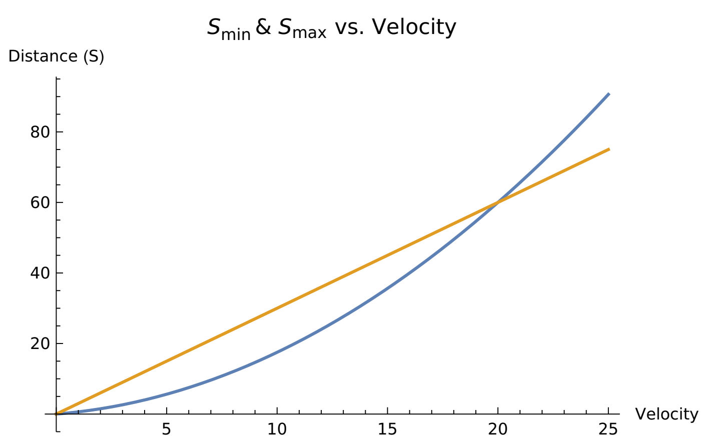
Problem 1

```
a = 4;
t = 3;
τ = .5;
```

$$S_{min} = \frac{v^2}{2\,a} + v\,\tau;$$

$$S_{max} = v\,t;$$

```
Plot[{S_min , S_max}, {v, 0, 25}, AxesLabel → {"Velocity", "Distance (S)"},
 PlotLabel → "S_min & S_max vs. Velocity"]
```



Problem 2

```
ClearAll["Global`*"]
F[t_] := k √(t - z)
F '[t]
```

$$\frac{k}{2\,\sqrt{t-z}}$$

```
FullSimplify[(m k) / (2 √((((v/k))^2 + t_s) - t_s))]
```

$$\frac{k\,m}{2\sqrt{\frac{v^2}{k^2}}}$$

```
FullSimplify[(m k) / (2 v/k)]
```

$$\frac{k^2\,m}{2\,v}$$

Problem 3

```
ClearAll["Global`*"]
```

$$\int_{v_0}^{v} e^{-\alpha v}\,dv$$

$$\frac{-e^{-v\,\alpha}+e^{-\alpha\,v_0}}{\alpha}$$

$$\frac{-b}{m}\int_{t_0}^{t} 1\,dt\ /.\ t_0 \to 0$$

$$-\frac{b\,t}{m}$$

```
Simplify[Solve[0 == 1/α Log[-(b t α)/m - e^(-α v_0)], t]]
```

$$\left\{\left\{t \to -\frac{\left(1+e^{-\alpha\,v_0}\right) m}{b\,\alpha}\right\}\right\}$$

$$\int_0^t \frac{1}{\alpha} \operatorname{Log}\left[\frac{-(b\, t\, \alpha)}{m} - e^{-\alpha\, v_0}\right] dt$$

$$\text{ConditionalExpression}\left[\frac{-\frac{e^{-\alpha v_0}\, m \operatorname{Log}\left[e^{-\alpha v_0}\, m\right]}{b\, \alpha} + \frac{e^{-\alpha v_0}\, m \operatorname{Log}\left[e^{-\alpha v_0}\, m + b\, t\, \alpha\right]}{b\, \alpha} + t\left(-1 + \operatorname{Log}\left[-\frac{e^{-\alpha v_0}\, m + b\, t\, \alpha}{m}\right]\right)}{\alpha},\right.$$

$$\left(\left(\operatorname{Re}\left[\frac{e^{-\alpha v_0}\, m}{b\, t\, \alpha}\right] \geq 0 \;\&\&\; \frac{m}{b\, t\, \alpha} \neq 0\right) \;||\; \frac{e^{-\alpha v_0}\, m}{b\, t\, \alpha} \notin \mathbb{R} \;||\; \operatorname{Re}\left[\frac{e^{-\alpha v_0}\, m}{b\, t\, \alpha}\right] < -1\right) \;\&\&$$

