Strengthened Senior High School

DepED
DEPARTMENT OF EDUCATION

Lesson Exemplars for Domestic Refrigeration and Air-Conditioning Servicing

TECH-PRO ELECTIVE



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LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**1**

I. OBJECTIVES		
A. Content Standard	The learner understands the concepts and principles of installing domestic refrigeration and air-conditioning units.	
B. Performance Standard	The learner performs the installation of domestic refrigeration and air-conditioning units with safety precautions	
C. Learning Competencies	Discuss overview of Refrigeration and Air Conditioning servicing	
II. REFERENCES and MATERIALS	**References:** TESDA TR - DRAC NC II; Air Conditioning and Refrigeration by Miller (Ch.1); PEC 2017 Part 1 **Materials:** Projector, laptop, speakers, sample service contract, job order forms, whiteboard	
III. CONTENT	Overview of Refrigeration and Air Conditioning servicing	
IV. OBJECTIVES	At the end of the lesson learners should be able to: **Identify** at least three current trends in the HVAC industry. **Classify** career opportunities in Contracting, Merchandising, Manufacturing, and Consulting. **Explain** the basic principle of heat transfer using everyday examples. **Appreciate** the role of DRAC technicians in Philippine society.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**1. Activating Prior Knowledge** Good morning! Let's start with a quick activity called Hot or Cold. I'll show you pictures. Raise your left hand if it needs	**Facilitation:** Use local items: *tuyo (dried fish), fresh pork, computer server, jeepney, vaccine vial, mangoes.*

	refrigeration (kept cold). Raise your right hand if it needs air conditioning (space cooling). *The teacher shows images one by one.* Why do we need to cool these? What happens if we don't? (Call 3 students). **2. Establishing the Purpose of the Lesson** Today we are looking at a billion-peso industry. DomRAC is not just repair, it's a path to owning a business, working abroad (Canada, Japan, UAE) or becoming a technical expert. Let's map the big picture.	**Rationale:** Activates schema about the *need* for cooling in daily Filipino life. **Rationale:** Connects to career aspirations and economic mobility—primary motivators for SHS-TVL students.
B. Instituting New Knowledge	**3. Presenting Examples** Watch these three short clips. Write one observation per clip. *Clip 1:* Technician using digital manifold gauge and thermal camera. *Clip 2:* Contractor signing maintenance deals for a mall. *Clip 3:* News report on global warming increasing AC demand. What did you see? (Write answers on board). You saw *technology*, *business*, and *environmental issues*. These are our three pillars. **4. Discussing New Concept** The teacher says: Copy this table in your notebook. **Topic A: Current Trends (Write 'T-G-S-P')**	**Facilitation:** Pause after each clip. Ask specific questions. **Rationale:** Structured, explicit lecture and local analogies.

	Smart Technology: You can cool your room using your phone before you get home. Wi-Fi thermostats. **G - Green Refrigerants:** Old ACs used R-22 (nakakasira ng ozone). New ones use R-32 or R-290 (environment-friendly). **S - Energy Efficiency (Inverter):** Look for the Philippine Energy Label (4-5 stars). Inverter technology saves 40% of electricity. **P - Predictive Maintenance:** Use thermal cameras to see a failing part *before* it breaks. No more waiting for a total breakdown. **Topic B: Career Pathways (CTEM Model)** **C - Contracting:** Bidding for projects. Example: Installing 20 ACs for a new BPO building. Requires license and capital. **T - Trading/Merchandising:** Selling compressors, copper tubes, tools. You need product knowledge, not necessarily repair skills. **E - Employment/Manufacturing:** Working for companies like Carrier, Daikin, Samsung. Stable income, benefits. **Maintenance/Consulting:** House-to-house service. This is the most common entry point for NC II holders. Low startup capital. **Teacher Ask:** Which path requires the least startup capital? **Topic C: Basic Principles** Forget magic. Refrigeration is simply **moving heat from where it is not wanted to where it doesn't matter**."	**Facilitation:** Fast-paced, buzzer system. The first correct answer gets a plus.

