

EE1002 Principles of Electronic Engineering Test 1

Part II: Written Questions (2 questions, 25 points per question, total 40 minutes)

Question 1

(a) Evaluate the following integrals.

a) $\int \cos^2(\pi t + 1) dt$

b) $\int \frac{\ln(\tan x)}{\cos x \sin x} dx$

c) $\int \frac{1+\ln x}{(x \ln x)^2} dx$

Answer:

a) $\frac{1}{2}t + \frac{1}{4\pi} \sin 2(\pi t + 1) + C$

b) $\frac{1}{2}(\ln \tan x)^2 + C$

c) $-\frac{1}{x \ln x} + C$

(b) Find the general solution of the equation by using the integrating factor method:

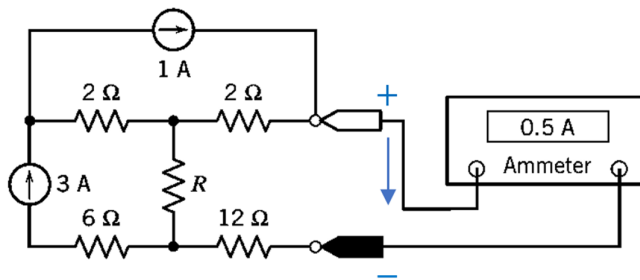
$$x^2 \frac{dy}{dx} - y = \frac{x^2}{(1 - e^x)e^{\frac{1}{x}}}$$

Answer:

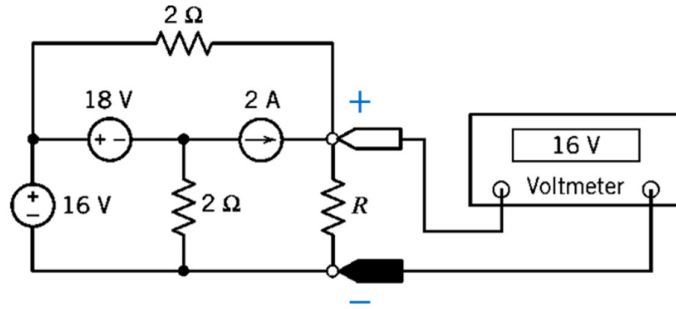
$$y = e^{-1/x} (-\ln|e^{-x} - 1| + C)$$

Question 2

(a) Consider the circuit shown in the following figure (Ideal Ammeter). Find the value of the resistance R .



(b) Consider the circuit shown in the following figure (Ideal Voltmeter). Find the value of the resistance R .



Answer:

- a) $2\ \Omega$
- b) $8\ \Omega$

Question 3

The speed $v(t)$ of a particle is a function of time t given by $v(t) = 2 - e^{-t}$.

- (a) Calculate the speeds of the particle at $t = 0$ and $t = 3$. What is the average speed over this time interval?
- (b) Calculate the distance s travelled by the particle between $t = 0$ and $t = 3$.
(Hint: $s = \int v(t)dt$)
- (c) Acceleration is the rate of change of velocity with respect to t . Determine the acceleration a as a function of time and find its value at $t = 4$.
- (d) When is the maximum acceleration obtained? What is the maximum acceleration?

Answer:

(a) $v(0) = 1, \quad v(3) = 2 - e^{-3}$

$$v_a = \frac{5 + e^{-3}}{3}$$

(b) $s = 2t + e^{-t} + C$

$$s = 5.0498$$

(c) $a = e^{-t}$

(d) The acceleration a is a monotonically decreasing function, therefore it is maximum when $t = 0$, i.e., $a_{\max} = a(0) = e^0 = 1$.