GOVERNMENT OF WESTERN AUSTRALIA

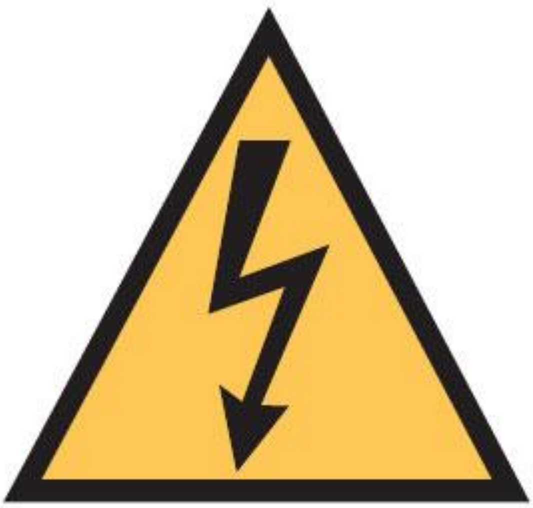
TAFE WA North Metropolitan

RTO Code: 52786

Portfolio of evidence

UEEEL0020 Part A

Solve problems in low voltage a.c. circuits



UEE Training Package Support Material

Based on:
National Electrotechnology Industry Standards

North Metropolitan TAFE
V1 July 2022

GOVERNMENT OF WESTERN AUSTRALIA | TAFE WA North Metropolitan

Assessment Task 3 Portfolio of Evidence

Qualification national code and title	UEE30820 Certificate III in Electrotechnology Electrician
Unit/s national code/s and title/s	UEEEL0020 - Solve problems in low voltage a.c. circuits

Student Name		**Assessment Type**	☐	Questioning (Oral / Written)
Student ID			☒	Portfolio
Lecturer Name		**Student Result (S/NYS)**		

By completing and submitting this signed form to my lecturer, I am stating that:

a. The attached submission is completely my own work
b. I have correctly cited all sources of information used in this work (if required)
c. I understand a copy of my assessment will be kept by the NMTAFE for their records
d. I understand my assessment may be selected for use in the NMTAFE's validation and audit process to ensure student assessment meets requirements

Student Signature		**Date**	

Assessment type (☑):

☐ Questioning (Oral/Written)
☐ Practical Demonstration
☐ 3rd Party Report
☒ Other – Project/Portfolio *(please specify)*

Assessment Resources:

Resources the assessor is to provide:

- Classroom setting as the venue.
- Test paper
- Graph paper

Resources the candidate is to provide:

- Black or Blue pen
- Pencil and eraser
- Scientific calculator (non-programmable)
- Maths drawing set
- AS/NZS 3000: current edition
- AS/NZS 3008.1.1 current edition
- WA Electrical Requirements current edition

Assessment Instructions:

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Qualification national code and title	UEE30820 Certificate III in Electrotechnology Electrician
Unit/s national code/s and title/s	UEEEL0020 - Solve problems in low voltage a.c. circuits

Task description:

The following Portfolio Assessment relates to the knowledge requirements and performance evidence of the unit. Make sure you complete all questions and practical activities

- To be deemed ***Satisfactory*** you are required to achieve a mark of **100%**
- The following **Knowledge Assessment** is an open book assessment and does not need to be completed under supervision
- The following **Practical Activities** must be completed under supervision in a simulated workplace environment
- If ***Not Yet Satisfactory*** you will be required to re-attempt the **Knowledge Questions** that are marked ***not satisfactory*** and/or any **Practical Activity** marked as **Not Yet Satisfactory**

Student Instructions:

Ensure you have access to all the resources required for this assessment as described below.

1. Read the **Questions** section. If you are not clear about a question, ask your assessor for further information.
2. You may be able to complete the questions verbally. This would need to be negotiated with your assessor**.**
3. Your assessor will provide feedback on your answers, including any questions that may require a further response.
4. If you have specific needs that you would like considered during this assessment, please discuss this with your assessor to identify any possible reasonable adjustments **prior** to commencing the assessment.
5. All diagrams must be neat, labelled and in pencil.
6. All calculations and numerical answers must be shown correct to two decimal places and include both the unit of measurement and metric prefix if applicable.

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Complete all Knowledge Questions.

Question 1	Find the frequency of a waveform with a periodic time of		
Answer	**A**. 0.1 Second		**B**. 40 ms
	C. 2ms		**D**.1µs
	A		
	B		
	C		
	D		
Feedback			☐ Satisfactory ☐ Not satisfactory

Question 2	A sinewave has a maximum value of 400 V. Determine its: **a** peak-to-peak voltage **b** RMS voltage **c** average half cycle voltage **d** instantaneous voltage at 50°		
Answer	**A**		
	B		
	C		
	D		
Feedback			☐ Satisfactory ☐ Not satisfactory

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Question 3	A sinewave has an instantaneous voltage of 120 V at 30° into its cycle. Determine its: **a** maximum voltage **b** RMS voltage	
Answer	**A**	
	B	
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 4	Two sinewaves are in phase with each other. One has an RMS value of 230 V, the other has a maximum voltage of 25 V. What is the combined RMS voltage?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 5	If the sinewaves in Question 4 are 180° out of phase, what is the combined RMS voltage?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 6	In a series AC circuit with two components, the voltage drop across one component (V_1) is 40 V/30° and the voltage drop across the other component (V_2) is 100 V -∠60°. Use a phasor diagram to find the applied voltage and its phase angle.	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 7	If an angle has a cosine of 0.5, determine the sine and the tangent of that angle.	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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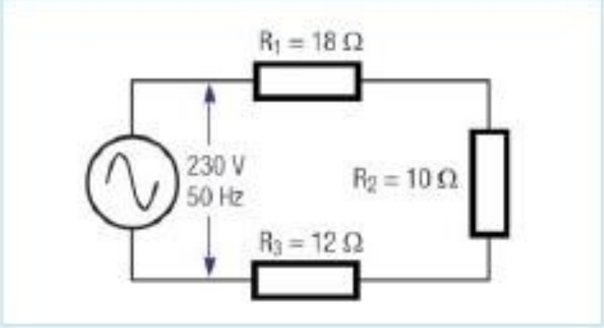
Question 8	For Figure **16.18,** calculate: **a** total power (P_T) taken by the circuit **b** power taken by each resistor. FIGURE 16.18 	
Answer	**A**	
	B	
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 9	A capacitor attached to a motor has a marked value of 100 μF, but when its capacitance is measured, the value shows as 36 μF. Calculate its capacitive reactance at 50 Hz for both capacitance values.	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 10	Calculate the current that would flow in a circuit containing a capacitor of the following values, when each is connected to a 230 V 50 Hz supply: **a** 2.2 μF **b** 56 μF **c** 0.01 μF		
Answer	**A**		
	B		
	C		
Feedback			☐ Satisfactory ☐ Not satisfactory