$$\left(\frac{e^{-\operatorname{Re}[\alpha]\, v_0}\left(-\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[m] + \operatorname{Re}[m] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\right)}{\operatorname{Re}[b]\,(\operatorname{Im}[\alpha] \times \operatorname{Re}[t] + \operatorname{Im}[t] \times \operatorname{Re}[\alpha]) + \operatorname{Im}[b]\,(-\operatorname{Im}[t] \times \operatorname{Im}[\alpha] + \operatorname{Re}[t] \times \operatorname{Re}[\alpha])} \notin \mathbb{R} \;||\right.$$

$$\Big(\operatorname{Im}[b] \times \operatorname{Im}[t] \times \operatorname{Im}[\alpha] \geq \operatorname{Im}[\alpha] \times \operatorname{Re}[b] \times \operatorname{Re}[t] + \operatorname{Im}[t] \times \operatorname{Re}[b] \times \operatorname{Re}[\alpha] + \operatorname{Im}[b] \times \operatorname{Re}[t] \times \operatorname{Re}[\alpha] \;\&\&$$

$$e^{-\operatorname{Re}[\alpha]\, v_0}\Big(\operatorname{Im}[m]\Big(\operatorname{Re}[t]\Big(\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[b] \times \operatorname{Im}[\alpha] - \operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Re}[b] \times \operatorname{Re}[\alpha] + \operatorname{Im}[\alpha] \times \operatorname{Re}[b] \times$$

$$\operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0] + \operatorname{Im}[b] \times \operatorname{Re}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\Big) + \operatorname{Im}[t]\Big(\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[\alpha] \times \operatorname{Re}[b] +$$

$$\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[b] \times \operatorname{Re}[\alpha] - \operatorname{Im}[b] \times \operatorname{Im}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0] + \operatorname{Re}[b] \times \operatorname{Re}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\Big)\Big) +$$

$$\operatorname{Re}[m]\Big(-\operatorname{Im}[b]\Big(\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[t] \times \operatorname{Im}[\alpha] - \operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Re}[t] \times \operatorname{Re}[\alpha] + \operatorname{Im}[\alpha] \times \operatorname{Re}[t] \times \operatorname{Sin}[\operatorname{Im}[\alpha]$$

$$v_0] + \operatorname{Im}[t] \times \operatorname{Re}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\Big) + \operatorname{Re}[b]\Big(\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[\alpha] \times \operatorname{Re}[t] + \operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times$$

$$\operatorname{Im}[t] \times \operatorname{Re}[\alpha] - \operatorname{Im}[t] \times \operatorname{Im}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0] + \operatorname{Re}[t] \times \operatorname{Re}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\Big)\Big)\Big) \leq 0\Big) \;||$$

$$\operatorname{Re}\left[\frac{e^{-\operatorname{Re}[\alpha]\, v_0}\left(-\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[m] + \operatorname{Re}[m] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\right)}{\operatorname{Re}[b]\,(\operatorname{Im}[\alpha] \times \operatorname{Re}[t] + \operatorname{Im}[t] \times \operatorname{Re}[\alpha]) + \operatorname{Im}[b]\,(-\operatorname{Im}[t] \times \operatorname{Im}[\alpha] + \operatorname{Re}[t] \times \operatorname{Re}[\alpha])}\right] \geq 1 \;||$$

$$\Big(e^{-\operatorname{Re}[\alpha]\, v_0}\Big(\operatorname{Im}[m]\Big(\operatorname{Re}[t]\Big(\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[b] \times \operatorname{Im}[\alpha] - \operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Re}[b] \times \operatorname{Re}[\alpha] + \operatorname{Im}[\alpha] \times \operatorname{Re}[b] \times$$

$$\operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0] + \operatorname{Im}[b] \times \operatorname{Re}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\Big) + \operatorname{Im}[t]\Big(\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[\alpha] \times \operatorname{Re}[b] +$$

