NATIONAL UNIVERSITY OF SINGAPORE

CG1111 – ENGINEERING PRINCIPLES AND PRACTICE I

QUIZ #1

06 OCTOBER 2018

INSTRUCTIONS:

1. This paper contains **20** multiple-choice questions (MCQs), with only a **SINGLE** correct answer each.
2. Answer **ALL** questions.
3. Use only **2B pencils** to shade the bubble sheet.
4. This is an **OPEN-BOOK** test.
5. There is no restriction on the use of programmable calculators.
6. There is **no penalty (i.e., no negative marks) for wrong answers**. Please attempt all questions.
7. You are **NOT ALLOWED** to use your **mobile phone, tablet** or **computer** during the test.
8. **DO NOT READ** the questions until you are told to do so.
9. Time allowed: **90 MINUTES**

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1. An appliance consists of 3 subsystems working in parallel with the following power efficiencies: $\eta_1 = 96\%$, $\eta_2 = 83\%$, $\eta_3 = 91\%$. What is the minimum input power required by the appliance if each subsystem's output power is 600 W?

   (A) 828 W

   (B) 2008 W

   (C) 670 W

   (D) 2483 W

2. What is the discharge current of a 12600 mWh battery operating at 3.6 V and 0.2C?

   (A) 2.52 A

   (B) 7 A

   (C) 0.016 A

   (D) 0.7 A

3. Calculate the number of batteries in series and the number of parallel branches required in a battery pack for a remote surveillance system consisting of Lithium Ion batteries, to last a period of 6 hours. The mid-point voltage per battery for the required maximum instantaneous C rate of 2C is 3.6 V. Single battery capacity at the maximum allowable 70% depth of discharge (same as end of discharge) is 6000 mAh. There are 4 subsystems working in series and the required operating voltage is 17 V. The subsystem efficiencies are 85%, 83%, 90%, and 78%, respectively, and the output power required is 80 W.

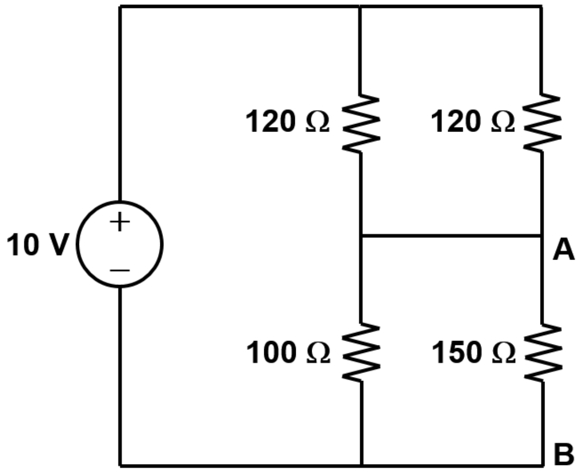
   (A) 5 batteries in series, 9 parallel branches

   (B) 5 batteries in series, 10 parallel branches

   (C) 4 batteries in series, 9 parallel branches

   (D) 4 batteries in series, 10 parallel branches

4.



The voltage difference V_{AB} (given by $V_A - V_B$) is

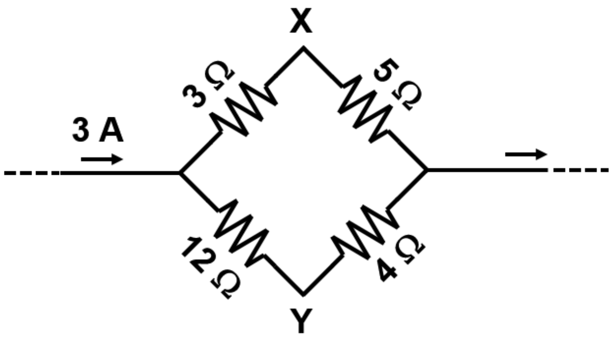
(A) 4.55 V

(B) 5.00 V

(C) 5.05 V

(D) 5.56 V

5.