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Question 11	What value of capacitance is needed to give a current of 0.2 A when it is connected to a 230 V 50 Hz supply?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 12	At what frequency does a 3 nF capacitor have a capacitive reactance of 500 Ω?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 13	If the total capacitance of an AC circuit is increased, how does this affect the capacitive reactance of the circuit and the current flowing in the circuit?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 14	Determine the inductive reactance of a coil with an inductance of 620 mH at a frequency of 400 Hz.	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 15	What value of inductance has an inductive reactance of 60 Ω at a frequency of 1 kHz?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 16	At what frequency does a 100 mH coil have an inductive reactance of 100 Ω?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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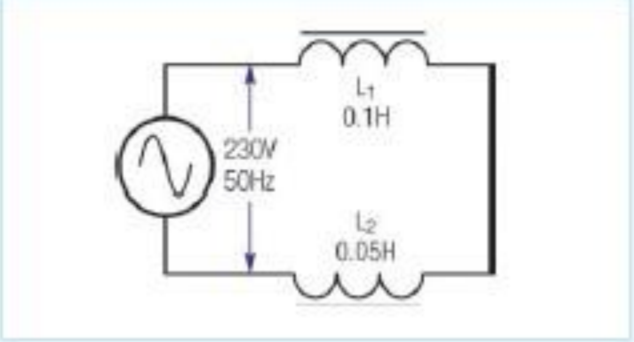
Question 17	Calculate the following from the circuit in Figure 16.19: **a** the total inductance **b** the total inductive reactance **c** the voltage drop across inductor L_1. **Include its phase relationship to the current in the inductor.** FIGURE 16.19 	
Answer	**A**	
	B	
	C	
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 18	**A.** Draw a phasor diagram showing the relationship between the applied voltage and current in a purely resistive AC circuit. **B**. Draw a phasor diagram showing the relationship between the applied voltage and current in a purely Inductive AC circuit. **C.** Draw a phasor diagram showing the relationship between the applied voltage and current in a purely capacitive AC circuit.		
Answer	**A**		
	B		
	C		
Feedback			☐ Satisfactory ☐ Not satisfactory

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Question 19	A large electrical contractor has a coil with an inductance of 0.3 H and a resistance of 20 ohms. It is connected to 230 V AC 50 Hz. Calculate the coil's: **a** inductive reactance **b** impedance **c** current **d** true consumption **(Note the inductance and resistance are represented in series in practical inductors)**	
Answer	**A**	
	B	
	C	
	D	
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 20	Calculate the phase angle (also identify if lead or lag) between the applied voltage and the current flowing in the coil of Question 19.	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 21	An old fluorescent light fitting has a ballast (coil) with an inductance of 1.1 H and a resistance of 36 ohms. Calculate its impedance at 50 Hz.	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 22	An AC circuit has three coils in series. Each coil has an inductance of 80 mH and a resistance of **10 Ω**. Calculate: **a** the total inductance **b** the impedance of the circuit at 50 Hz.		
Answer	**A**		
	B		
Feedback			☐ Satisfactory ☐ Not satisfactory

Question 23	A relay coil has an inductance of 160 mH and a resistance of 80 ohms. Calculate the: **a** coil's impedance at 50Hz **b** phase angle between current and voltage when the coil is connected to a 50 Hz supply.		
Answer	**A**		
	B		
Feedback			☐ Satisfactory ☐ Not satisfactory

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Question 24	A 3.3 μF capacitor is in series with a 1 kΩ resistor. Determine the impedance of the circuit at: **a** 50 Hz **b** 1 kHz.	
Answer	**A**	
	B	
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 25	Calculate the phase angle between applied voltage and current in the circuit in Question 24. Do this for both frequencies. (include leading or lagging)	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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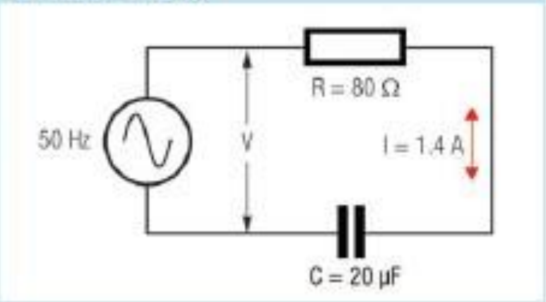
Question 26	The circuit in Figure 17.29 is connected to a 50 Hz AC supply **FIGURE 17.29**  Calculate the: **a** voltage drops across the resistor and the capacitor **b** applied voltage **c** the phase angle between current and the applied voltage.	
Answer	**A**	
	B	
	C	
Feedback		☐ Satisfactory ☐ Not satisfactory

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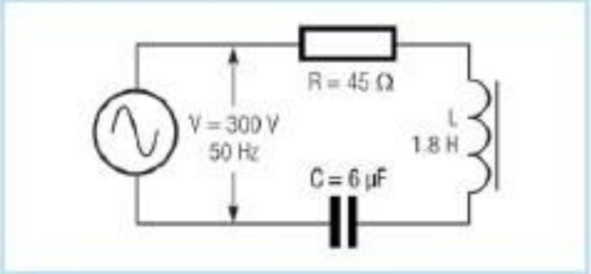
Question 27	Calculate the current flowing in the circuit in Figure 17.30. FIGURE 17.30  	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 28	A series RLC circuit has a capacitance of 1.8 μF, inductance of 80 mH and a total resistance of 16 Ω. Calculate the: **a** circuit's resonant frequency **b** impedance of the circuit at resonance		
Answer	**A**		
	B		
Feedback			☐ Satisfactory ☐ Not satisfactory

Question 29	A 230V AC 50Hz parallel circuit with many branches that have reactive components takes a total current of 36 A∠–22°(lag).What is the impedance of the circuit, and is it inductive or capacitive?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 30	A 0.35 H inductor with zero resistance and a 150 Ω resistor are in parallel with a 100 V 50 Hz supply. Calculate the: **a.** branch currents **b.** total current and its phase angle (Φ) to the applied voltage **c**. impedance of the circuit.	
Answer	**A**	
	B	
	C	
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 31	Using a phasor diagram solve the following; A 230 V electrical circuit has two branches, one carrying a current of 12 A at 25°lag, the other a current of 10 A at 50°lead. Determine the: **a.** total circuit current and its phase angle to the applied voltage **b.** Impedance of the circuit.	
Answer	**A**	
	B	
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 32	A 10 µF capacitor and a 500 Ω resistor are in parallel with a 100 V 50 Hz supply. Calculate the: **a.** branch currents **b.** total current and its phase difference to the applied voltage **c.** Impedance of the circuit.	
Answer	**A**	
	B	
	C	
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 33

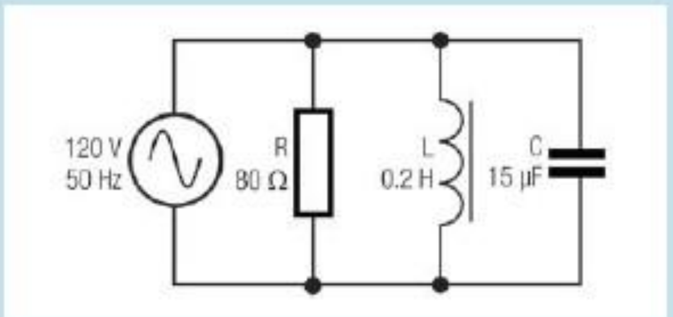
For the circuit in Figure 18.23, calculate the:

a. Value and phase angle of each branch current

b. Total circuit current and its phase angle to the applied voltage

c. Impedance of the circuit.