	5. Developing Mastery **Activity: "4 Pics 1 Word"** *Set 1:* [Phone+AC app] + [Wi-Fi] + [Thermostat] + [Mobile] = **SMART AC** *Set 2:* [Hard hat] + [Blueprint] + [Building] + [Money] = **CONTRACTING** *Set 3:* [Flame] + [Ice melting] + [Arrow] + [Sun] = **HEAT TRANSFER**	**Rationale:** Gamification increases dopamine and recall.
C. Demonstrating Knowledge and Skills	**1. Finding Practical Application** Teacher says: Scenario: Aling Nena says, "why hire a certified technician? My brother can install the AC. Based on what you learned, what do you tell her? **2. Making Generalization** Teacher Says: Complete this sentence: Refrigeration and Air Conditioning servicing is not just about fixing broken units; it is about _____. Collect 3-4 answers. **3. Evaluating Learning** I. Multiple Choice (10 pts). Encircle the letter. 1. Which refrigerant is environmentally friendly? a) R-22 b) R-32 c) Freon-12 d) Gasoline	**Facilitation:** Role-play. One student acts as Aling Nena. **Rationale:** Forces synthesis into a personally meaningful statement. **Rationale:** Moves from theory to persuasive communication and professional ethics.

	2. Which career pathway involves bidding for large installation projects? a) Merchandising b) Manufacturing c) Contracting d) Consulting 3. Refrigeration is simply... a) Creating cold air b) Moving heat c) Removing humidity d) Freezing water 4. Which trend allows smartphone control? a) Green Refrigerants b) Smart HVAC c) Predictive Maintenance d) Manual Control 5. What is the function of the refrigerant? a) Produce electricity b) Carry heat c) Clean filter d) Lubricate fan 6. Which career is "house-to-house repair"? a) Manufacturing Engineer b) Sales Agent c) Maintenance Technician d) Architect 7. Natural heat flow moves from... a) Cold to hot b) Hot to cold c) Left to right d) Low to high pressure 8. An NC II holder CANNOT: a) Install window-type AC b) Diagnose leak c) Design 20-story building HVAC d) Clean condenser 9. Predictive Maintenance uses a... a) Hammer b) Thermal camera c) Soldering iron d) Stethoscope 10. Which is Merchandising? a) Selling copper tubes b) Repairing freezer c) Teaching HVAC d) Installing ducts **ANSWER KEY** 1-b, 2-c, 3-b, 4-b, 5-b, 6-c, 7-b, 8-c, 9-b, 10-a	*Give short and direct questions based on the lesson objectives*

	4. Additional Activities Interview one appliance store salesperson: What is the most common complaint about AC units? Report in 2 sentences.	
VI. ASSESSMENT	***Performance Task:*** ***Scenario-Based Interview (15 pts)*** *Situation: A family friend, Mr. Reyes, is planning to buy two air conditioners for his small resort in Batangas. He is torn between buying a standard non-inverter unit (cheaper upfront cost) and an inverter unit (more expensive but has a high energy efficiency rating). He also does not know whether to just ask his handyman to install it or to hire a certified DomRAC technician.* *Task: Based on what you learned in this lesson, write a short dialogue or a persuasive paragraph (5-7 sentences) advising Mr. Reyes. In your response, you must:* 1. ***Recommend*** *which type of AC to buy and explain why (refer to the Green/Smart/Energy Efficiency trend).* 2. ***Explain*** *why hiring a certified technician is important (connect to safety, professionalism, or career pathways like Maintenance/Consulting).* 3. ***Use*** *the basic principle of heat transfer (moving heat from where it is not wanted to where it doesn't matter) in your explanation.* ***Rubric:*** • ***Content & Accuracy (10 pts):*** *Correctly applies trends, career concepts, and heat transfer principle.* • ***Clarity & Real-world Connection (5 pts):*** *Advice is practical, clear, and shows appreciation for the technician's role in Philippine society.* *(Alternative simpler task if the above is too advanced for the first lesson)*	
VII. REFLECTION	*This section presents the key highlights and challenges encountered by both teachers and learners during the teaching-learning process throughout the unit. It also includes the adjustments made by the teacher to improve instruction*	

VIII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.

LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**2**

I. OBJECTIVES		
A. Content Standard	The learner understands the concepts and principles of installing domestic refrigeration and air-conditioning units.	
B. Performance Standard	The learner performs the installation of domestic refrigeration and air-conditioning units with safety precautions	
C. Learning Competencies	Discuss overview of Refrigeration and Air Conditioning servicing	
II. REFERENCES and MATERIALS	**References:** TESDA TR - DRAC NC II; Refrigeration and Air Conditioning by Langley (Ch. 2-3); PEC 2017 **Materials:** Cutaway model of a refrigerator/window-type AC, actual components (compressor, condenser, evaporator, capillary tube), diagrams, magnifying glass	
III. CONTENT	Refrigeration Systems	
IV. OBJECTIVES	At the end of the lesson learners should be able to: 1. **Identify** the four major components of a vapor-compression refrigeration system. 2. **Describe** the function of each component using the acronym CCME. 3. **Differentiate** domestic, commercial and industrial refrigeration systems. 4. **Locate** each component on an actual window-type air conditioner.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**1. Activating Prior Knowledge** **Teacher Says:** Last time, we learned that refrigeration is moving heat. Today, we asked: *How* does it move? Let's start with a quick Organ Hunt. I will say a function. You raise your hand and name the part that does it.	**Facilitation:** Use a real opened window-type AC or large poster. Point to parts as students name them.

	Teacher functions: Makes the gas high pressure (Compressor). Releases heat outside (Condenser). Absorbs heat inside (Evaporator). Today, we will learn exactly what each part does. **2**. **Establishing the Purpose of the Lesson** **Teacher Says:** Imagine you are a doctor. A patient is sick. You cannot prescribe medicine if you don't know the organs. The same here. If a unit 'not cooling, you must know if the heart(compressor), lungs (condenser), or stomach (evaporator) is sick. Today, we learn the anatomy of a refrigeration system.	**Rationale:** Elicits prior knowledge about mechanical parts. Activates curiosity. Emphasizes diagnostic necessity.
B. Instituting New Knowledge	**3. Presenting Examples** **Teacher Says:** I will pass around three items: 1. a working compressor (small) 2. a piece of condenser coil 3. a capillary tube. Touch them (careful, edges are sharp!). *Teacher asks:* What do you notice about the compressor? (Heavy, sealed). The condenser? (Fins, metal). The capillary tube? (Very small opening). **4. Discussing New Concept** Open your notebook. Title: The Four Major Components - CCME. We will use this acronym forever.	**Facilitation:** Use a rotation system. Each group gets 2 minutes per component. **Rationale:** Structured, explicit lecture and **Rationale:** Tactile learning. Concrete experience before abstract theory. **Rationale:** Mnemonic CCME(Compressor, Condenser,

	Component 1: Compressor (The Heart) **Location:** At the back/bottom of a ref, or inside the outdoor unit of a split-type AC. **Function:** It receives low-pressure cold gas from the evaporator. It compresses it into high-pressure HOT gas. It pumps the refrigerant around the system. If the compressor is dead, the whole system is dead. **Types we use:** Reciprocating (piston), Rotary (common in window-type), Scroll (quiet, for inverter). **Component 2: Condenser (The 'Heat Releaser')** **Location:** The hot coils at the back of a refrigerator or the outdoor part of an AC. **Function:** The hot gas from compressor enters. Air (or water) passes over the coils. Heat is released to the outside. The gas turns into a high-pressure WARM LIQUID. *Analogy:* Parang pawis mo. When you sweat (gas), and wind blows (air over condenser), you feel cold because heat left your body. **Types:** Fin-and-tube (most common), microchannel (newer, lighter). **Component 3: Metering Device (The Gatekeeper)** **Location:** Between the condenser and evaporator. Usually a small copper tube called 'capillary tube' (cap tube) in domestic units. **Function:** It restricts flow. It causes a pressure drop. The high-pressure warm liquid becomes low-pressure COLD liquid (some flash gas). *This creates the cooling effect.* *Analogy:* Your thumb on a garden hose. When you cover the opening (restrict), water sprays out cold and fast. **Types for now:** Capillary tube (fixed), Thermal Expansion Valve (TXV - we see this in bigger units).	Metering, Evaporator) aids memorization. **Facilitation:** Fast-paced, buzzer system. First correct answer gets a plus.