A current of 3 A flows through a resistor network as shown in the figure above. The voltage difference V_{XY} (given by $V_X - V_Y$) is

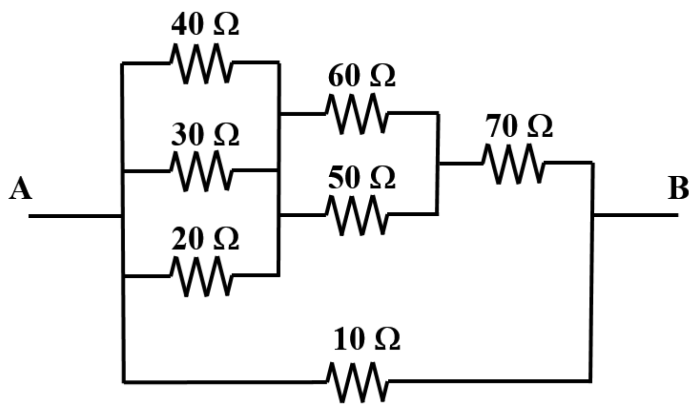
(A) –21.00 V

(B) –6.00 V

(C) 6.00 V

(D) 21.00 V

6.



For the resistor network shown in the figure above, what is the equivalent resistance R_{AB} between the terminals A and B?

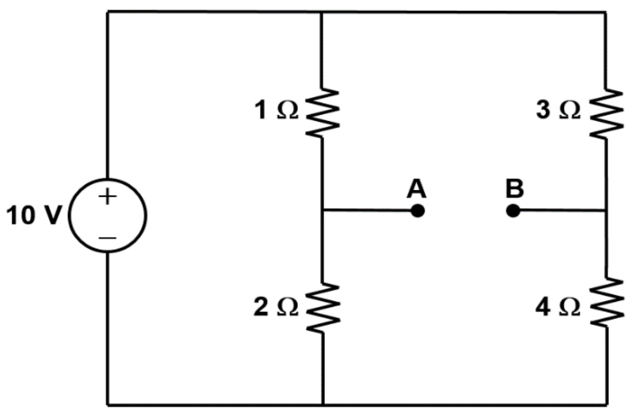
(A) 9.14 Ω

(B) 10.94 Ω

(C) 106.5 Ω

(D) 116.5 Ω

7.



What is the Thevenin resistance of the Thevenin equivalent circuit seen across nodes **A** and **B**?

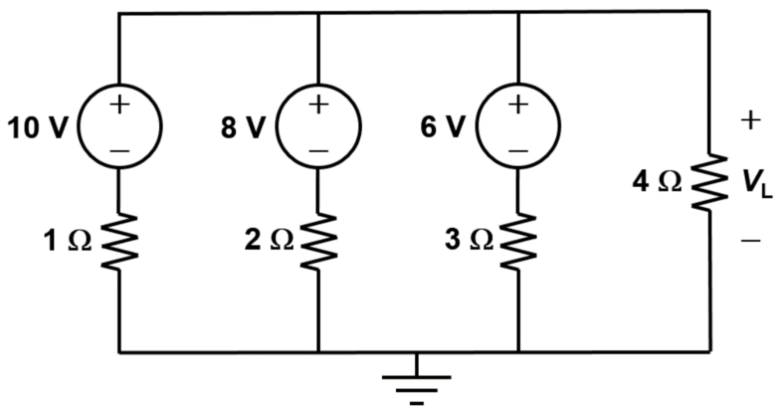
(A) 2.38 Ω

(B) 2.08 Ω

(C) 0.48 Ω

(D) 10 Ω

8.



For the circuit shown in the figure above, what is the voltage V_L?
(Hint: Use Node Voltage Analysis method)

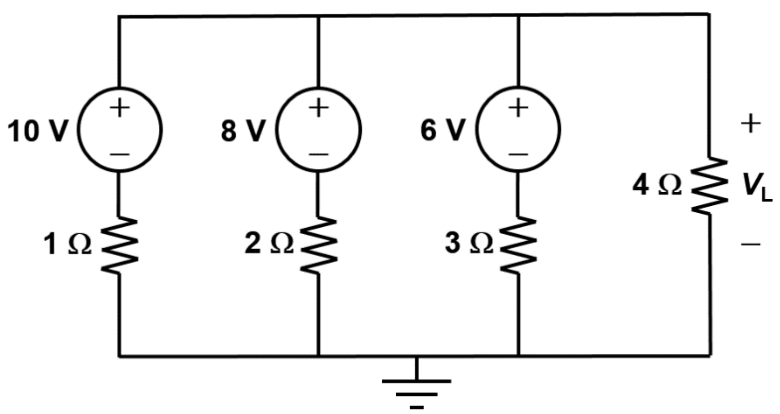
(A) 3.43 V

(B) 5.33 V

(C) 8 V

(D) 7.68 V

9.



