UCSD ECE 45 Preparedness Test

1. (MATH 20B) Rewrite the following complex numbers given in rectangular coordinates in polar coordinates:

   (a) $4 + 4j$

   (b) 3

   (c) $-2j$

   (d) $-12 + 3j$

2. (MATH 20B) Simplify the following complex expressions. Write your answer in phasor notation.

   (a) $(4 + 3j) - (2 - 6j)$

   (b) $(1 + 2j)(4 + 6j)$

   (c) $(1 + 2j)(4 - 6j)$

   (d) $\dfrac{(2 + 4j)}{(6 - 7j)}$

   (e) $\dfrac{(1 + 2j) + (3 + 4j)}{(2 - 3j) - 4}$

   (f) $[(1 + 2j)(2 + 3j)]^*$ where * denotes the complex conjugate

3. (MATH 20B) Given Euler's formula $e^{jx} = cos(x) + jsin(x)$, show that:

   (a) $cos(x) = \dfrac{e^{jx} + e^{-jx}}{2}$

   (b) $sin(x) = \dfrac{e^{jx} - e^{-jx}}{2j}$

4. (MATH 20B) Use Euler's formula to write $f(t)$ as a finite sum of complex exponentials:

   (a) $f(t) = 1 + cos(t) + sin(2t + 90°)$

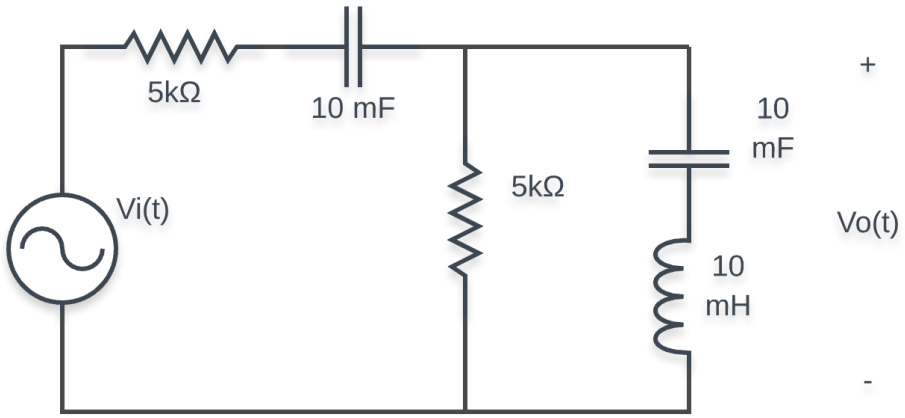
   (b) $f(t) = cos^2(2t) + sin(3t)$ (Solve (b) using both trigonometric identities first **and** then using Euler's formula)

5. (ECE 35) Given the following circuit, find $v_o(t)$ for

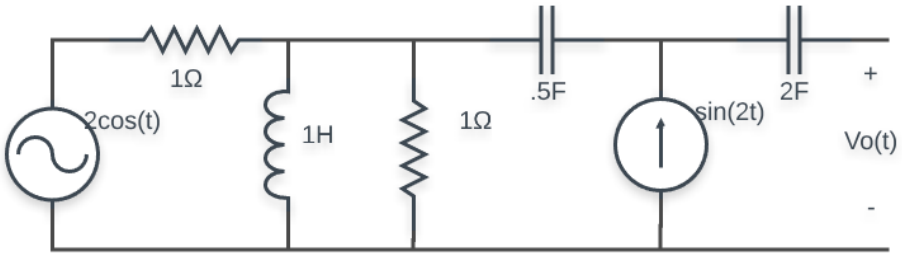
   (a) $v_i(t) = cos(100t)$

(b) $v_i(t) = cos(10^6 t)$

(c) $v_i(t) = cos(\omega t)$ as $\omega \to \infty$



6. (ECE 35) Given the following circuit, find $v_o(t)$.



7. (MATH 20B) Evaluate the following sums

(a) $\sum_{n=0}^{20} (\frac{1}{2})^n$

(b) $\sum_{n=0}^{\infty} (\frac{1}{2})^n$

(c) $\sum_{n=1}^{\infty} \frac{1}{3}(\frac{1}{3})^n$

8. (MATH 20B) Simplify the following expressions:

(a) $x^2(x^3)$

(b) $\sqrt{x}x^4$

(c) $x^{-2}(x^{0.7})$

(d) $\dfrac{x^5}{x^{10}}$

(e) $((x^4)^3)^2$

(f) $(x^5)^{4!}$

9. (MATH 20B) In the following logarithmic expressions, solve for x:

(a) $log_{10}(5) + log_{10}(3) = log_{10}(x)$

(b) $log_5(3) - log_5(5) = log_5(x)$

(c) $ln(6^8) = xln(6)$

(d) $log_{10}(x) = 5$

(e) $ln(3^x) = 7$

(f) $ln(x^3) = 7$

10. (MATH 20B) Evaluate the following integrals:

(a) $\int cos(t)dt$

(b) $\int_0^t cos(t)dt$

(c) $\int \frac{5}{x}dx$

(d) $\int e^x dx$

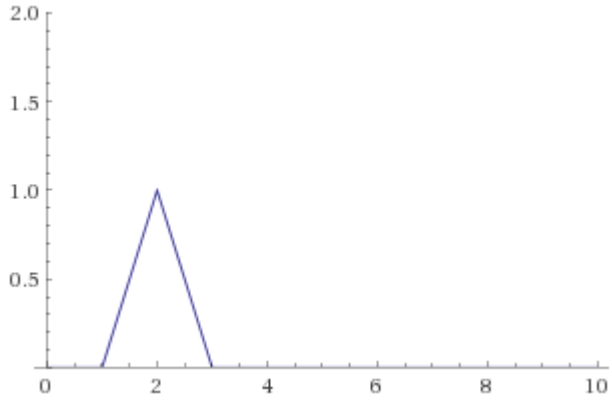
(e) $\int e^{jx}dx$

(f) $\int_{-\infty}^t x(\tau)e^{j\tau}d\tau$ where $x(\tau) = \begin{cases} 1 & -3 < \tau < 3 \\ 0 & else \end{cases}$

(g) $\int_0^y xe^{-x^2}dx$

(h) $\int_{-\frac{y}{2}}^{\frac{y}{2}} \frac{2x+4}{(x+3)(x+4)}dx$

11. (MATH 20B) The function y(t) is given by the graph below.



Draw the following:

(a) $y(t-2)$

(b) $2y(2t-2)$

(c) $\frac{1}{2}y(\frac{-t}{3}+4)$