	Component 4: Evaporator (The Heat Absorber) **Location:** Inside the refrigerator or the indoor unit of an AC (the cold part). **Function:** The cold liquid enters. Warm room air is blown across it. The liquid refrigerant absorbs heat and BOILS into a low-pressure COLD GAS. This is where your room gets cold. *Analogy:* Ice on your skin. The ice absorbs heat from your body and melts (changes state). Same here, but refrigerant boils at -20°C	**Rationale:** Gamification increases dopamine and recall.

Component	What it does	State of refrigerant
Compressor	Pumps, increases pressure	Low pressure gas → High pressure HOT gas
Condenser	Releases heat	Hot gas → Warm liquid
Metering	Restricts flow	Warm liquid → Cold liquid + gas
Evaporator	Absorbs heat	Cold liquid + gas → Cold gas

5. Developing Mastery

Activity: "Line-Up Relay"

Teacher Says: In your group, arrange the components in the correct order of refrigerant flow. Then match each component to its function. First group to raise hands with correct arrangement wins.

Answer order: Compressor → Condenser → Metering → Evaporator (then back to compressor).

Facilitation: Divide class into 4 groups. Each group gets 4 cards (names of components) and 4 cards (functions).

Rationale: Kinesthetic and collaborative learning. Sequence understanding is critical.

C. Demonstrating Knowledge and Skills	**1. Finding Practical Application** **Teacher Says:** Scenario: A customer says, My refrigerator is running but the freezer is not cold. The back coils are very hot. What could be wrong? Based on CCME which component should you check first? *Answer:* Condenser is hot = compressor okay. Problem is further downstream (metering device clogged, evaporator fan not working or low refrigerant). **2. Making Generalization** Complete this sentence: The four major components of a refrigeration system work like a relay team; if _____ fails then _____. *Example:* If the compressor fails, then no refrigerant moves and no cooling happens. **3. Evaluating Learning** **Multiple Choice (10 pts).** Encircle the letter of the correct answer. 1. Which component is considered the "heart" of the refrigeration system? a) Condenser b) Evaporator c) Compressor d) Capillary tube 2. Where does the refrigerant change from gas to liquid by releasing heat? a) Compressor b) Condenser c) Evaporator d) Metering device	**Facilitation:** Guide students to think: Hot coils (condenser) means compressor is working. Problem likely evaporator or metering device or refrigerant leak. **Rationale:** Diagnostic thinking. Links components to real troubleshooting. **Rationale:** Emphasizes interdependence of components.

	3. Which component creates the pressure drop that causes cooling? a) Compressor b) Condenser c) Evaporator d) Metering device 4. Which component absorbs heat from the room? a) Compressor b) Condenser c) Evaporator d) Metering device 5. What is the most common metering device in domestic refrigerators? a) TXV b) Capillary tube c) Orifice plate d) Float valve 6. The compressor receives refrigerant that is... a) High pressure hot gas b) Low pressure cold gas c) High pressure liquid d) Low pressure liquid 7. The condenser discharges... a) Cold air inside b) Hot air outside c) Refrigerant leak d) Water 8. Which component is located inside the refrigerated space? a) Compressor b) Condenser c) Evaporator d) Metering device 9. What happens to refrigerant in the evaporator? a) It condenses b) It boils/evaporates c) It freezes d) It compresses 10. The correct order of refrigerant flow is: a) Evap→Comp→Cond→Meter b) Comp→Cond→Meter→Evap c) Cond→Evap→Comp→Meter d) Meter→Evap→Comp→Cond **ANSWER KEY** 1-c, 2-b, 3-d, 4-c, 5-b, 6-b, 7-b, 8-c, 9-b, 10-b	