For the circuit shown in the figure above, the 6 V voltage source is

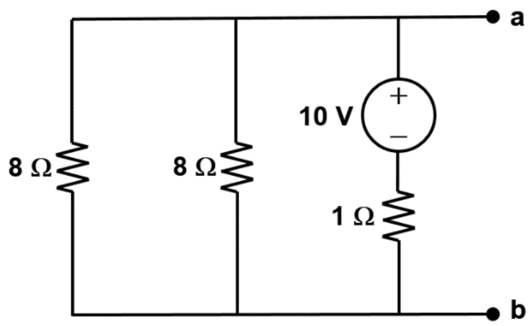
(A) not supplying, nor consuming power.

(B) supplying a power of 5.14 W.

(C) consuming a power of 3.36 W.

(D) consuming a power of 0.94 W.

10.



Suppose a load resistance R_L is to be placed across the nodes **a** and **b** in the circuit above, so as to draw maximum power. What is this maximum power that can be utilized by the load R_L?

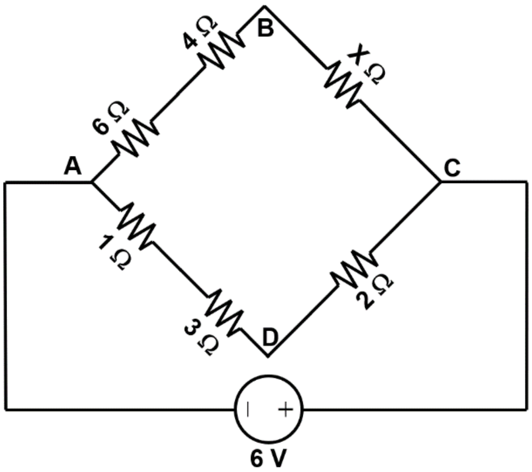
(A) 10 W

(B) 20 W

(C) 40 W

(D) 80 W

11.



For the circuit shown in the figure above, if the voltage difference V_{BD} (given by $V_B - V_D$) is 1 V, what is the value of resistance X?

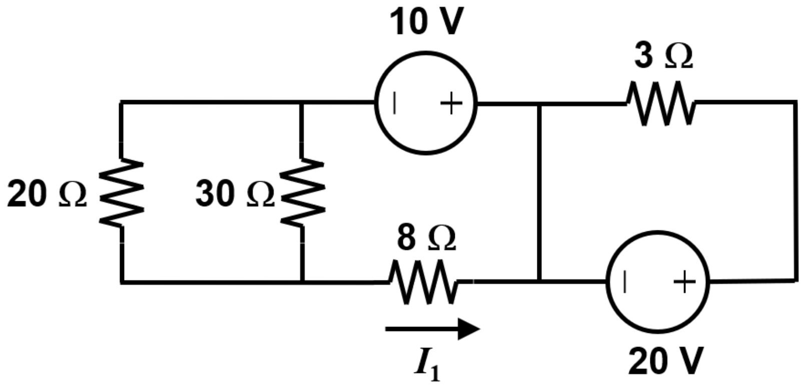
(A) 0.5 Ω

(B) 1 Ω

(C) 2 Ω

(D) 4 Ω

12.



For the circuit shown in the figure above, what is the value of current I_1?

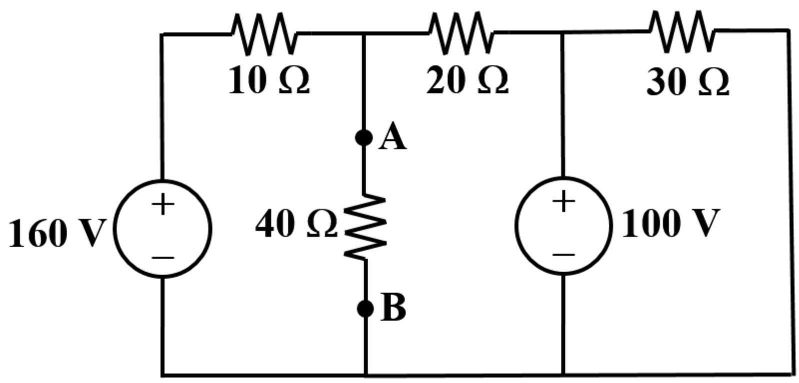
(A) 0.5 A

(B) –0.26 A

(C) 0.32 A

(D) –0.5 A

13.



For the circuit shown in the figure above, what is the Thevenin equivalent circuit as seen by the 40 Ω resistor (i.e., between nodes A and B)?