FIGURE 18.23



Answer	**A**	
	B	
	C	
Feedback		☐ Satisfactory ☐ Not satisfactory

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Question 34	Calculate the resonant frequency of the circuit in Figure 18.23. *(Assume the inductor and capacitor are ideal components.)*	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

Question 35	If the circuit in Figure 18.23 is operating at its resonant frequency, how much current is taken from the supply, and what is its phase angle?	
Answer		
Feedback		☐ Satisfactory ☐ Not satisfactory

END OF ASSESSMENT

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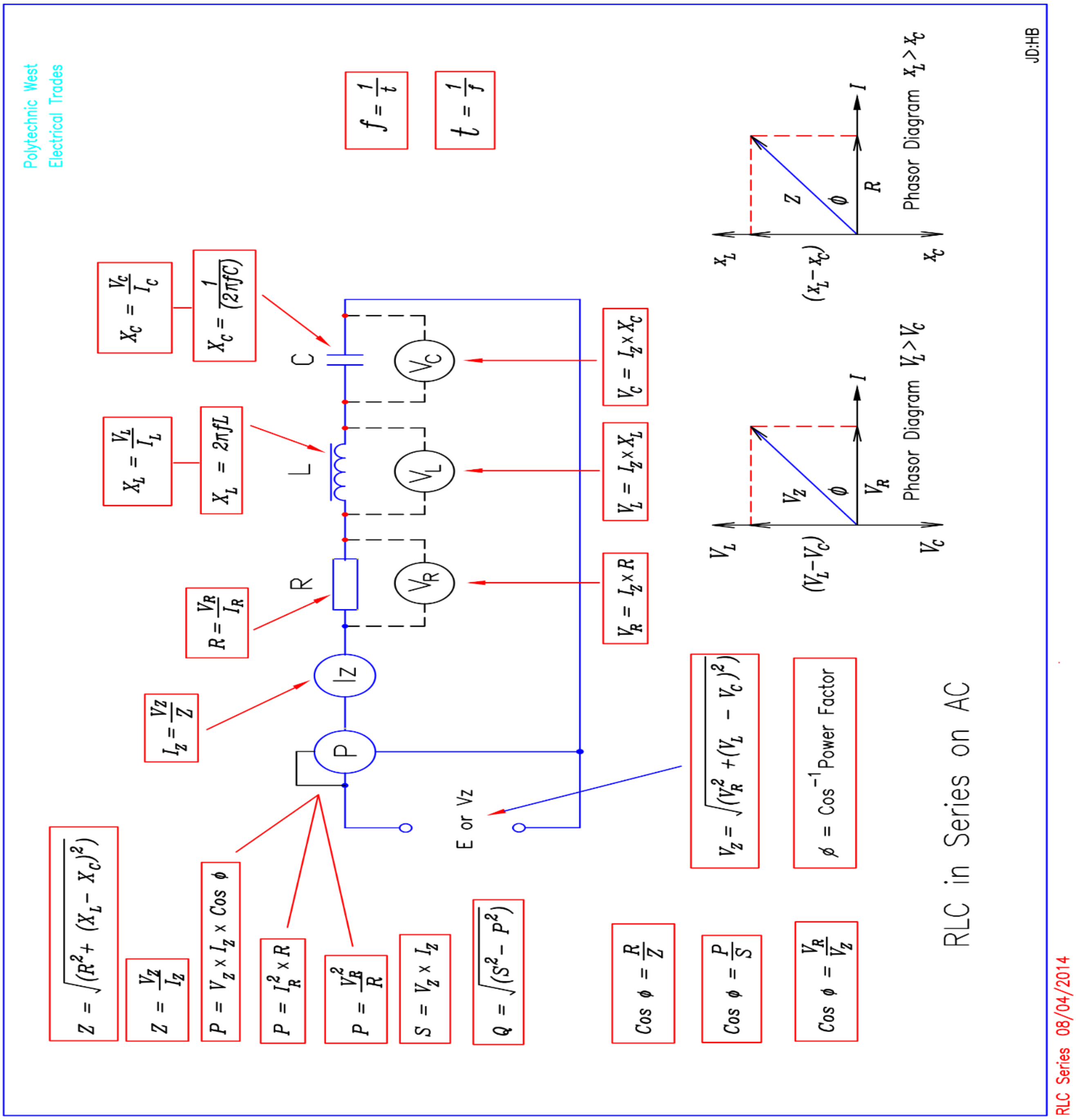

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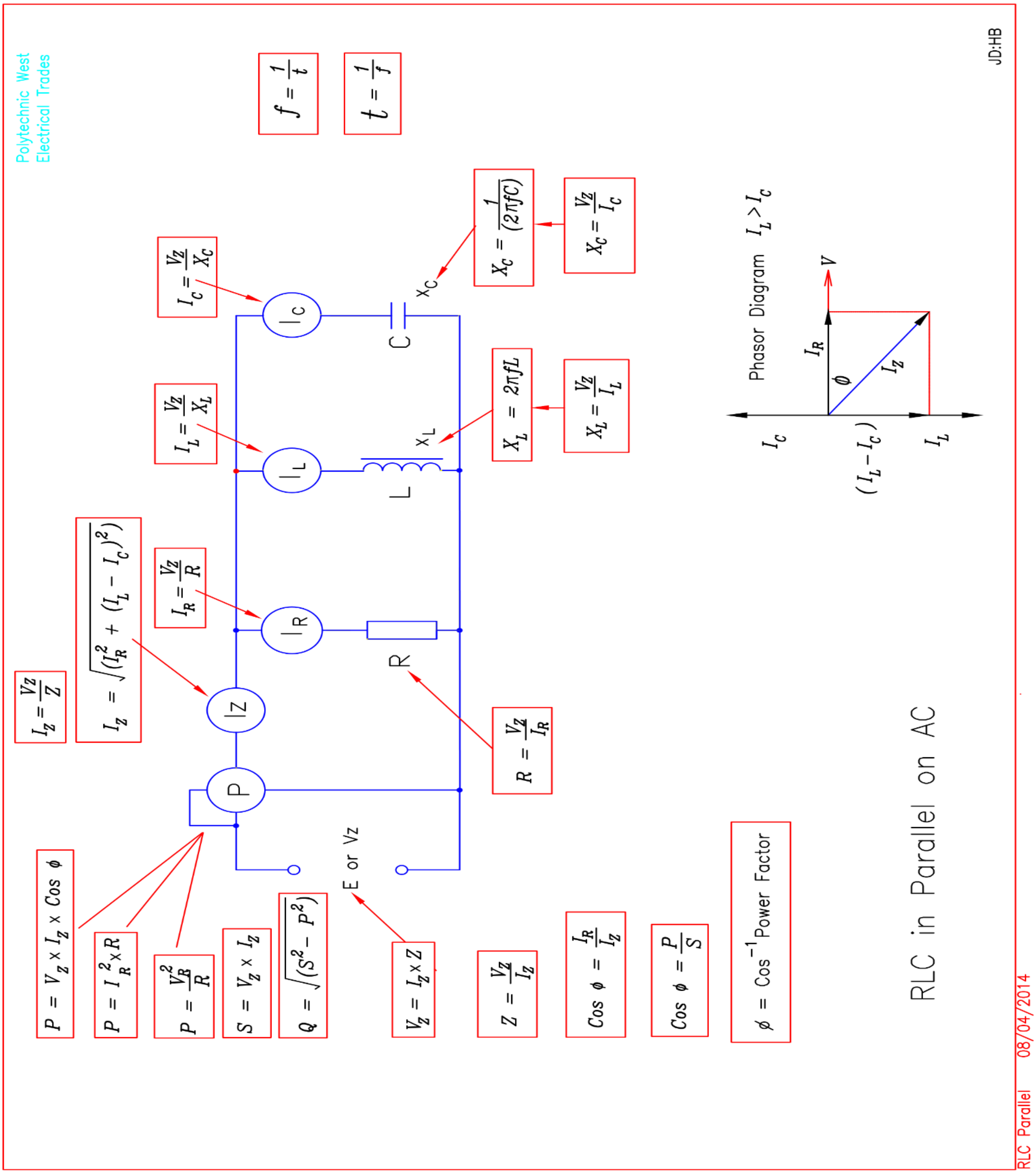


