107 學年第二學期 普通物理 B 第二次段考試題

[Wolfson Ch. 25-28] 2019/05/07, ***8:20am – 09:50am***

B

(i)答案卷第一張正面為封面。第一張正、反兩面**不要寫任何答案。**

(ii)依空格號碼順序在第二張**正面**寫下所有填充題答案，不要寫計算過程。

(iii)依計算題之題號順序在第二張**反面**以後寫下演算過程與答案，**每題從新的一頁寫起**。

(iv)根據題目給的參數，**注意答案有效數位。(Please express your answer in significant figures.)**

Constants: $g = 9.81\ m/s^2$; $\mu_o = 4\pi \times 10^{-7}\ N/A^2$

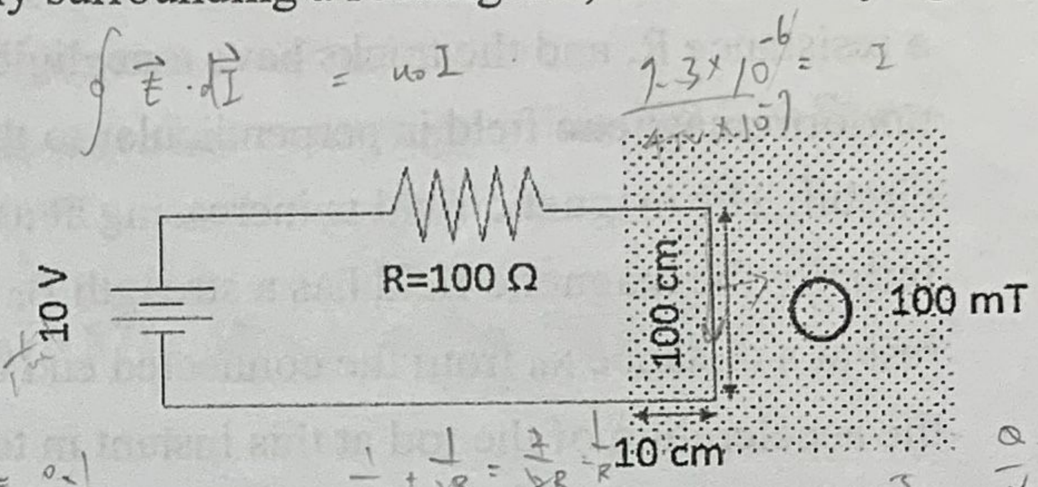
Part I. Filling the blank (5 points per blank)

• Consider a driven RLC circuit with R = 8 Ohm, L = 2.2 mH, and C = 11.5 μF. What is the impedance Z of the circuit when the circuit is driven at the frequency ω = 2π*618 Hz? Z = 【1】 Ohm.

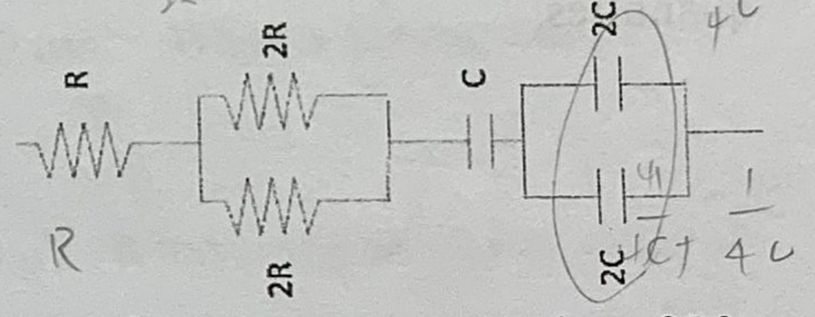
• A power plant generates a power of 1.5×10^5 W for a neighboring town with a connecting transmission line of 10 mΩ resistance, Operated at 110 V, the energy losses account for **[2a]** W, while operated at 24 kV the losses are **[2b]** W

• The line integral of the magnetic field along a closed path entirely surrounding a rectangular, current carrying cable is 7.3 μTm. A current of **[3]** A is flowing through the cable.