	4. Additional Activities Draw the CCME sequence on a short bond paper. Label each component and write one sentence about its function.	
VI. ASSESSMENT	***Performance Task:*** On a diagram of a window-type AC label the four major components and write one sentence explaining the function of each. **Scoring Guide:** • Correct label of Compressor: 2 pts • Correct label of Condenser: 2 pts • Correct label of Metering Device: 2 pts • Correct label of Evaporator: 2 pts • Accurate function sentence for each: 1 pt each (4 pts) • **Total: 12 pts** (Passing: 10)	
VII. REFLECTION	*This section presents the key highlights and challenges encountered by both teachers and learners during the teaching-learning process throughout the unit. It also includes the adjustments made by the teacher to improve instruction*	
VIII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.	

LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**3**

I. OBJECTIVES		
A. Content Standard	The learner understands the concepts and principles of installing domestic refrigeration and air-conditioning units.	
B. Performance Standard	The learner performs the installation of domestic refrigeration and air-conditioning units with safety precautions	
C. Learning Competencies	Discuss the refrigeration cycle.	
II. REFERENCES and MATERIALS	**References:** TESDA TR - DRAC NC II; Modern Refrigeration and Air Conditioning (Althouse); PEC 2017 **Materials:** Pressure-enthalpy (P-H) diagram poster, colored markers (red, blue, green, yellow), simulation software (PhET Refrigeration Cycle), dry ice demonstration materials (with safety gear)	
III. CONTENT	The Refrigeration Cycle	
IV. OBJECTIVES	At the end of the lesson learners should be able to: 1. **Sequence** the four stages of the refrigeration cycle correctly. 2. **Explain** what happens to refrigerant pressure and temperature at each stage. 3. **Trace** the cycle on a simple diagram using colored arrows. 4. **Predict** what happens to the cycle if one stage is interrupted.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**1. Activating Prior Knowledge** **Teacher Says:** Let's review our CCME. I will point to a component. You shout its function.	**Facilitation:** Fast-paced. Use a real unit or large poster

	Teacher points to compressors, condenser, capillary tube, and evaporator. **Teacher Says:** Now, these four components don't work alone. They work on a *cycle*. Today we followed the refrigerant's journey. **2. Establishing the Purpose of the Lesson** **Teacher Says:** Why do we need to learn the cycle? Because when a customer says, 'My AC is not cooling,' you need to find *where* in the cycle the problem is. Is it before the condenser? After the evaporator? The cycle is your map. No map = lost technician.	**Rationale:** Quick retrieval practice before building that knowledge. **Rationale:** Emphasizes diagnostic application of cycle knowledge.
B. Instituting New Knowledge	**3. Presenting Examples** **Teacher Says:** Watch this 2-minute animation of the refrigeration cycle. Watch the colors: RED = hot, BLUE = cold. *Play YouTube animation.* **Teacher Says:** What color was the gas leaving the compressor? (Red - hot). Leaving the evaporator? (Blue - cold). Now let's understand why. **4. Discussing New Concept** **Teacher Script:** We will trace the cycle stage by stage. Copy this diagram on your paper. Use four colors: RED, ORANGE, GREEN, BLUE.	**Facilitation:** Play animation twice. First time just watching. Second time, students draw the cycle in their notebooks. **Rationale:** Visual representation of an invisible process. Animation bridges abstract to concrete. **Rationale:** Multi-sensory learning (visual, auditory, kinesthetic - coloring).

