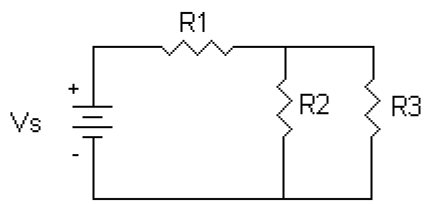
PROBLEM-SOLVING EXERCISE #2
DIVIDE AND CONQUER TECHNIQUES
A SOLUTION

PART A

Use the technique of simplifying this circuit using equivalent resistances into smaller, simpler circuits.

Given the following circuit:



If R1 = 36 Ω, R2 = 24 Ω, R3 = 12 Ω, and Vs = 6 Volts, determine the circuit equivalent resistance (REQ) and the circuit current (I). Also calculate the branch currents through R2 and R3, and the voltage drops across R1, R2, and R3.

$R_{2,3}$ =(R2 x R3)/(R2 + R3) = 8 Ω
REQ = R1 + $R_{2,3}$ = 44 Ω

I = I1 =V / REQ = 6 / 44 = 0.1363 A

I2 = I (R3 / (R2 + R3)) = 0.045455 A

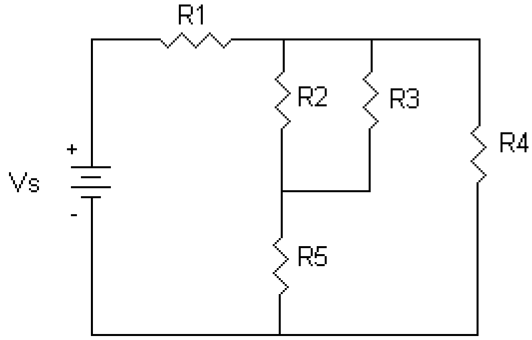
I3 = I (R2 / (R2 + R3)) = 0.090909 A

V1 = I1(R1) = 4.909091 V
V2 = I2(R2) = 1.090909 V
V3 = I3(R3) = 1.090909 V

PART B

Use the technique of simplifying this circuit using equivalent resistances into smaller, simpler circuits.

Given the following circuit:



If R1 = 12 Ω, R2 = 24 Ω, R3 = 18 Ω, R4 = 12 Ω, R5 = 24 Ω and Vs = 12 Volts, determine the circuit equivalent resistance (REQ) and the circuit current (I). Also calculate the branch currents through R2, R3, R4, and R5, and the voltage drops across R1, R2, R3, R4 and R5.

R23 = (R2 x R3)/(R2 + R3) = 10.28571 Ω

I = I1 = Vs/ REQ = 12 / 20.88889 = 0.574468 A

R235 = R23 + R5 = 34.28571 Ω
R2345 =(R235 x R4)/(R235 + R4) = 8.888889 Ω
REQ = R1 + R2345 = 20.88889Ω

I4 = I (R235) / (R235 + R4) = 0.425532 A
I5 = I – I4 = 0.148936 A

I2 = I5 (R3) / (R2 + R3) = 0.06383 A
I3 = I5 – I2 = 0.085106 A

V1 = I (R1) = 6.893617 V
V2 = I2(R2) = 1.531915 V

V3 = I3(R3) = 1.531915 V
V4 = I4(R4) = 5.106383V
V5 = I5(R5) = 3.574468 V

PART C

Use the technique of separating the problem into X- and Y- components to solve this problem:

A soccer ball is kicked off the ground, with a velocity of 18 meters / second, at an upward angle of 15 degrees. Using a gravitational constant, **g**, of 9.8 meters / second^2 calculate the following:

1) The time it takes for the soccer ball to hit the ground. ***(seconds)***
2) The maximum height the soccer ball achieves. ***(meters)***
3) The distance the soccer ball travels before it hits the ground. ***(meters)***

First, find tymax (when Vy = 0), using Vy equation:
$Vy(tymax) = V \sin(\theta) - g(tymax)$
$0 = 18(\sin(15)) - (9.8)(tymax)$
$tymax = 4.658743/9.8 = 0.475382$ *sec*

Now find Py(tymax) using Py equation:
$Py(tymax) = 0 + 18(\sin(15))(0.475382) - (0.5)(9.8)(0.475382)^2$
$Py(tymax) = 2.214682 - 1.107341$
$Py(tymax) = 1.107341$ *m*

Use tymax to find total t
$t = 2tymax$
$t = (2)(0.475382)$
$t = 0.950764$ *sec*

Find Px using Px equation
$Px(t) = Vx(t) + Pxo$
$Px(t) = 18(\cos(15))(0.950764) + 0$
$Px(t) = 16.53061$ *m*

Final answers:
1) $t = 0.950764$ *sec*
2) $Py(tymax) = 1.107341$ *m*
3) $Px(t) = 16.53061$ *m*

PART D

Use the technique of separating the problem into X- and Y- components to solve this problem:

A Halloween prankster throws an egg out the window of an office building down onto the parking lot below. The egg is thrown with a velocity of 10 meters / second, at an upward angle of 37 degrees, and is released exactly 65 meters above the surface of the parking lot. The egg lands on the roof of a parked SUV, 2 meters above the surface of the parking lot.

Using a gravitational constant, **g**, of 9.8 meters / second^2 calculate the following:

1) The time it takes for the egg to hit the parked SUV. ***(seconds)***

2) The total distance away from the building that the egg lands. ***(meters)***

First, find t using Py equation:
$Py = Py_0 + V \sin(\theta)t - 0.5gt^2$
$2 = 65 + 10(\sin(37))t - (4.9)\, t^2$
Using the Quadratic Equation to solve for t
$t = 4.251989$ sec

Now find Px(t) using Px equation
$Px(t) = Px_0 + V\cos(\theta)t$
$Px(t) = 0 + 10(\cos(37))(4.251989)$
$Px(t) = 33.95789$ m

Final answers:
1) $t = 4.251989$ sec
2) $Px(t) = 33.95789$ m