• The following circuit with a current flowing is partially located in a magnetic field of 100 mT with the field showing out of the plan. The total force on the circuit is **[4]**N. (including direction)



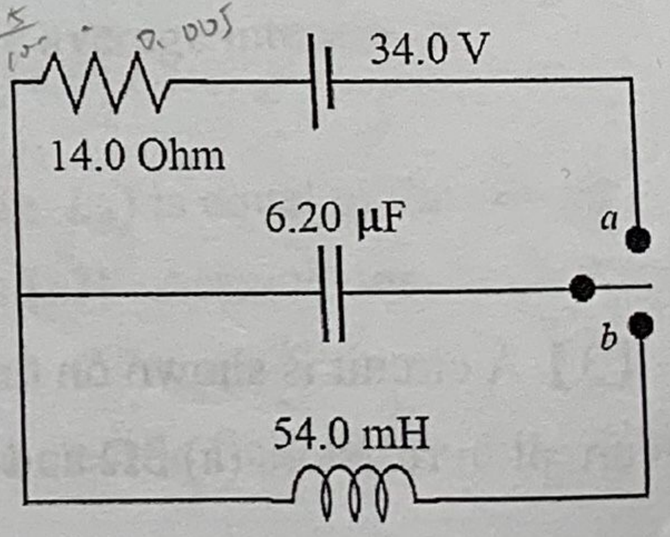
• The right diagram shows a network of resistances and capacitances. The total resistance is **[5a]** R and the total capacitance **[5b]** C.



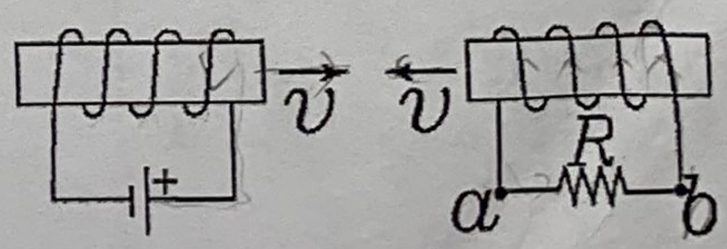
• You bought a new HTC U12 mobile phone. The battery is specified with a maximum storage capacity of 39 kJ. The processor operates at 3 V. When playing videos, the maximum watching time is 8 h. The current flowing is **[6]** A.

• A current of I = 100 A is flowing through a conducting rod of 20 cm length, 2.0 mm diameter, and a weight of 100 g. The rod is placed horizontally inside a magnet field. How large must be the magnetic field strength to balance the weight of the rod? **[7]**T.

• In the circuit shown at right, the switch has been in position a for a long time. It is now thrown to position b, resulting in an oscillating current $I_0 \sin(\omega t)$. (a) What is the frequency of the oscillating current? $\omega = 2\pi$*【8】Hz. (b) What is the amplitude of the oscillating current? I_0 = 【9】 A.



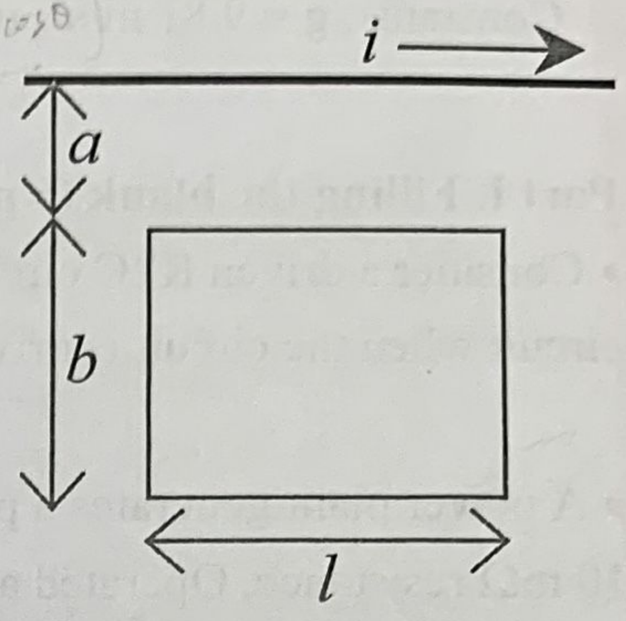
• In right figure two solenoids are approaching each other with a speed v. The induced current through the resistor R is (A) from a to b, (B) from b to a, (C) There is no induced current through the resistor. Statement **[10]** is correct.