Practical Activities Overview

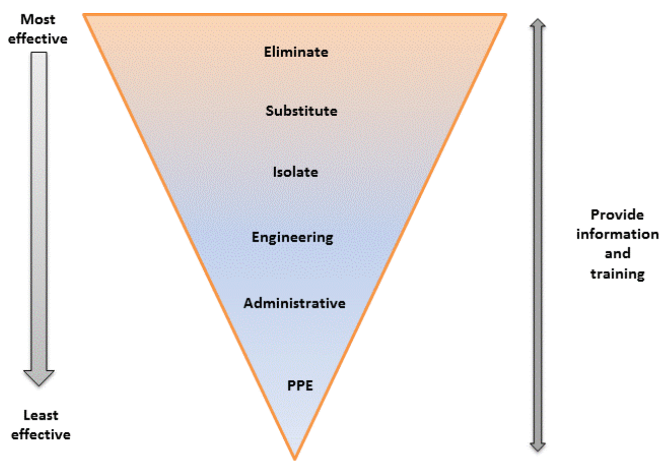
Assessment Task 3 Portfolio of Evidence

Qualification national code and title	UEE30820 Certificate III in Electrotechnology Electrician
Unit/s national code/s and title/s	UEEEL0020 - Solve problems in low voltage a.c. circuits

Risk assessment

		1	**2**	**3**	**4**	**5**
Consequence		**Rare** The event may occur in exceptional circumstances	**Unlikely** The event could occur sometimes	**Moderate** The event should occur sometimes	**Likely** The event will probably occur in most circumstances	**Almost Certain** The event is expected to occur in most circumstances
1	**Insignificant** No injuries or health issues	LOW	LOW	LOW	LOW	MODERATE
2	**Minor** First aid treatment	LOW	LOW	MODERATE	MODERATE	HIGH
3	**Moderate** Medical treatment, potential LTI	LOW	MODERATE	HIGH	HIGH	CRITICAL
4	**Major** Permanent disability or disease	LOW	MODERATE	HIGH	CRITICAL	CATASTROPHIC
5	**Extreme** Death	MODERATE	HIGH	CRITICAL	CATASTROPHIC	CATASTROPHIC

1. **Eliminate** – if it is possible, the hazard should be removed completely. For example, get rid of dangerous machines.
2. **Substitute** – replace something that produces the hazard with something that does not produce a hazard. For example, replacing solvent based paint with water based paint. Risk assessment on the substitution must be conducted to ensure that it will not pose another hazard.
3. **Engineering control** – isolate a person from the hazard by creating physical barrier or making changes to process, equipment or plant to reduce the hazard. For example, install ventilation systems.
4. **Administrative control** – change the way a person works by establishing policies and procedures to minimise the risks. For example, job scheduling to limit exposure and posting hazard signs.
5. Use **personal protective equipment** (PPE) – protect a person from the hazard by wearing PPE. For example, wearing gloves, safety glasses, hard hats and high-visibility clothing. PPE must be correctly fitted, used and maintained to provide protection.



Hierarchy of control

Assessment Task 3 Portfolio of Evidence

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Safe Work Method Statement

Revised Risk Rating							
Hazard Control Measures							
Risk Rating							
Hazards							
Task Steps							
Task Step #							

Student Signature……………………

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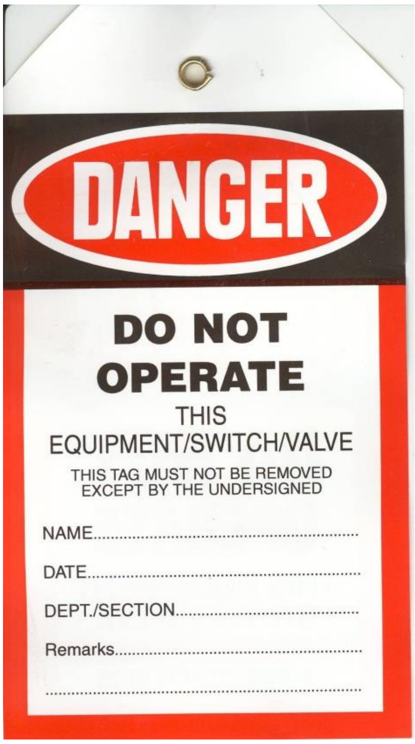
Danger Tag Procedure



Use of Danger Tags

If you have a practical task to do and there is a possibility that you could be injured if someone turns on the electricity, then you **MUST** fasten a red danger tag to the machine main isolation switch, circuit-breaker or the equipment plug top.

Each danger tag you use must clearly show; your name, your section (class) and the date.

Nobody must operate the danger tagged switch or control point until the job is made safe and the danger tag has been removed.

Your lecturer will check your task before you are allowed to remove your danger tag.

Only the person, who is named on the tag and attached the tag, is allowed to remove it.

Points to Watch

Make absolutely sure the switch/circuit-breaker/plug top is the correct one to tag. If you have any doubts, ask your lecturer.

Make sure that you have switched the isolator to **OFF** position before you attach your danger tag.

Fasten the danger tag securely.

The purpose of using Danger Tags is to prevent electrical accidents from happening.

Failure to follow Danger Tag Procedures when working on practical activities and practical assessments will result in a **not yet competent** comment recorded for this Unit of Competency – UEENEEG102A

Student's Signature _________________________ Date: _________________

Practical Activity 1

Qualification national code and title	UEE30820 Certificate III in Electrotechnology Electrician
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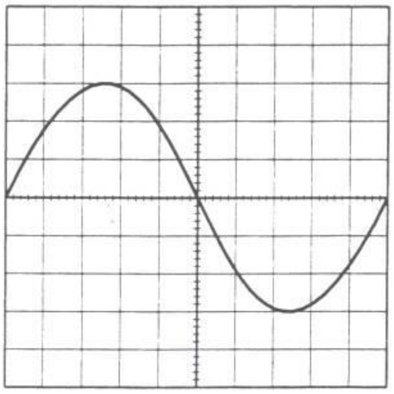
Question 1	Volts per Div: 100 V/DIV Sweep time per Div: 100 μs / DIV  From the information supplied, determine: (a)the peak value (b)the peak to peak value (c)the RMS value (d)the average value (e)the period of the wave (f)the frequency g)the instantaneous value after 40^0
c	

Practical Activity 2

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Qualification national code and title	UEE30820 Certificate III in Electrotechnology Electrician
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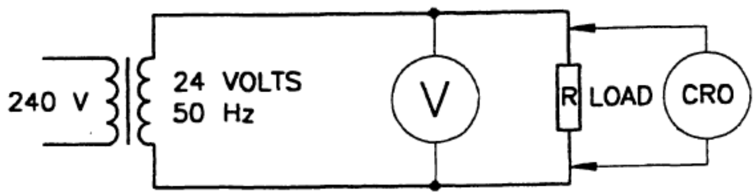
Objective

To verify the relationship between the peak value and the rms value of a sinusoidal a.c. waveform.

Equipment

RMS measurement project board
ELV a.c. power supply (24 volts or similar)
Oscilloscope (CRO)
Connecting leads
Multimeter

Circuit Diagram



Procedure

1. Connect the circuit according to the circuit diagram above.
2. Check for short circuits with a multimeter set on the ohms x 1 range. Switch the multimeter off after the check.
3. Have your connections checked by your Lecturer.
4. Energise the circuit, and determine the peak value and frequency of the waveform using the CRO. Accurately sketch the CRO display in the space provided below.
5. Measure the voltage across the load resistor with a multimeter and record the result.
6. Switch the circuit off and remove the plug from the outlet.
7. Have your results checked by your Lecturer.
8. Disconnect your wiring and return all of the equipment to its proper place.

