NATIONAL UNIVERSITY OF SINGAPORE

EXAMINATION FOR

(Semester II: 2012/2013)

CG1108 – ELECTRICAL ENGINEERING

April / May 2013 - Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. This paper contains **FOUR (4)** questions and comprises **FIVE (5)** printed pages.
2. All questions are compulsory. Answer **ALL** questions.
3. This is a **CLOSED BOOK** examination.
4. Programmable calculators are not allowed.

SECTION-A: ANSWER ALL QUESTIONS IN THIS SECTION

Q.1 (a) Use **Mesh Current Analysis** method to find voltage V_{AB} in Fig. Q.1.a.

(10 marks)

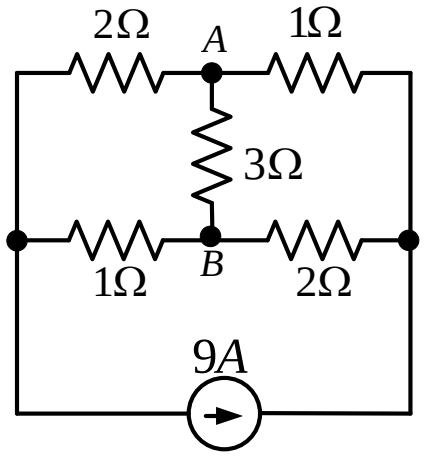

Fig. Q.1.a

(b) Use **Node Voltage Analysis** to find the current (i) drawn from the battery in circuit given in Fig. Q.1.b.

How much **power** is delivered (or absorbed) by the current source?

(10 marks)

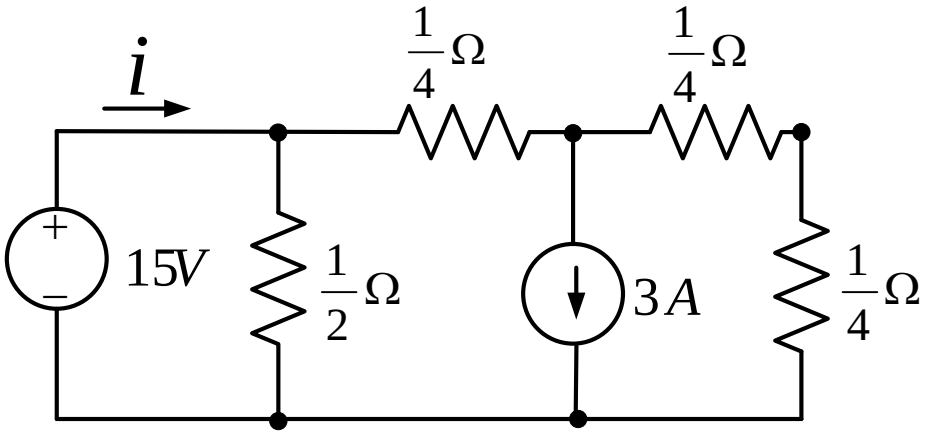

Fig. Q.1.b

Qn.1 is continued on Page3

(c) In circuit shown in Fig. Q.1.c, find the output voltage v_o using **Superposition principle**.

(10 marks)

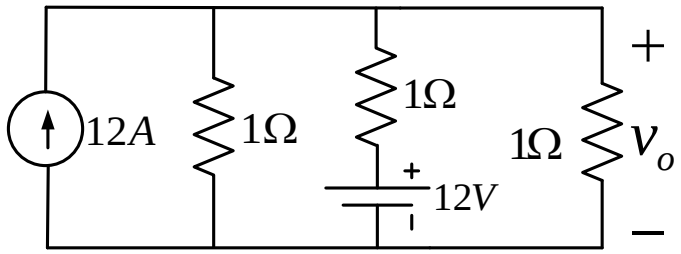

Fig. Q.1.c

(d) In circuit shown in Fig. Q.1.d, find the **Norton's equivalent** between *a* and *b*. Find the **maximum power** that can be drawn from the circuit by the load resistance, R_L.

(10 marks)

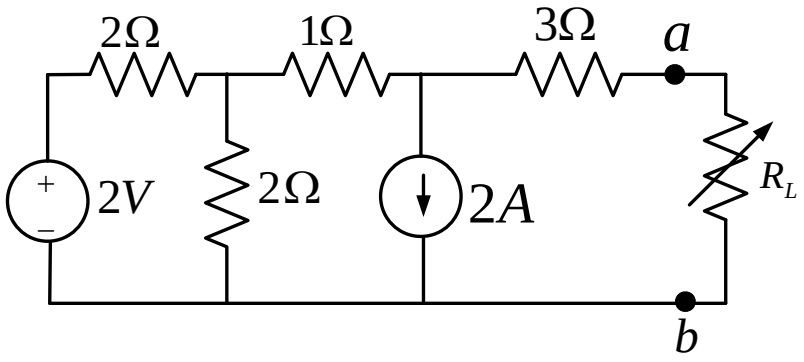

Fig. Q.1.d

(e) In circuit shown in Fig. Q.1.e, the current source is AC sinusoidal $i_s(t) = 10\cos 2t$ A. Find the **power dissipated** by the resistor.

