

Please provide your solutions on a separate sheet of paper provided.

Write your name down first, on that sheet!

You can keep this sheet.

1 problem, 15 minutes.

Problem 1 Consider a particle in one dimension. For each following potential energy

(i) find $\langle \hat{T} \rangle$ in terms of $\langle \hat{V} \rangle$, and

(ii) find E (energy eigenvalue) in terms of $\langle \hat{T} \rangle$,

for an energy eigenstate of the Hamiltonian. Briefly explain your answer. (Note the virial theorem: $\langle \hat{T} \rangle = \frac{n}{2} \langle \hat{V} \rangle$.)

(a) $V(x) = \frac{1}{2}kx^2$, ($k > 0$, SHO).

(b) $V(x) = \begin{cases} \infty & x < 0 \\ \frac{1}{2}kx^2 & x \geq 0 \end{cases}$, ($k > 0$).

(c) $V(x) = mg|x|$, ($mg > 0$; ~~bouncing particle under gravity~~).

(d) $V(x) = \begin{cases} \infty & x < 0 \\ mgx & x \geq 0 \end{cases}$, ($mg > 0$; bouncing particle under gravity).

Your name: