4. Consider the following force field vector

\[ \mathbf{F} = (F_x, F_y, F_z) = (ax + by^2, az + 2bxy, ay + bz^2). \]

Is that force conservative? If yes, calculate the corresponding potential energy.

5. A particle of mass \( m \) moves under a force \( F = -cx^3 \), where \( c \) is a positive constant. Find the potential energy \( V(x) \). If the particle starts from rest at \( x = -a \), what is the velocity when it reaches \( x = 0 \)? Where in the subsequent motion does it instantaneously come to rest?

6. A particle of mass \( m \) moves under a conservative force with potential energy

\[ V(x) = \frac{cx}{x^2 + a^2}, \]

where \( a \) and \( c \) are positive constants. Find the position of stable equilibrium, and the period of small oscillations about it. If the particle starts from this point with velocity \( v \), find the values of \( v \) for which it (i) oscillates, (ii) escapes to \(-\infty\) and (iii) escapes to \(+\infty\).