Results

CRO Display

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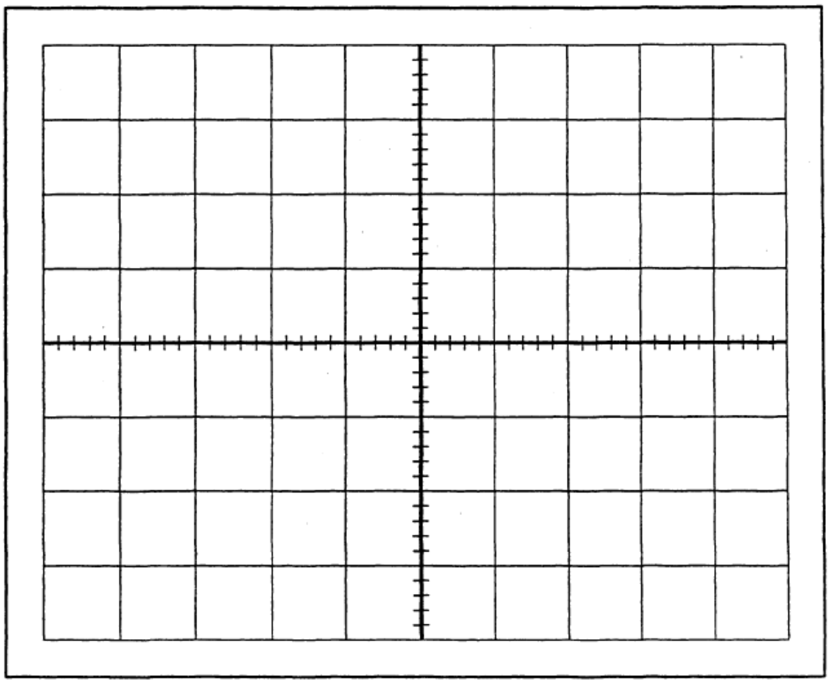

Time/div Setting: ____

Volts/div Setting: ____

Peak Voltage: ____

Peak to Peak Voltage: ____

Instantaneous Voltage at 30º: ________________________________

Calculated Frequency: ____________________________________Hz

Multimeter

Voltage Range: ____

Voltmeter Reading: ____

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Questions

1. Was the peak value indicated on the CRO the same as the value indicated on the multimeter? If not, explain why.

2. What is the theoretical rms value of a sinusoidal a.c. waveform which has a peak value of 100V?

   ___________________________ volts

3. What is the theoretical peak value of a sinusoidal a.c. waveform which has an rms value of 100V?

   __________________________ volts

4. What peak value of a.c. has the same heating effect as $100V_{dc}$?

5. If a typical multimeter indicated $240V_{ac}$ across the supply terminals of single phase single insulated appliance, what is the minimum voltage the appliance insulation must be able to withstand to earth in the circuit?

Practical Activity 3

Assessment Task 3 Portfolio of Evidence

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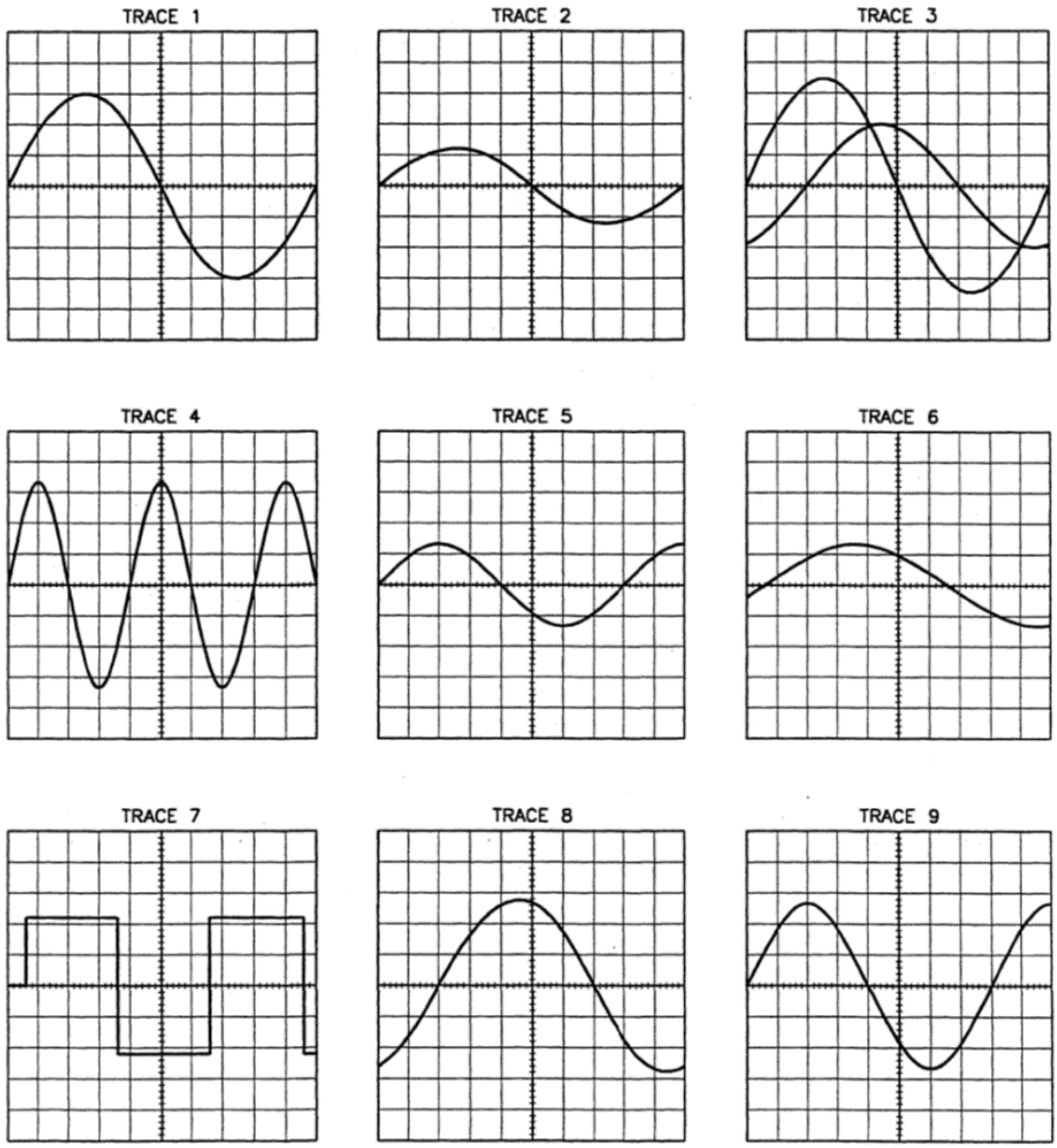
Unit/s national code/s and title/s	UEEEL0020 - Solve problems in low voltage a.c. circuits

Oscilloscope Displays



The Oscilloscope

1. **Refer to CRO Trace 1**
What PEAK VOLTAGE is indicated

7. **Refer to CRO Trace 7**
What is the FREQUENCY of the square

on the oscilloscope display
(in volts)?
Volts per Division: 100V
Time per Division: 100µs

2. **Refer to CRO Trace 2**

What PEAK VOLTAGE is indicated on the oscilloscope display (in volts)?

Volts per Division: 10mV
Time per Division: 10ms

3. **Refer to CRO Trace 3**

What is the FREQUENCY of the larger sine curve (in Hz)?

Volts per Division: 100V
Time per Division: 10ms

4. **Refer to CRO Trace 4**

What PEAK VOLTAGE is indicated on the oscilloscope display?

Volts per Division: 10V
Time per Division: 100µs

5. **Refer to CRO Trace 5**

What RMS VOLTAGE is indicated on the oscilloscope display?

Volts per Division: 10mV
Time per Division: 100ms

6. **Refer to CRO Trace 6**

What PEAK TO PEAK VOLTAGE is indicated on the CRO display (in volts)?

Volts per Division: 10mV
Time per Division: 10ms

wave on the CRO display (in Hz)?