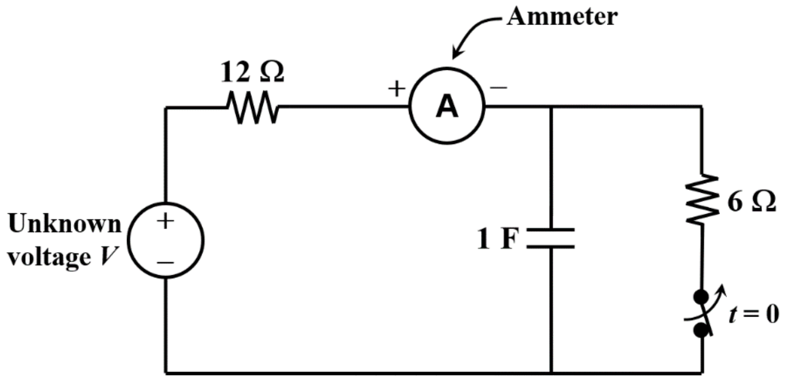
(A) V_T = 120 V, R_T = 6.67 Ω

(B) V_T = 140 V, R_T = 6.67 Ω

(C) V_T = 120 V, R_T = 5.45 Ω

(D) V_T = 140 V, R_T = 5.45 Ω

14.



For the circuit shown in the figure above, the switch has been closed for a long time, and the current measured by the ammeter was 1 A before time $t = 0$. At time $t = 0$, the switch is opened. What would be the current reading on the ammeter at time $t = 0^+$ s?

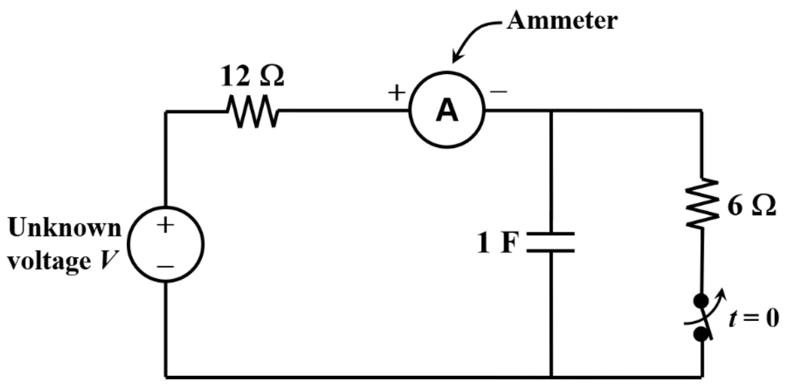
(A) Very large current

(B) 1.5 A

(C) 1 A

(D) 0.5 A

15.



For the circuit shown in the figure above, the switch has been closed for a long time, and the current measured by the ammeter was 1 A before time $t = 0$. At time $t = 0$, the switch is opened. What would be the current reading on the ammeter at time $t = 12$ s?

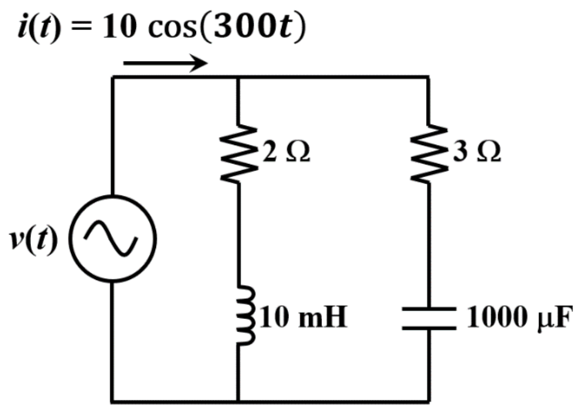
(A) 0.37 A

(B) 0.55 A

(C) 0.87 A

(D) 1.18 A

16.



In the circuit shown in the figure above, the voltage $v(t)$ is

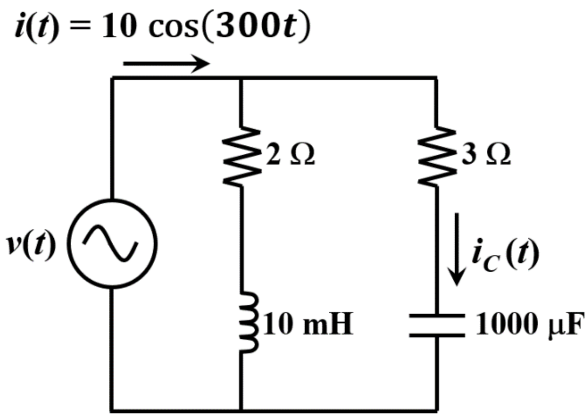
(A) 12.3 cos(300t + 38.1°) V

(B) 44.8 cos(300t – 48.0°) V

(C) 36.1 cos(300t + 56.3°) V

(D) 32.3 cos(300t + 12.1°) V

17.



