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phys 425 &01
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Problem 1.3 a) Checking the integral value that I got.

$$\text{Integrate}\left[A * e^{-\lambda\,(x-a)^2},\ \{x,\ -\text{Infinity},\ \text{Infinity}\}\right]$$

$$\text{ConditionalExpression}\left[\frac{A\sqrt{\pi}}{\sqrt{\lambda}},\ \text{Re}[\lambda] \geq 0\right]$$

1.3 b) Checking the integral value that I got. Even if we did the below integrals via U-sub. this show that we get the same result (see just below).

$$\text{Integrate}\left[\sqrt{\left(\frac{\lambda}{\pi}\right)} * (u+a) * e^{-\lambda\,(u)^2},\ \{u,\ -\text{Infinity},\ \text{Infinity}\}\right]$$

$$\text{ConditionalExpression}[a,\ \text{Re}[\lambda] > 0]$$

$$\text{Integrate}\left[\sqrt{\left(\frac{\lambda}{\pi}\right)} * (x) * e^{-\lambda\,(x-a)^2},\ \{x,\ -\text{Infinity},\ \text{Infinity}\}\right]$$

$$\text{ConditionalExpression}[a,\ \text{Re}[\lambda] \geq 0]$$

$$\text{Integrate}\left[\sqrt{\left(\frac{\lambda}{\pi}\right)} * (x)^2 * e^{-\lambda\,(x-a)^2},\ \{x,\ -\text{Infinity},\ \text{Infinity}\}\right]$$

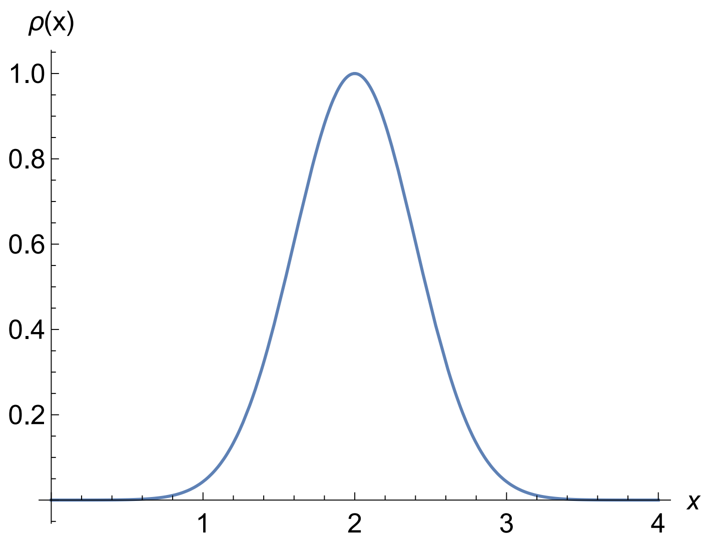
$$\text{ConditionalExpression}\left[\frac{1+2a^2\lambda}{2\lambda},\ \text{Re}[\lambda] \geq 0\right]$$

1.3) c) Defining Piecewise function here. Also plotting the Gaussian function with a = 2 and $\lambda = \pi$.

$$\text{Piecewise}\left[\left\{\left\{\frac{\lambda}{\pi},\ x == a\right\},\ \left\{\sqrt{\left(\frac{\lambda}{\pi}\right)} * e^{-\lambda\,(x-a)^2},\ x \neq a\right\}\right\}\right]$$

$$\begin{cases} \frac{\lambda}{\pi} & x == a \\ \frac{e^{-(-a+x)^2\lambda}\sqrt{\lambda}}{\sqrt{\pi}} & x \neq a \\ 0 & \text{True} \end{cases}$$

```
Plot[Piecewise[{{π/π, g == 2}, {Sqrt[(π/π)] * e^(-π*(g-2)^2), g ≠ 2}}], {g, 0, 4},
 AspectRatio → 3/4, AxesLabel → {x, "ρ(x)"}, AxesStyle → Directive[Black, 14]]
```



Problem 3) 1.5)a) Checking the integral value that I got.

```
Integrate[e^(-2*λ*Abs[x]), {x, -Infinity, Infinity}]
```

$$\begin{cases} \frac{1}{\lambda} & \text{Re}[\lambda] > 0 \\ \text{Integrate}\left[e^{-2\lambda\,\text{Abs}[x]}, \{x, -\infty, \infty\}, \text{Assumptions} \to \text{Re}[\lambda] \le 0\right] & \text{True} \end{cases}$$

Problem 3) 1.5) b) Checking the integral value that I got.

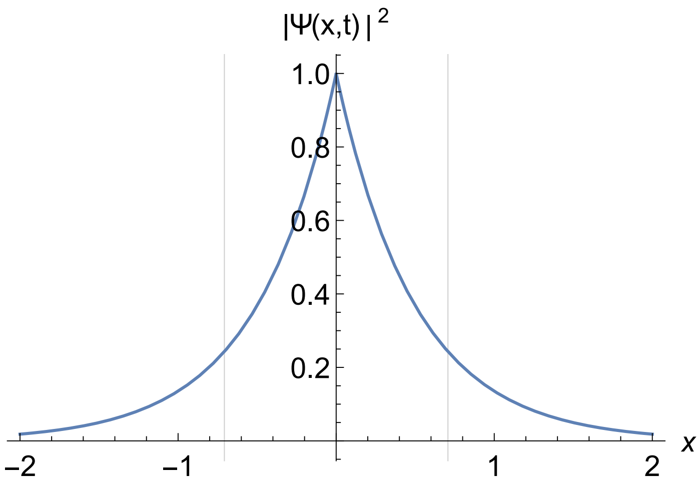
```
Integrate[x * e^(-2*λ*Abs[x]), {x, -Infinity, Infinity}]
```

$$\begin{cases} 0 & \text{Re}[\lambda] > 0 \\ \text{Integrate}\left[e^{-2\lambda\,\text{Abs}[x]}\, x, \{x, -\infty, \infty\}, \text{Assumptions} \to \text{Re}[\lambda] \le 0\right] & \text{True} \end{cases}$$

We let $\lambda = 1$ for this part to show the graph below our σ becomes $\sigma = \frac{1}{\sqrt{2}}$.

```
μ := 0
σ := 1/Sqrt[2]
```

```
Plot[Piecewise[{{1, h == 0}, {e^(-2*(h)), h > 0}, {e^(2*(h)), h < 0}}],
 {h, -2, 2}, AxesLabel → {x, "|Ψ(x,t)|^2"},
 AxesStyle → Directive[Black, 15], GridLines → {{μ - σ, μ + σ}, {}}]
```



Problem 4)1.11)a) This is a plot of the probability density $\rho(\theta)$. Notice we get a uniform distribution.

```
Plot[Piecewise[{{1/π, 0 ≤ d ≤ π}}], {d, -π/2, 3π/2}, AxesLabel → {θ, "ρ(θ)"},
 AxesStyle → Directive[Black, 15], PlotStyle → {Thick, Red}]
```