Volts per Division: 100mV
Time per Division: 1ms

8. **Refer to CRO Trace 8**

What is the FREQUENCY of the sine wave displayed on the CRO (in Hz)?

Volts per Division: 1V
Time per Division: 100µs

9. **Refer to CRO Trace 9**

What is the PERIODIC TIME for the sine wave displayed on the CRO (in seconds)?

Volts per Division: 1V
Time per Division: 100ms

10. **Refer to CRO Trace 1**

What RMS VOLTAGE is indicated on the oscilloscope display?

Volts per Division: 1V
Time per Division: 1ms

11. **Refer to CRO Trace 3**

What is the phase difference between the two sine curves?

Volts per Division: 1V
Time per Division: 100µs

12. **Refer to CRO Trace 1**

What PEAK TO PEAK VOLTAGE is indicated on the CRO display (in volts)?

Volts per Division: 100V
Time per Division: 100ms

Answers to Oscilloscope Questions

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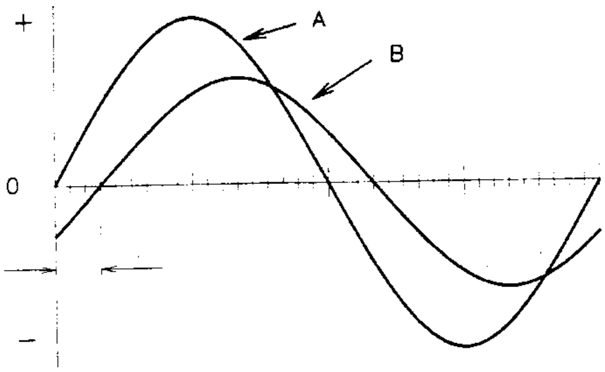
	Describe the phase relationship and determine the angle between the two AC sine waves shown below.  	
Answer		☐ Satisfactory ☐ Not satisfactory

Resistance in an A.C. Circuit

Objective

To verify the relationship between the values in a resistive a.c. circuit

Equipment

Resistive a.c. project board with 2 power resistors

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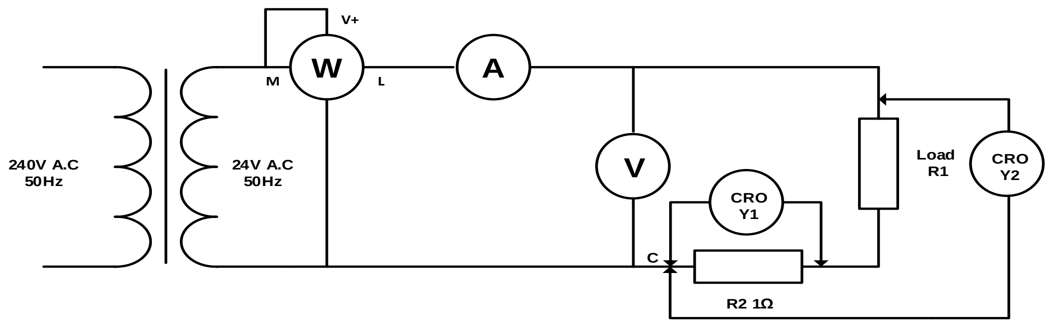
1 ohm wire wound series resistor
0 – 1 KW single phase analogue wattmeter
Dual Trace Oscilloscope (CRO)
Bridge Megger
Ammeters and voltmeters as required
Multimeter
ELV a.c. power supply – 24 volts or similar (double wound transformer)
Connecting leads

Circuit Diagram



Procedure

1. Measure the resistance of R1 using the Bridge Megger. Record the resistance in Results Table 1.

2. Determine the nominal voltage of the extra-low voltage a.c. power supply by inspection of the nameplate.

3. Calculate the expected values of current and power in the circuit, and record your results in Table 1.

4. Connect the components as shown in the circuit diagram above. Make sure that the ranges of the instruments selected are appropriate for the expected circuit values.

5. Connect one channel of the CRO across the output from the ELV supply, and the other in parallel with the 1Ω series resistor. **Make sure that the common terminal is connected as shown in the circuit diagram.**

6. Have your connections checked by your Lecturer.

7. Energise the circuit and adjust the CRO to display at least one cycle on each channel. Record all readings in the Results Table; the readings need to be as accurate as possible.

8. Determine the peak voltage indicated on the CRO. Accurately sketch the CRO display in the space provided below.

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9. Compare the readings obtained with the values previously calculated.

10. Switch the circuit off, and remove the plug from the outlet.

11. Have your results checked by your Lecturer.

12. Repeat the procedure using the other load resistor on the project board.

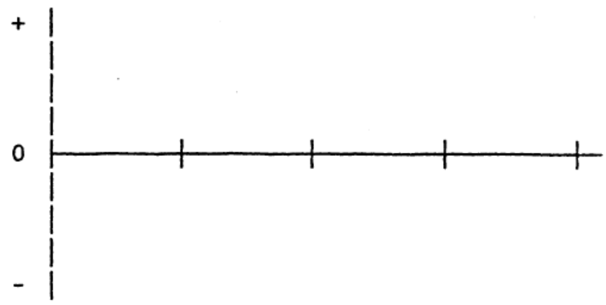
13. Disconnect your wiring and return all of the equipment to its proper place.

Results Table 1 (Resistor 1)

	Observed or Calculated	Measured	Comment
Resistance			
Applied Voltage			
Line Current			
Power			

Observed phase angle between voltage and current ____________________degrees

Sketch of phase Relationship (1 cycle):



Results Table 2 (Resistor 2)

	Observed or Calculated	Measured	Comment
Resistance			
Applied Voltage			

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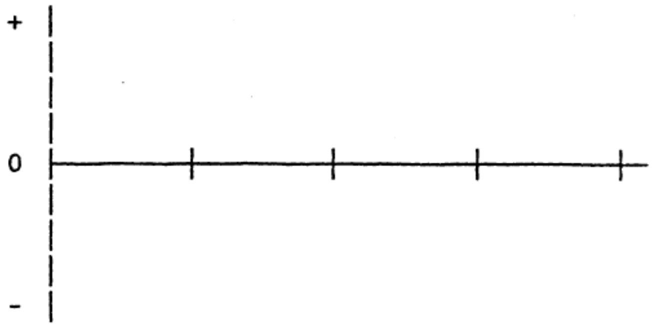
Line Current			
Power			

The phase angle between voltage and current is ________________degrees
Sketch of phase Relationship (1 cycle):



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Questions

1. Were the meter readings exactly the same as the calculated values? If not, explain why there were differences.

2. Was the voltmeter reading approximately equal to the peak voltage displayed on the CRO? If not, explain why they were different.

3. From your results, what was the average rate at which electrical energy was being converted to heat when the circuit was operating?

   Resistor 1: ______________________________

   Resistor 2: ______________________________

4. What was the phase relationship between the line voltage and the current through the resistor, as indicated on the CRO?

5. Was the wattmeter reading approximately equal to the product of the measured line current and line voltage in the circuit?

6. How much of the total circuit power was being dissipated in the resistors?

   For Resistor 1: ______________________________

   For Resistor 2: ______________________________

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Resistance and Inductance in Parallel

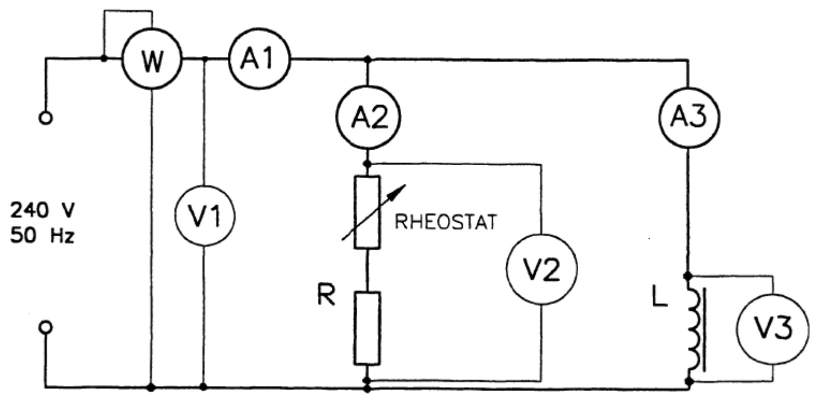
Objective

To observe the effects of changing the resistance in an a.c. circuit consisting of a resistor and an inductor connected in parallel.