In the circuit shown in the figure above, the current $i_C(t)$ is

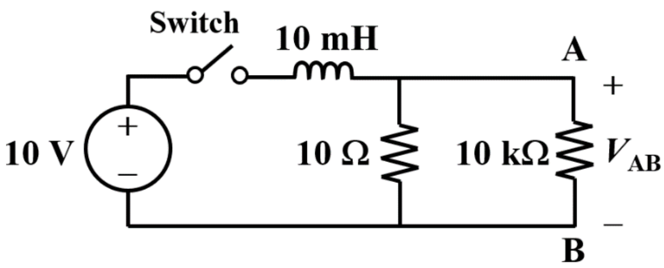
(A) 7.2 cos(300t + 60.1°) A

(B) 7.2 cos(300t – 60.1°) A

(C) 8.9 cos(300t – 44.2°) A

(D) 8.9 cos(300t + 44.2°) A

18.



In the circuit shown in the figure above, the switch was initially OPEN for a long time. At time t = 0, the switch is closed. What is the voltage V_{AB} at time $t = 0^+$ (i.e., immediately after the switch is closed)?

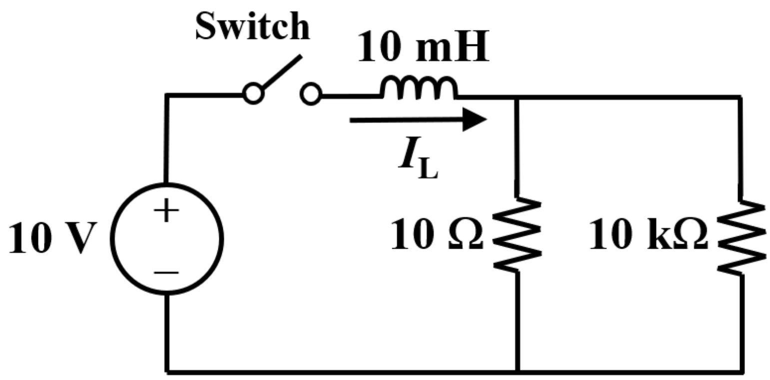
(A) 10.00 V

(B) 9.99 V

(C) 0.01 V

(D) 0 V

19.



In the circuit shown in the figure above, the switch was initially OPEN for a long time. At time t = 0, the switch is closed. What is the inductor current I_L at time t = 1 ms?

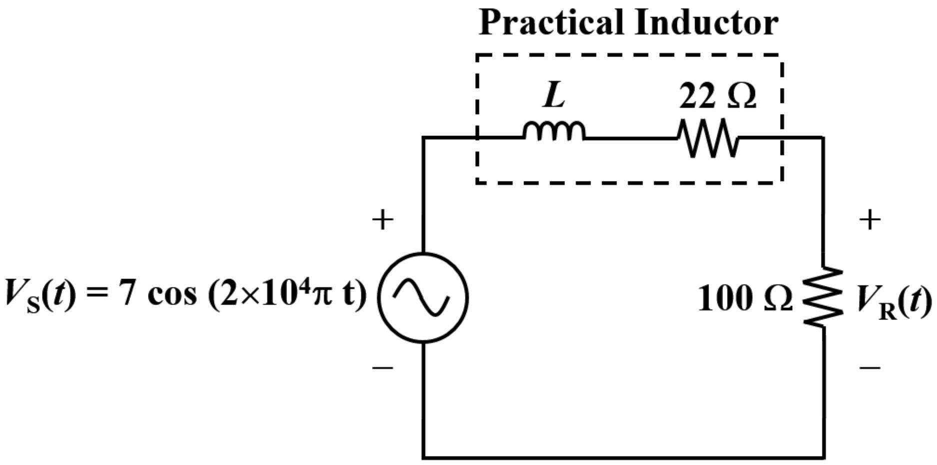
(A) 0.368 A

(B) 0.632 A

(C) 1.001 A

(D) 0.001 A

20.



In the circuit shown in the figure above, a 100 Ω resistor is connected in series with a practical inductor. The practical inductor has a resistance of 22 Ω, and an unknown inductance L. Suppose the phase angle of the voltage V_R(t) is found to be –67° with respect to the source voltage V_S(t), the inductance L can be obtained as:

(A) 0.825 mH

(B) 3.75 mH

(C) 4.57 mH

(D) 5.88 mH

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