1. **Complex numbers - polar (6 pts).**
   Any complex number $z$ written in rectangular (Cartesian) form
   
   $$ z = x + iy $$
   
   where $x$ is the real and $y$ is the imaginary part, can also be written in polar (phasor) form
   
   $$ z = |z|(\cos \theta + i \sin \theta) = |z|e^{i\theta} $$
   
   where $\theta$ is the phase $\angle z$ and $|z|$ is the magnitude of the complex number $z$.

   Using the Euler formula, compute the magnitude and phase of the complex numbers provided in rectangular form below:
   
   (i) $z = 3 + 2i$
   (ii) $z = 1 - i$
   (iii) $z = e^{2-i\pi}$

   (Please be careful while calculating the phase of $z = x + iy$. The phase $\angle z$ is not always equal to $\arctan \frac{y}{x}$. Tangent is periodic with $\pi$ (i.e. $\tan \theta = \tan (\pi + \theta)$), and $\arctan \frac{y}{x} = \arctan \frac{-y}{x}$. However, that property is not true for $e^{i\theta}$! Hence, depending on the signs of $x$ and $y$, you should pick the right angle. Insert your final answers into the polar form and check the equality.)

2. **Complex numbers - rectangular (6 pts).**
   Compute the real and imaginary parts of the complex numbers:
   
   (a) $e^i$
   (b) $e^{it}(\cos(3t) + \sin(2t))$ ($t$ is real)
   (c) $1/(1 + i)$

3. **Imaginary square root (4 pts).**
   Express the square root of $(1 + i)$ in rectangular coordinates.

4. **Phase calculation (8 pts).**
   The complex number $z$ is given by
   
   $$ z = \frac{z_1}{z_2} = \frac{1 + 3i}{1 - i} $$

   (a) Express $z$ in rectangular form.
   (b) Express $z$ in polar form. Compute the magnitude and phase of $z$ in terms of the magnitude and phase of $z_1$ and $z_2$.
   (c) Using the results of (a) and (b), show that $\arctan 3 + \arctan 2 = \frac{3\pi}{4}$. 

5. *Shifting and scaling functions (10 pts).*

Let

\[
 f(t) = \begin{cases} 
 t & 0 \leq t < 1 \\
 2 - t & 1 \leq t < 2 \\
 0 & \text{else.}
\end{cases} \tag{1}
\]

Sketch each of the following signals. All sketches must have clearly labeled axes.

(a) \( f(t) \)
(b) \( f(t) + 1 \)
(c) \( f(\frac{t}{2}) \)
(d) \( f(t + 2) \)
(e) \( f(-t - 1) \)