	Stage 1: Compression (Compressor) - COLOR: RED **Starting point:** Refrigerant enters compressor as a LOW PRESSURE, LOW TEMPERATURE GAS (around 10-20 psi, 10°C). **What happens inside:** The compressor squeezes the gas. The molecules are forced closer together. **Result:** The refrigerant becomes a HIGH PRESSURE, HIGH TEMPERATURE GAS (around 150-250 psi, 70-100°C). *Analogy:* Using a bike pump. When you push the pump (compress), the bottom of the pump gets very hot. **Draw on your diagram:** RED arrow from compressor to condenser. **Stage 2: Condensation (Condenser) - COLOR: ORANGE** **Starting point:** Hot gas enters the condenser coils. **What happens inside:** The condenser fan blows outside air (or water) across the coils. Heat moves FROM the hot refrigerant TO the cooler outside air. **Result:** The refrigerant RELEASES heat. It changes state from GAS to LIQUID. But it is still HIGH PRESSURE, now WARM LIQUID (around 35-45°C). *Analogy:* Steam from a kettle. When it hits a cold window, it turns into water droplets (condenses) and releases heat. **Draw:** ORANGE arrow from condenser to metering device. **Stage 3: Expansion (Metering Device) - COLOR: GREEN** **Starting point:** High pressure warm liquid enters the capillary tube (very small opening). **What happens inside:** The refrigerant is forced through a tiny hole. This creates a sudden pressure DROP. **Result:** The refrigerant becomes LOW PRESSURE, COLD LIQUID + some GAS (around 0-5°C, some even -5°C). The temperature drops dramatically.	**Facilitation:** Fast-paced, buzzer system. The first correct answer gets a plus. **Rationale:** Gamification increases dopamine and recall.

Analogy: Your thumb on a garden hose. When you cover the opening, the water comes out cold and fast because pressure drops.
Draw: GREEN arrow from metering device to evaporator.

Stage 4: Evaporation (Evaporator) - COLOR: BLUE

Starting point: Cold liquid gas mixture enters the evaporator coils inside the room/freezer.
What happens inside: The indoor fan blows warm room air across the cold evaporator coils. Heat moves FROM the warm room air TO the cold refrigerant.
Result: The refrigerant ABSORBS heat. It changes state from LIQUID to GAS (it boils/evaporates). It becomes LOW PRESSURE, COLD GAS (around 10°C, ready to go back to the compressor).
Analogy: Alcohol on your skin. It feels cold because it absorbs heat from your body to evaporate.
Draw: BLUE arrow from the evaporator back to the compressor (completing the circle).

Stage	Component	Pressure	Temp	State
Compression	Compressor	Low – High	Low – High	gas
Condensation	Condenser	High	High - Warm	Gas - Liquid
Expansion	Metering	High – Low	Warm – Cold	Liquid - Mix
Evaporation	Evaporator	Low	Cold – Colder	Mix - Gas

Teacher Says: The cycle never stops. It repeats as long as the compressor runs. That's why it's called a *cycle*.

	5. Developing Mastery **Activity: "Cycle Relay Race"** **Teacher Says:** In your group, arrange the cards in the correct order: Stage name, then its description. First group to finish with all correct win's a plus. Sample card: Stage 2 - Condensation: High pressure gas becomes warm liquid; heat is released.	**Facilitation:** Split class into 4 groups. Each group gets a set of 8 cards (4 stage names, 4 descriptions).
C. Demonstrating Knowledge and Skills	**1. Finding Practical Application** **Teacher Says:** Scenario: You are called to a restaurant. Their walk-in freezer is not freezing. You feel the condenser and it is COLD (not warm). The compressor is running. Which stage of the cycle is most likely the problem? *Answer:* Compression stage (compressor not compressing) OR no refrigerant (nothing to compress). **2. Making Generalization** **Teacher Says:** Complete this analogy: The refrigeration cycle is like a water wheel because… *Sample answer: because* water (refrigerant) must flow continuously in a circle. If the wheel stops at any point, the whole system stops.	**Facilitation:** Guide to students: Cold condenser means no hot gas is reaching it. Compressor runs but no compression? Could be bad compressor valves or no refrigerant. **Rationale:** Diagnostic reasoning using cycle knowledge. **Rationale:** Forces deeper understanding through analogy construction.

