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2)Problem 1.9)a) Element of -keyboard shortcut is esc el esc.

$Assumptions = {x, t, m, a, A,ℏ}∈ Reals

$(x \mid t \mid m \mid a \mid A \mid ℏ) \in$ Reals

F[x_] := $e^{-a*\left(\frac{(m*x^2)}{ℏ}\right)}$

Integrate$\left[(F[x])^2, \{x, -∞, ∞\}\right]$

ConditionalExpression$\left[\dfrac{\sqrt{\frac{\pi}{2}}}{\sqrt{\frac{a\,m}{ℏ}}}, a\,m\,ℏ > 0\right]$

(*finding the integral of <x> from -∞ to ∞*)
Integrate$\left[x * (F[x])^2, \{x, -∞, ∞\}\right]$

ConditionalExpression$[0, a\,m\,ℏ > 0]$

Integrate$\left[(x)^2 * (F[x])^2, \{x, -∞, ∞\}\right]$

ConditionalExpression$\left[\dfrac{\sqrt{\frac{\pi}{2}}}{4\left(\frac{a\,m}{ℏ}\right)^{3/2}}, a\,m\,ℏ > 0\right]$

(*Let us redefine F[x] wit the normaliozation
 constant in so that future calculations are easier.*)
F1[x_] := $\left(\dfrac{(2 * a * m)}{(ℏ * \pi)}\right)^{\frac{1}{4}} * e^{-a*\left(\frac{(m*x^2)}{ℏ}\right)}$

Integrate$\left[x * (F1[x])^2, \{x, -∞, ∞\}\right]$

ConditionalExpression$[0, a\,m\,ℏ > 0]$

Integrate$\left[(F1[x])^2, \{x, -∞, ∞\}\right]$

ConditionalExpression$[1, a\,m\,ℏ > 0]$

Integrate$\left[(x * F1[x])^2, \{x, -∞, ∞\}\right]$

ConditionalExpression$\left[\dfrac{ℏ}{4\,a\,m}, a\,m\,ℏ > 0\right]$

3)Problem 1.17) c)

(* Let us define the function at time t =
0. ALong with the normalization constant since we calculated it previously.*)

F2[x_] := Piecewise[{{0, x < -a}, {$\left(\sqrt{\dfrac{15}{16*a^5}}\right)$ * $(a^2 - x^2)$, -a ≤ x ≤ a}, {0, x > a}}]

(*Here we shall check the value that we calculated
for the expectation for the position. we do get zero. *)
Integrate[x * $(F2[x])^2$, {x, -a, a}]

0

Integrate[$\left(\dfrac{\hbar}{\iota}\right)$ * F2[x] * D[F2[x], x], {x, -a, a}]

0

(*Here we shall check the value that we calculated for the expectation for <x^2>. *)
Integrate[$(x)^2$ * $(F2[x])^2$, {x, -a, a}]

$\begin{cases} \dfrac{a^2}{7} & a > 0 \\ 0 & \text{True} \end{cases}$

(*Problem 3)1.17) part e)checking the partial I evaluated twice to see if it
matches. It does. Also {x,n} in the D[] command evaluates the partial n times. *)
D[$(a^2 - x^2)$, {x, 2}]

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