• At a given instance the current and the induced emf in an inductor are 25 kA/s and 10 V, respectively. What is the value of inductance? L = 【11】 H.

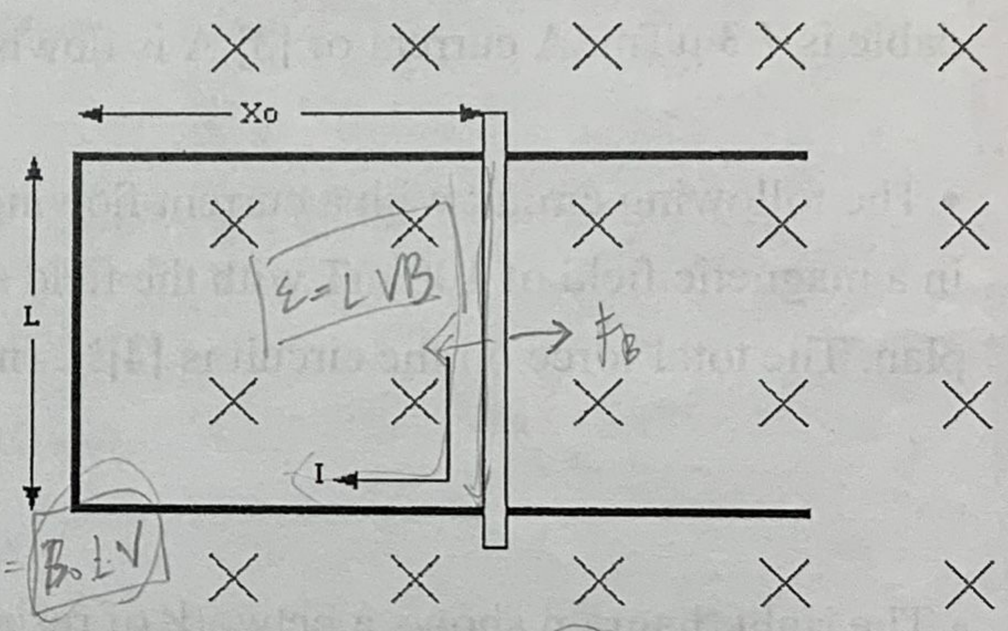
• Three-phase ac electricity is used worldwide, each phase is 120 degrees out of phase with one another. If you use a commercial multimeter to measure the *rms* value of the single phase voltage. You may find a value of 120 V. (a) If you measure the single phase voltage with an oscilloscope instead, you will find oscillation amplitude V_0 = 【12】 Volt. (b) If you use a multimeter to measure the voltage difference between two phase voltages, you will find the value to be ΔV = 【13】 Volt.

• The right figure shows a rectangular loop positioned near a very long wire carrying current i. Please calculate the mutual inductance of the coil-wire combination. M = 【14】.



Part II Problems (10 points per problem)

【1】 A metal rod of length L and mass m is free to slide, without friction, on two parallel metal tracks. The tracks are connected at one end so that they and the rod form a closed circuit, see figure below. The rod has a resistance R, and the tracks have a negligible resistance. A uniform magnetic field is perpendicular to the plane of this circuit. The magnetic field is increasing at a constant rate *dB/dt*. Initially the magnetic field has a strength B_0 and the rod is at rest at a distance x_0 from the connected end of the rails. Express the acceleration of the rod at this instant in terms of the given quantities.



【2】 A charged particle (Q=100μC) travels at a speed of $\vec{v} = 3.0\hat{\imath} + 4.5\hat{\jmath}$ m/s through a magnetic field $\vec{B} = 7.3\hat{\imath} + 5.4\hat{k}$ T. a) Determine the magnetic force acting on the particle. b) Calculate the dot products $\vec{F} \bullet \vec{v}$ and $\vec{F} \bullet \vec{B}$!

【3】 A circuit is shown on the right. Find the magnitude and direction of the current in resistors (a) 3Ω and (b) 8 Ω, respectively.