	3. Evaluating Learning **Multiple Choice (10 pts).** Encircle the letter with the correct answer. 1. In which stage does the refrigerant change from gas to liquid? a) Compression b) Condensation c) Expansion d) Evaporation 2. In which stage does the refrigerant absorb heat? a) Compression b) Condensation c) Expansion d) Evaporation 3. What happens to pressure in the expansion stage? a) Increases greatly b) Decreases suddenly c) Stays the same d) Fluctuates randomly 4. The refrigerant leaving the compressor is… a) Low pressure cold gas b) High pressure hot gas c) High pressure warm liquid d) Low pressure cold liquid 5. Which component is associated with the evaporation stage? a) Compressor b) Condenser c) Metering device d) Evaporator 6. What color arrow represents the condensation stage in our lesson? a) Red b) Orange c) Green d) Blue 7. The refrigerant entering the evaporator is… a) High pressure hot gas b) High pressure warm liquid c) Low pressure cold liquid+gas d) Low pressure cold gas 8. Which stage is responsible for releasing heat to the outside? a) Compression b) Condensation c) Expansion d) Evaporation	

	9. If the metering device is clogged, which stage is directly affected? a) Compression b) Condensation c) Expansion d) Evaporation 10. The correct sequence of the refrigeration cycle is a) Evap→Comp→Cond→Exp b) Comp→Cond→Exp→Evap c) Cond→Exp→Evap→Comp d) Exp→Evap→Comp→Cond **ANSWER KEY** 1-b, 2-d, 3-b, 4-b, 5-d, 6-b, 7-c, 8-b, 9-c, 10-b **4. Additional Activities** Draw the four-stage cycle on a short bond paper. Use colored arrows (Red, Orange, Green, Blue). Label each stage and write the state of refrigerant.	
VI. ASSESSMENT	**Performance Task Component:** On a diagram of a refrigeration system, use colored arrows (Red, Orange, Green, Blue) to trace the cycle. Write one sentence explaining what happens at each stage. **Scoring Guide:** • Correct color sequence: 4 pts • Correct arrow direction: 4 pts • Accurate description for each stage: 2 pts each (8 pts) • **Total: 16 pts** (Passing: 13)	

VII. REFLECTION	*This section presents the key highlights and challenges encountered by both teachers and learners during the teaching-learning process throughout the unit. It also includes the adjustments made by the teacher to improve instruction*
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LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**4**

I. OBJECTIVES		
A. Content Standard	The learner understands the concepts and principles of installing domestic refrigeration and air-conditioning units.	
B. Performance Standard	The learner performs the installation of domestic refrigeration and air-conditioning units with safety precautions	
C. Learning Competencies	Discuss states of matter, units of heat, heat transfer, sensible heat, latent heat, superheat, and subcooling.	
II. REFERENCES and MATERIALS	**References:** TESDA TR - DRAC NC II; Principles of Refrigeration by Dossat; PEC 2017 **Materials:** Ice cubes, beaker, thermometer, hot plate, water, digital thermometer, stopwatch, candle, metal rod	
III. CONTENT	States of Matter and Heat Principles	
IV. OBJECTIVES	At the end of the lesson learners should be able to: 1. **Identify** the three states of matter and their changes. 2. **Differentiate** sensible heat from latent heat using examples. 3. **Explain** the three methods of heat transfer. 4. **Define** superheat and subcooling in the context of the refrigeration cycle. 5. **Calculate** simple sensible heat problems.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**1. Activating Prior Knowledge** **Demonstration: "Melting Ice"**	**Facilitation:** Do this at the front where all can see. Use a clear container.