Equipment

240V, 50Hz a.c. supply
An inductor (40W fluorescent choke or similar)
480Ω resistor (1A or similar)
1000Ω rheostat (1A or similar)
0 – 150W single phase analogue wattmeter or similar
Three 0-1A a.c. ammeters
Multimeter
Single phase power board
Connecting leads

Circuit Diagram



DANGER TAG PROCEDURE REQUIRED

Procedure

1. Connect the circuit according to the circuit diagram given above.
2. Set the 1000Ω rheostat to MAXIMUM resistance.
3. Check for short circuits with a multimeter set on the ohms x 1 range. Switch the multimeter off after the check.

4. Have your connections checked by your Lecturer.

5. Connect the circuit to the 240V, 50Hz supply. Record the meter readings in the Results Table.

6. Reduce the resistance of the 1000Ω rheostat to zero in three approximately equal steps, and record the meter readings at each step. Do not allow the current in the rheostat to exceed 1A at any time.

7. Switch the circuit off, remove the plug from the outlet and attach your danger tag to the plug top.

8. Have your results checked by your Lecturer.

9. Disconnect your wiring and return all of the equipment to its proper place.

Measurements

Results Table – R and L in Parallel

	Measurements				Calculations	
Rheostat Setting	I_R	I_L	I_Z	P	Z	Power Factor
Step 1 (Maximum R)						
Step 2						
Step 3						
Step 4 (Minimum R)						

Line voltage: ______________________________

Phasor Diagram

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Questions

1. Draw a phasor diagram to scale and show the relationship between I_R, I_L and I_Z for each setting of the rheostat (all on one phasor diagram).
   Use a scale of 20mm = 0.1A.

2. Use your scaled phasor diagram to ESTIMATE what the line current and power factor would be if the current in the resistor was increased to 1A (with the inductor current I_L remaining unchanged).

   ____

3. Why was there a slight difference between the calculated line current and the measured line current?

   ____

   ____

4. When was the power factor of this test circuit 'best' (ie. closer to 1) – when the resistance was high or low?

   ____

5. Calculate the resistance of the resistive branch when it has 0.6A flowing through it, assuming a line voltage of 240V.

   ____

6. What would happen to the power factor of the circuit if the line voltage was reduced to 120V?

   ____

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Resistance, Inductance and Capacitance in Parallel

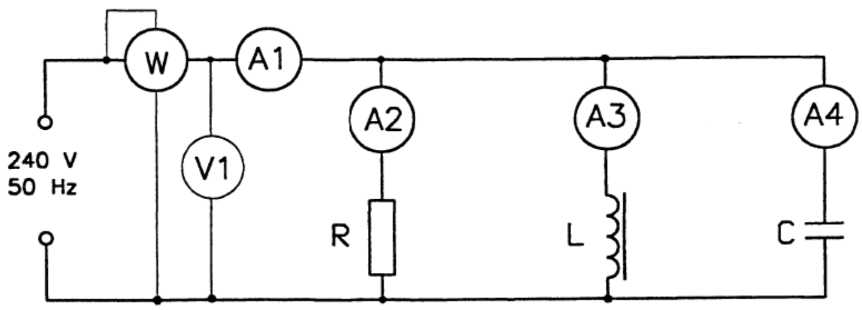
Objective

To observe the characteristics of an a.c. circuit consisting of a resistor an inductor and a capacitor connected in parallel.

Equipment

240V, 50Hz a.c. supply
480Ω resistor (1A)
An inductor (40W fluorescent ballast or similar)
A 3μF paper capacitor
A 0-150W single phase analogue wattmeter or similar
Three 0-1A a.c. ammeters
Multimeter
Single phase power board
Connecting leads

Circuit Diagram



DANGER TAG PROCEDURE REQUIRED

Procedure

1. Connect the circuit according to the circuit diagram given above.

2. Check for short circuits with a multimeter set on the ohms x 1 range. Switch the multimeter off after the check.

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3. Have your connections checked by your Lecturer.
4. Connect the circuit to the 240V, 50Hz supply. Record the meter readings in the Measurements Results Table.
5. Switch the circuit off, remove the plug from the outlet and attach your danger tag to the plug top.
6. Calculate the values necessary to complete the Calculations Results Table.
7. Have your results checked by your Lecturer.
8. Disconnect your wiring and return all of the equipment to its proper place.

Results

Results Table – R, L and C in Parallel

Measurements					
E	I_Z	I_R	I_L	I_C	P

Calculations							
R	L	X_L	X_C	Z	S	Q	Cos θ

Phasor Diagram

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Questions

1. Prove by calculation that the power dissipated by the circuit (as indicated on the wattmeter) is the power dissipated only by the resistor (disregard power losses in the ballast).

   ____

   ____

   ____

   ____

2. Was the power factor of the circuit 'good' or 'bad'?

   ____

3. What would the impedance of the circuit be if the frequency was increased to the point of resonance?

   ____

4. Was the line current the sum of the currents in the individual parallel branches?   Why?

____

____

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Varying Capacitance in a Parallel RLC Circuit

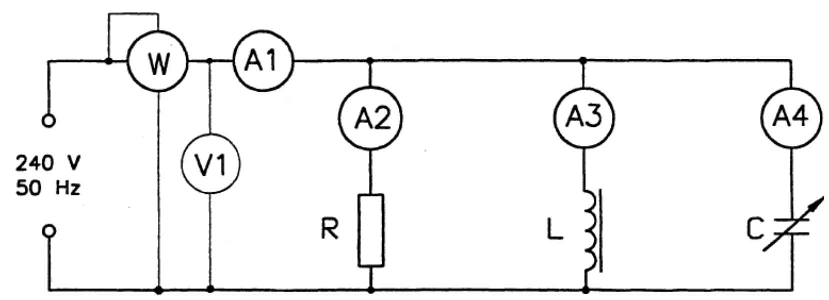
Objective

To observe the effect of varying the capacitance in an parallel RLC circuit.

Equipment

240V, 50Hz a.c. supply
480Ω resistor (1A)
An inductor (36W fluorescent ballast or similar)
A variable 240V switchable paper capacitor bank (about 2μF to 10μF)
A 0-150W single phase analogue wattmeter or similar
Three 0-1A a.c. ammeters
One 0-2A a.c. ammeter
Multimeter
Single phase power board
Connecting leads

Circuit Diagram



DANGER TAG PROCEDURE REQUIRED

Procedure

1. Connect the circuit according to the circuit diagram given above (with no capacitance in the circuit).

2. Check for short circuits with a multimeter set on the ohms x 1 range. Switch the multimeter off after the check.

3. Have your connections checked by your Lecturer.
4. Connect the circuit to the 240V, 50Hz supply. Record the meter readings in the Measurements Results Table.

5. Alter the value of capacitance to about 2μF by operating the switches on the capacitor bank. Record the meter readings in the Measurements Results Table.

6. Alter the value of the capacitance to about 6μF and 10μF by operating the switches on the capacitor bank. Record the meter readings in the Measurements Results Table.

