

# The Theoretical Minimum

## Classical Mechanics - Solutions

I01E01

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**Exercise 1.** *Using a graphic calculator or a program like Mathematica, plot each of the following functions. See the next section if you are unfamiliar with the trigonometric functions.*

$$f(t) = t^4 + 3t^3 - 12t^2 + t - 6$$

$$g(x) = \sin x - \cos x$$

$$\theta(\alpha) = e^\alpha + \alpha \ln \alpha$$

$$x(t) = \sin^2 t - \cos t$$

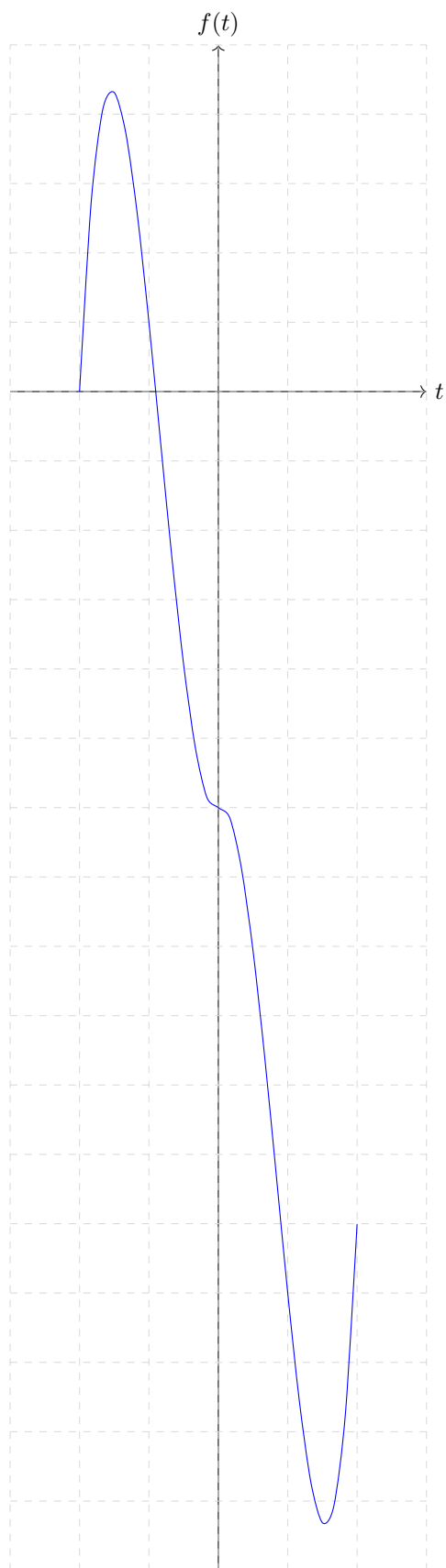


Figure 1:  $f(t) = t^4 + 3t^3 - 12t^2 + t - 6$

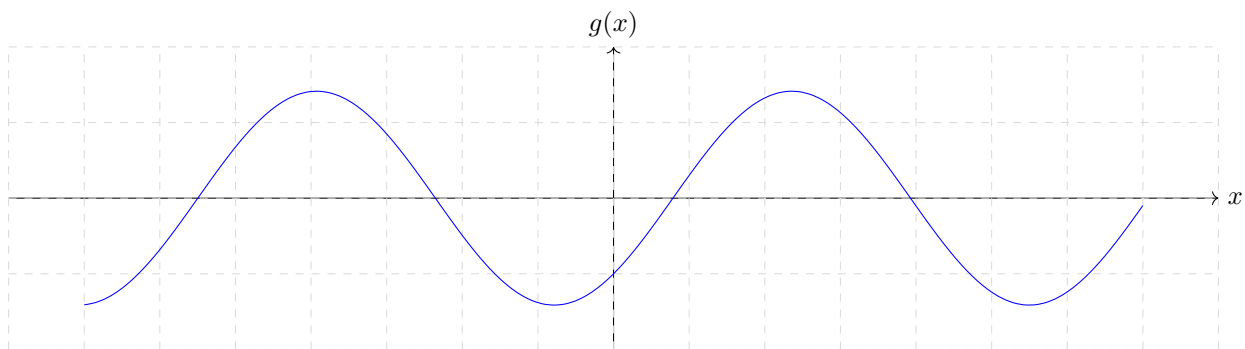


Figure 2:  $g(x) = \sin x - \cos x$

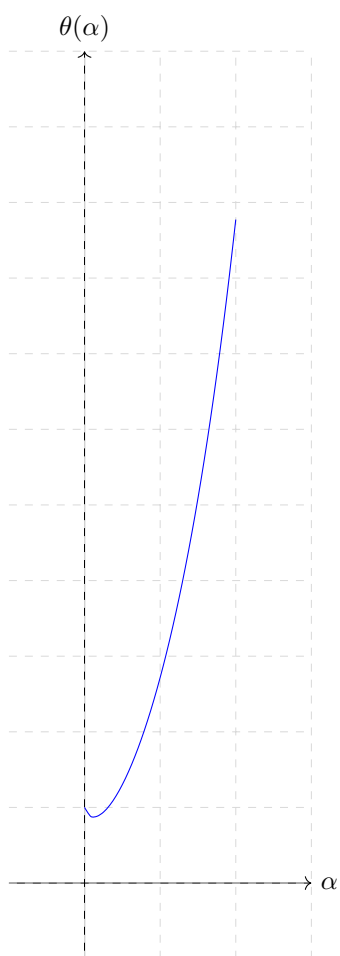


Figure 3:  $\theta(\alpha) = e^\alpha + \alpha \ln \alpha$

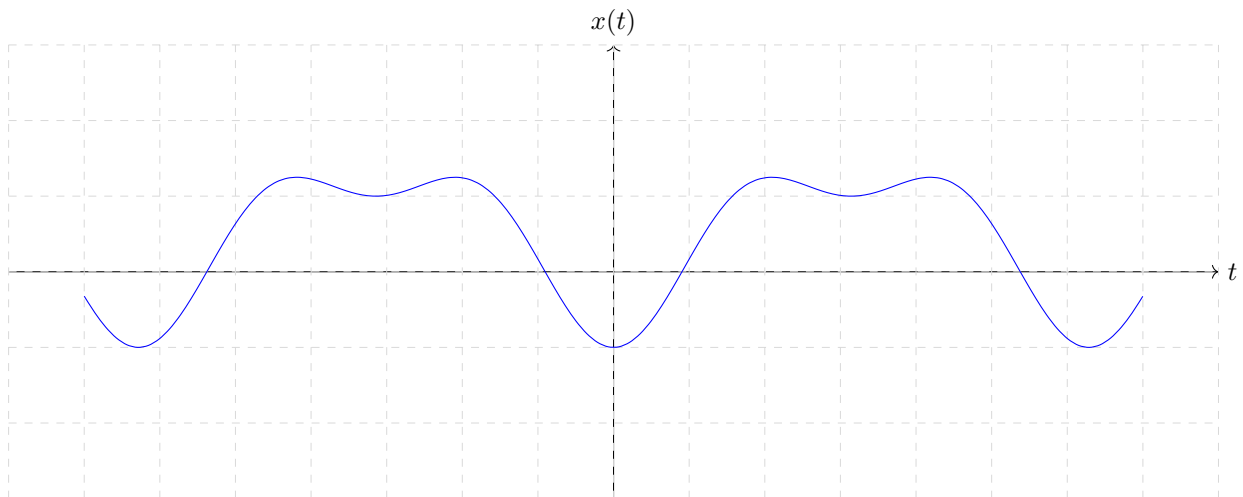


Figure 4:  $x(t) = \sin^2 t - \cos t$

**Remark 1.** All those plots were created using *TiKz* (with *L<sup>A</sup>T<sub>E</sub>X* then). For instance, here's the code for the last plot:

```
\begin{figure}[H]
  \centering
  \begin{tikzpicture}
    \tikzmath{
      \xmin = -7;
      \xmax = 7;
      \ymin = -2;
      \ymax = 2;
    }
    \draw[->] (\xmin-1, 0) -- (\xmax+1, 0) node[right] {$t$};
    \draw[->] (0, \ymin-1) -- (0, \ymax+1) node[above] {$x(t)$};
    \draw[help lines, color=gray!30, dashed]
      (\xmin-1,\ymin-1) grid (\xmax+1,\ymax+1);
    \draw[scale=1, domain=\xmin:\xmax, smooth, samples=100, variable=\t, blue]
      plot ({\t}, {\sin(\t r)^2 - cos(\t r)});
  \end{tikzpicture}
  \caption{$x(t) = \sin^2 t - \cos t$}
\end{figure}
```