Lennard-Jones interaction energy $E_{ij}$ of a spherical surface $S$ with radius $a$ and atomic density $\rho$, with some point $\mathbf{r}$ a distance $\delta$ from the centre of the sphere, assuming the continuum approximation and Lennard-Jones constants of $A$ and $B$. After adoting an appropriate parameterisation, which of the following is the integral form of the interaction energy $E_{ij}$?

- $E_{ij} = \int_{S} \int_{S} \left(-6A \rho^2 \delta^2 + 12B \rho^2 \delta^2\right) \, a^2 \cos \phi \, d\theta \, d\phi$
- $E_{ij} = \int_{S} \int_{S} \left(-6A \rho^2 \delta^2 + 12B \rho^2 \delta^2\right) \, a^2 \sin \phi \, d\theta \, d\phi$
- $E_{ij} = \int_{S} \int_{S} \left(-6A \rho^2 \delta^2 + 12B \rho^2 \delta^2\right) \, a \cos \phi \, d\theta \, d\phi$
- $E_{ij} = \int_{S} \int_{S} \left(-6A \rho^2 \delta^2 + 12B \rho^2 \delta^2\right) \, a \sin \phi \, d\theta \, d\phi$

No, the answer is incorrect. Score: 0

Accepted Answers:

$E_{ij} = \int_{S} \int_{S} \left(-6A \rho^2 \delta^2 + 12B \rho^2 \delta^2\right) \, a^2 \cos \phi \, d\theta \, d\phi$

3) By treating $E_{ij}$ from the question (2) above, as a hypergeometric integral, integrate the expression and express the result in terms of in terms of hypergeometric functions.

- $E_{ij} = 2 \pi \rho^2 \left[ \frac{A}{(\delta - a)^2} \int_{3,1,2} \frac{-4a \delta}{(\delta - a)^2} + \frac{B}{(\delta - a)^2} \int_{6,1,2} \frac{-4a \delta}{(\delta - a)^2} \right]$
- $E_{ij} = 2 \pi \rho^2 \left[ \frac{A}{(\delta - a)^2} \int_{3,1,2} \frac{-4a \delta}{(\delta - a)^2} + \frac{B}{(\delta - a)^2} \int_{6,1,2} \frac{-4a \delta}{(\delta - a)^2} \right]$
- $E_{ij} = 2 \pi \rho^2 \left[ \frac{A}{(\delta - a)^2} \int_{3,1,2} \frac{-4a \delta}{(\delta - a)^2} + \frac{B}{(\delta - a)^2} \int_{6,1,2} \frac{-4a \delta}{(\delta - a)^2} \right]$
- $E_{ij} = 2 \pi \rho^2 \left[ \frac{A}{(\delta - a)^2} \int_{3,1,2} \frac{-4a \delta}{(\delta - a)^2} + \frac{B}{(\delta - a)^2} \int_{6,1,2} \frac{-4a \delta}{(\delta - a)^2} \right]$

No, the answer is incorrect. Score: 0

Accepted Answers:

$E_{ij} = 2 \pi \rho^2 \left[ \frac{A}{(\delta - a)^2} \int_{3,1,2} \frac{-4a \delta}{(\delta - a)^2} + \frac{B}{(\delta - a)^2} \int_{6,1,2} \frac{-4a \delta}{(\delta - a)^2} \right]$