$$\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[b] \times \operatorname{Re}[\alpha] - \operatorname{Im}[b] \times \operatorname{Im}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0] + \operatorname{Re}[b] \times \operatorname{Re}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\Big)\Big) +$$

$$\operatorname{Re}[m]\Big(-\operatorname{Im}[b]\Big(\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[t] \times \operatorname{Im}[\alpha] - \operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Re}[t] \times \operatorname{Re}[\alpha] + \operatorname{Im}[\alpha] \times \operatorname{Re}[t] \times$$

$$\operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0] + \operatorname{Im}[t] \times \operatorname{Re}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\Big) + \operatorname{Re}[b]\Big(\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[\alpha] \times \operatorname{Re}[t] +$$

$$\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[t] \times \operatorname{Re}[\alpha] - \operatorname{Im}[t] \times \operatorname{Im}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0] + \operatorname{Re}[t] \times \operatorname{Re}[\alpha] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\Big)\Big)\Big) \geq$$

$$0 \;\&\&\; \operatorname{Im}[b] \times \operatorname{Im}[t] \times \operatorname{Im}[\alpha] \leq \operatorname{Im}[\alpha] \times \operatorname{Re}[b] \times \operatorname{Re}[t] + \operatorname{Im}[t] \times \operatorname{Re}[b] \times \operatorname{Re}[\alpha] + \operatorname{Im}[b] \times \operatorname{Re}[t] \times \operatorname{Re}[\alpha]\Big) \;||$$

$$\left.\left.\operatorname{Re}\left[\frac{e^{-\operatorname{Re}[\alpha]\, v_0}\left(-\operatorname{Cos}[\operatorname{Im}[\alpha]\, v_0] \times \operatorname{Im}[m] + \operatorname{Re}[m] \times \operatorname{Sin}[\operatorname{Im}[\alpha]\, v_0]\right)}{\operatorname{Re}[b]\,(\operatorname{Im}[\alpha] \times \operatorname{Re}[t] + \operatorname{Im}[t] \times \operatorname{Re}[\alpha]) + \operatorname{Im}[b]\,(-\operatorname{Im}[t] \times \operatorname{Im}[\alpha] + \operatorname{Re}[t] \times \operatorname{Re}[\alpha])}\right] \leq 0\right)\right]$$

$$x(t)=\frac{-\frac{e^{-\alpha v_0}\, m \operatorname{Log}\left[e^{-\alpha v_0}\, m\right]}{b\, \alpha} + \frac{e^{-\alpha v_0}\, m \operatorname{Log}\left[e^{-\alpha v_0}\, m + b\, t\, \alpha\right]}{b\, \alpha} + t\left(-1 + \operatorname{Log}\left[-\frac{e^{-\alpha v_0}\, m + b\, t\, \alpha}{m}\right]\right)}{\alpha}$$

Problem 4

```
Solve[0 == 2 m g - (μ m g √(1 - Sin[θ]) + m g Sin[θ]), θ]
```

Solve: Inverse functions are being used by Solve, so some solutions may not be found; use Reduce for complete solution information.

$$\left\{\left\{\theta \to \mathrm{ArcSin}\left[\frac{1}{2}\left(4-\mu^2-\mu\sqrt{-4+\mu^2}\right)\right]\right\}, \left\{\theta \to -\mathrm{ArcSin}\left[\frac{1}{2}\left(-4+\mu^2-\mu\sqrt{-4+\mu^2}\right)\right]\right\},\right.$$
$$\left.\left\{\theta \to \mathrm{ArcSin}\left[\frac{1}{2}\left(4-\mu^2+\mu\sqrt{-4+\mu^2}\right)\right]\right\}, \left\{\theta \to -\mathrm{ArcSin}\left[\frac{1}{2}\left(-4+\mu^2+\mu\sqrt{-4+\mu^2}\right)\right]\right\}\right\}$$