7. Switch the circuit off and remove the plug from the outlet. Attach your danger tag to the plug top.

8. Calculate the values necessary to complete the Calculations Results Table, and draw a phasor diagram of each condition (using the same scale for each).

9. Have your results checked by your Lecturer.

10. Disconnect your wiring and return all of the equipment to its proper place.

Results

Results Tables- RLC in Parallel with Variable Capacitance

	Measurements					
	E	I_Z	I_R	I_L	I_C	P
R & L Only						
2 μF						
6 μF						
10 μF						

	Calculations							
	R	L	X_L	X_C	Z	S	Q	Cos Θ

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R & L Only								
2 μF								
6 μF								
10 μF								

Phasor Diagrams:

Questions

1. At what value of capacitance was the line current (I_Z) least.

   ____

2. Did the line current fall each time capacitance was connected into the circuit? Give a reason for your answer.

   ____

3. At what value of capacitance was the power factor of the circuit 'best' (closest to a unity power factor)?

   ____

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4. Did the reading on the wattmeter change significantly, as more capacitance was connected into the circuit?

____

5. Calculate the cost of operating the circuit for 10 hours in each condition, assuming that electrical energy costs 25 cents for every kilowatt hour (Cost = kW x hr x cost per kWh)

____

6. Based on your results, does an a.c. circuit cost more to operate if the power factor is 'low'?

____

7. Calculate the resonant frequency for each value of capacitance in the circuit.

____

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An Inductor on A.C.

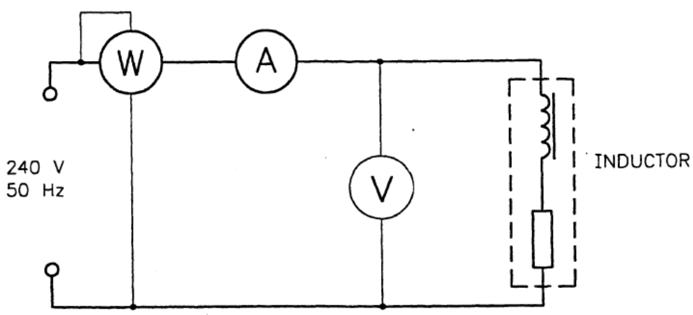
Objective

To verify the relationships between the values in an a.c. circuit consisting of an inductor with internal d.c. resistance.

Equipment

240V, 50Hz a.c. supply
An inductor (40W fluorescent choke or similar)
0-100W single phase analogue wattmeter or similar
0-1A a.c. ammeter
Multimeter
Single phase power board
Connecting leads

Circuit Diagram



Procedure

DANGER TAG PROCEDURE REQUIRED

1. Zero the multimeter on the ohms x 1 range, then measure the d.c. resistance of the inductor. Record the resistance in the Results Table.

2. Connect the circuit according to the circuit diagram given above (note that the resistor shown simulates the internal d.c. resistance of the inductor).

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3. Check for short circuits with a multimeter set on the ohms x 1 range. Switch the multimeter off after the check.
4. Have your connections checked by your Lecturer.
5. Connect the circuit to the 240V, 50Hz supply. Measure line voltage, line current and power, and record your results in the Table.
6. Switch the circuit off, remove the plug from the outlet, attach your danger tag to the plug top.
7. Draw a phasor diagram showing the relationship between the resistance, inductive reactance and impedance in the circuit.
8. Calculate the values necessary to complete the table headed 'Calculations' (show all working on a separate sheet).
9. Have your results and calculations checked by your Lecturer.
10. Disconnect your wiring and return all of the equipment to its proper place.

Measurements

Results Table

Resistance of inductor	
Line voltage	
Line current	
Power	

Phasor Diagram

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Calculations

Impedance	
Inductive reactance	
Inductance	
True Power	
Power Factor	
Apparent Power	
Reactive Power	
Angle of lag	
Current on d.c.	

Questions

1. Why was the current drawn on a.c. different from the current which would be drawn by the same inductor on d.c.?

____

2. List four factors which govern the current drawn by an inductor if it is supplied from a constant voltage a.c. supply

______________________________ ______________________________

______________________________ ______________________________

3. Does the d.c. resistance of the inductor have a significant effect on the current drawn by the inductor on a.c.?

---

4. How much of the line current is doing useful work in the circuit?

____

5. What is the resonant frequency of the test circuit?

____

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Resistance, Inductance and Capacitance in Series

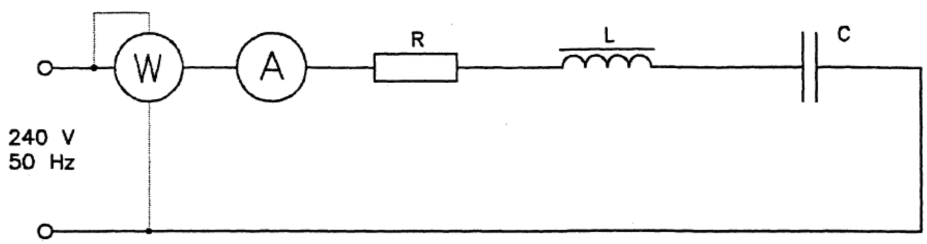
Objective

To observe the effects of connecting resistance, inductance and capacitance in series in an a.c. circuit.

Equipment

240V, 50Hz a.c. supply
480Ω resistor (1A)
3µF paper capacitor or similar
An inductor (36W fluorescent ballast or similar)
A 0-150W single phase analogue wattmeter or similar
One 0-1A a.c. ammeter
Multimeter
Single phase power board
Connecting leads

Circuit Diagram



Procedure

DANGER TAG PROCEDURE REQUIRED

1. Connect the circuit according to the circuit diagram given above.
2. Check for short circuits with a multimeter set on the ohms x 1 range. Switch the multimeter off after the check.
3. Have your connections checked by your Lecturer.

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4. Connect the circuit to the 240V, 50Hz supply. Measure the voltage across each component with a multimeter, and record the reading in the Measurements Results Table. For each voltage reading, set the multimeter on the highest available a.c. range first.

5. Switch the circuit off, remove the plug from the outlet and attach your danger tag to the plug top.

6. Calculate the values necessary to complete the Calculations Results Table, and draw a phasor diagram of the circuit. Disregard the internal resistance of the inductor.

7. Have your results checked by your Lecturer.

8. Disconnect your wiring and return all of the equipment to its proper place.

Results

Results Tables - RLC in Series

Measurements					
I_Z	V_Z	V_R	V_L	V_C	P

Calculations							
R	L	X_L	X_C	Z	S	Q	Cos Φ

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Phasor Diagram

Questions

1. Did the sum of the voltages across the components in this circuit add up to the line voltages? Explain your answer.

2. What dangerous condition could exist if the inductive reactance and the capacitive reactance were equal in a series a.c. circuit? What is the name of this condition?

____

3. Use your results to show that the only power dissipated in this circuit is the power dissipated by the resistor.

____

4. Use your results to determine whether the power factor of the circuit was lagging or leading. What is the value of the angle of lag or lead in this circuit?

____

5. What is the minimum value of power factor according to the WA Distributions Connections Manual?

____

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Reasonable Adjustment			
Adjustment Required	☐ **Yes**	☐ **No**	
Describe the adjustments that have been made to the assessment:			
Assessor name and signature		**Date**	
Student name and signature		**Date**	

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Assessment Outcome Knowledge Questions	☐ **Satisfactory**	☐ **Not Satisfactory**
Assessment Outcome Practical Activities	☐ **Satisfactory**	☐ **Not Satisfactory**

Knowledge Questions / Practical Activity Feedback:

Actions Required if Not Satisfactory:

Assessor name and signature		**Date**	
Student name and signature		**Date**	