Unit 19 · Alternating Current

WORKSHEET

Full marks 33

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 33

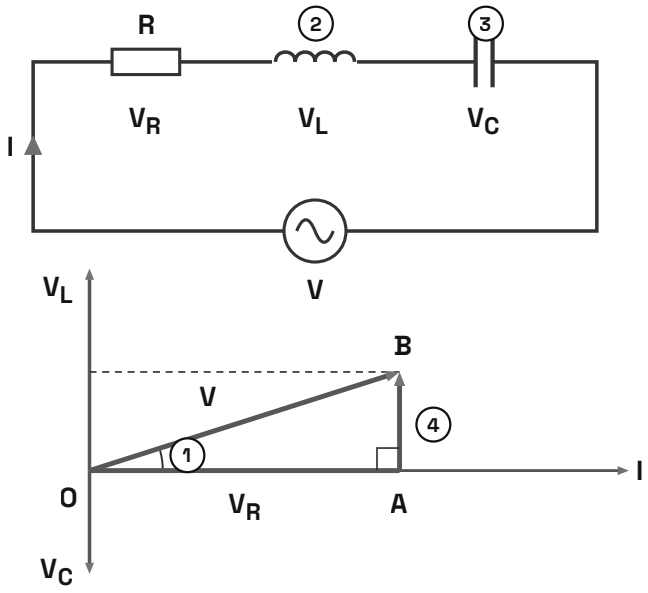
1 Key words [3]

Match each term in Column A with its meaning in Column B. One item in Column B is not needed. Each pair carries 0.5 mark.

Column A		Column B
1. rms value	☐	**a.** $\cos\varphi$, the ratio of the real power to $V_{rms}I_{rms}$
2. reactance	☐	**b.** the total opposition of a circuit to a.c., $\sqrt{R^2 + (X_L - X_C)^2}$
3. impedance	☐	**c.** the state of an LCR circuit when $X_L = X_C$ and the current is greatest
4. resonance	☐	**d.** the largest value the current reaches in a cycle
5. power factor	☐	**e.** the opposition of a pure inductor or capacitor to a.c., in ohms
6. wattless current	☐	**f.** the steady current that would heat a resistor at the same rate
		g. a current 90° out of phase with the voltage, using no power on average

2 Label the diagram [2]

The diagram shows an LCR series circuit and its phasor diagram. Write the label that belongs in place of 1 to 4. Each carries 0.5 mark.



1. _____ **2.** _____

3. _____ **4.** _____

3 Multiple choice [5]

Choose the correct option for each of the following questions.

i. An alternating voltage is $V = 170\sin 120\pi t$ volts. Its rms value and frequency are: [1]

a. 170 V and 60 Hz
b. 120 V and 60 Hz
c. 120 V and 120 Hz
d. 108 V and 60 Hz

ii. The reactance of a pure inductor of 0.5 H on a 50 Hz supply is about: [1]

a. 25 Ω
b. 100 Ω
c. 157 Ω
d. 0.0064 Ω

iii. The reactance of a 5 μF capacitor on a 50 Hz supply is about: [1]

a. 637 Ω
b. 1.6×10^{-3} Ω
c. 250 Ω
d. 3180 Ω

iv. A coil of 25 mH and a capacitor of 10 μF are in series. The circuit resonates at about: [1]

a. 2000 Hz
b. 318 Hz
c. 50 Hz
d. 100 Hz

v. In a circuit with a pure capacitor only, the current: [1]

a. is in phase with the voltage
b. leads the voltage by 90°
c. lags the voltage by 90°
d. leads the voltage by 180°

4 Short answers [6]

Write short answers to the following questions.

a. A capacitor blocks a steady d.c. but lets a.c. through. Explain, using its reactance. [2]

b. A pure inductor on an a.c. supply carries a current, yet it uses no power on average. Why? [2]

c. An a.c. ammeter reads rms values, not the average of the current over a cycle. Why? [2]

Science Playground, Katunje, Bhaktapur
https://science-playground.com/learn/grade-12-physics/alternating-current

5 Long answer [4]

Write a long answer to the following question.

A resistor R, an inductor L and a capacitor C are in series across an a.c. supply of rms voltage V. Draw a phasor diagram for the circuit, taking $X_L > X_C$, and use it to find its impedance and the phase angle between the voltage and the current.

6 Numerical problems [10]

Solve the following problems. Show your working.

a. A 40 Ω resistor and a 50 μF capacitor are in series across a 230 V, 50 Hz supply. Find i. the capacitor's reactance, ii. the impedance, iii. the current, and iv. the power used. [4]

Answer:

b. A coil of 0.20 H, a capacitor of 5.0 μF and a resistor of 25 Ω are in series across a 10 V rms supply whose frequency can be changed. Find the resonant frequency, the current at resonance and the quality factor. [3]

Answer:

c. A heater of resistance 60 Ω is joined to the 230 V (rms) mains. Find the rms current, the peak current, and the power of the heater. **[3]**

Answer: _____

7 Think **[3]**

A lamp is joined in series first with a capacitor, then with a coil of almost no resistance, on an a.c. supply whose voltage stays the same but whose frequency Anusha can raise. What happens to the lamp's brightness in each case as she raises the frequency? What happens to each on a d.c. supply?

8 Activity: Telling a.c. from d.c. with two LEDs (Activity 19.1) (not marked)

Join a red and a green LED side by side, opposite ways round, in series with a 330 Ω resistor. Try them on a 4.5 V battery and on a low-voltage a.c. supply (never the mains). In a dim room, wave them quickly from side to side.

Supply	Which LEDs light	The streak when waved
Battery		
Battery, wires swapped		
Low-voltage a.c.		

What does the streak on a.c. tell you?