(10 marks)

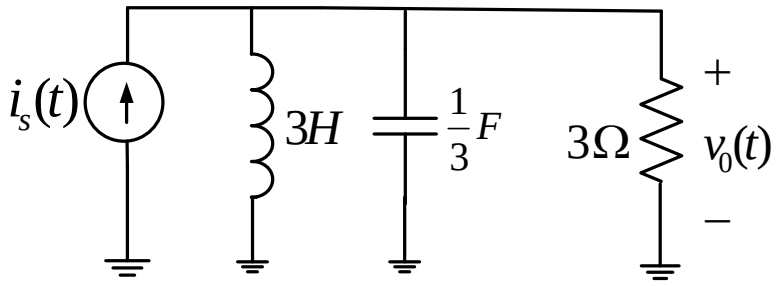

Fig. Q.1.e

SECTION-B: ANSWER ALL QUESTIONS IN THIS SECTION

Q.2 The circuit in Figure Q.2 is that of a burglar alarm. The alarm itself is modeled by a $1k\Omega$ resistor. The alarm will not sound until the current in it exceeds $100\mu A$. Find the **delay** between switch being closed and the alarm sounding. Assume the capacitor to be initially discharged.

(15 marks)

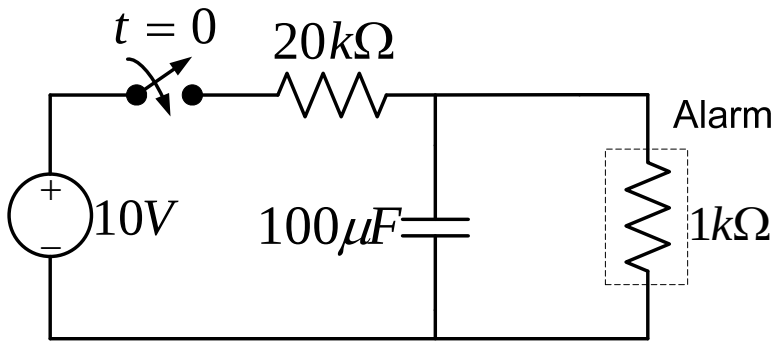

Fig. Q.2

Q.3 As shown in Figure Q.3, an AC sinusoidal voltage source is supplying two loads through a step-down ideal transformer. Load-1 is of 110W with a *lagging power factor* of 0.5. Load-2 is of 55W with a *leading power factor* of 0.86.

Find the **current** I_p if there is no capacitor connected to the primary side.

Find the value of the **capacitor** C to be connected at the primary of the transformer so that the source current I_P is in phase with the source voltage.

Draw a **phasor diagram** of the source voltage, primary current, capacitor current and the load currents, after capacitor is connected.

(20 marks)

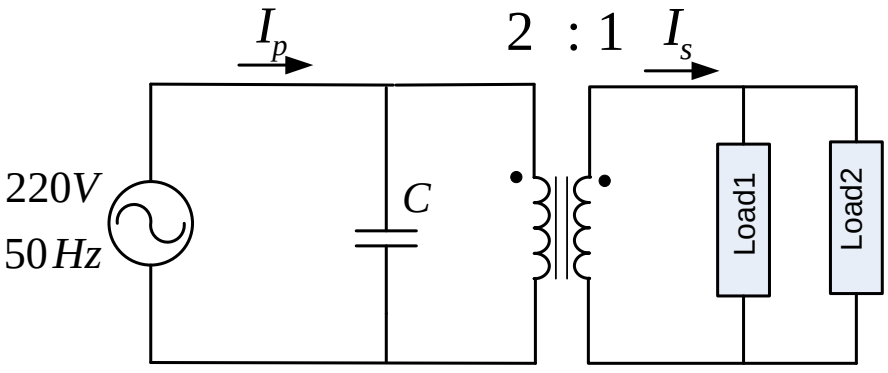

Fig. Q.3

Q.4 The magnetic circuit given in Figure Q.4 is made of sheet steel, except for the air gap between *de*. Find the inductance of the coil. Ignore the flux fringing effect.

Given,

$l_{ab} = l_{bg} = l_{gh} = l_{ha} = 0.2\,\text{m}$

$l_{bc} = l_{fg} = 0.1\,\text{m}$

$l_{cd} = l_{ef} = 0.099\,\text{m}$

$\mu_0 = 4\pi \times 10^{-7}$ H/m

μ_r (sheet steel) = 4000

(15 marks)

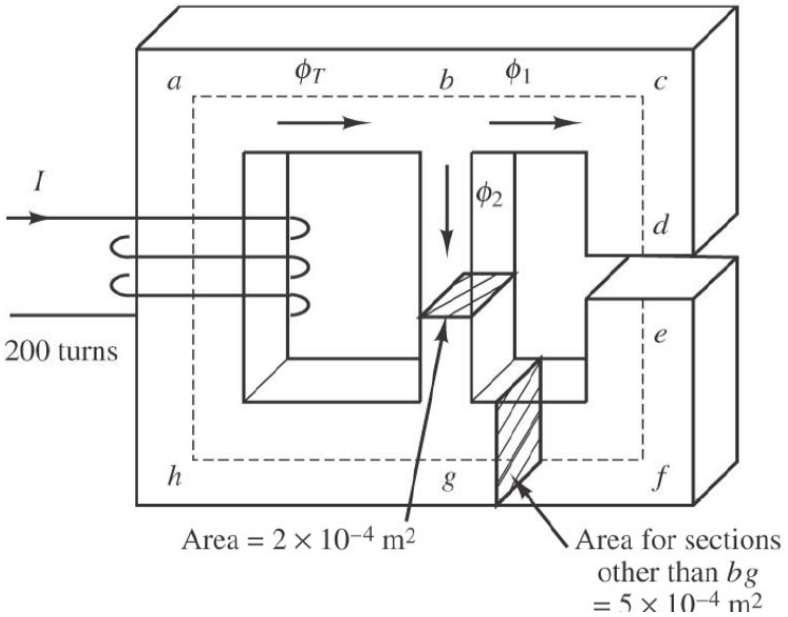

Fig. Q.4

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