	Teacher Says: I have an ice cube. I will heat it up. Watch the thermometer. *The teacher heats ice until it melts, then until the water boils.* **Teacher Asks:** What did you observe? Did the temperature stay the same while melting? (Yes). Why? We will answer that today. **2. Establishing the Purpose of the Lesson** **Teacher Says:** Why do we study this? Because in DomRAC, we don't just say it's cold. We measure how much heat is removed. We calculate BTU. We check superheat and subcooling. These are the numbers that separate a professional from a barabara	**Rationale:** Concrete observation of state change. Establishes a baseline for latent/sensible heat discussion. **Rationale:** Emphasizes diagnostic application of cycle knowledge.
B. Instituting New Knowledge	**3. Presenting Examples** **Demonstration 1: Heat Transfer by Conduction** The teacher heats one end of a metal rod. Students feel the other end is getting hot. **Demonstration 2: Convection** The teacher lights an incense stick above a candle flame. Smoke rises.	**Facilitation:** Use a metal rod and a candle. Heat one end. Students touch the other end. **Rationale:** Direct sensory experience of conduction. **Rationale:** Visual demonstration of convection currents.

	Demonstration 3: Radiation The teacher holds a hand near (but not touching) a hot light bulb. **Teacher Says:** Three different ways of heat moves. Everything happens in your AC unit. **4. Discussing New Concept** We have five key concepts today. **Topic A: States of Matter and Changes** **Three states:** Solid (ice), Liquid (water), Gas (steam/water vapor). **Changes of state:** Melting (solid→liquid), Freezing (liquid→solid), Evaporation/Boiling (liquid→gas), Condensation (gas→liquid). **KEY POINT for DRAC:** In the evaporator refrigerant LIQUID BOILS into GAS even at -20°C. In the condenser refrigerant GAS CONDENSES into LIQUID even at 40°C. The refrigerant changes state at temperatures different from water! **Topic B: Units of Heat** Heat is energy. We measure it in: - **Joule (J)** - scientific unit - **Calorie (cal)** - heat to raise 1g water by 1°C - **BTU (British Thermal Unit)** - heat to raise 1 lb water by 1°F. This is what we use in HVAC. Conversion: 1 BTU = 1055 Joules ≈ 252 calories.	**Rationale:** Structured, sequential, with real-world connections.

	Topic C: Methods of Heat Transfer **Conduction:** Heat moves through solid materials. Example: Copper tube gets hot along its length. AC uses copper because it conducts well. **Convection:** Heat moves through fluids (liquids/gases) by circulation. Example: Hot air rises. AC uses fans to force convection. **Radiation:** Heat moves as electromagnetic waves. Example: Sun warms your face. AC does not use radiation primarily, but we consider solar radiation in heat load calculation. **Topic D: Sensible vs. Latent Heat** **Sensible Heat:** Heat that you can *feel* or *sense*. It changes temperature but NOT state. Example: Heating water from 10°C to 30°C. You feel it getting warmer. It's still water. **Latent Heat:** Hidden heat. It changes STATE but NOT the temperature. Example: Ice melts at 0°C. Add heat; it melts, but temperature stays 0°C until all ice is melted. The heat is 'hidden' in a state of change. *Why this matters in AC:* - In the **evaporator**: Refrigerant absorbs LATENT heat as it boils from liquid to gas. This is where the cooling happens! - In the **condenser**: Refrigerant releases LATENT heat as it condenses from gas to liquid.	

	- **Sensible heat** changes the temperature of the refrigerant (superheat, subcooling). **Topic E: Superheat and Subcooling** **Superheat:** The amount of sensible heat added to a GAS *after* it has completely evaporated. Measured as: Actual gas temperature - Saturation temperature. *Example:* Refrigerant boils at 10°C. You measure the gas leaving evaporator at 20°C. Superheat = 10°C. *Why check?* Low superheat = liquid may enter compressor (BAD - damages compressor). Too high = not enough refrigerant. **Subcooling:** The amount of sensible heat REMOVED from a LIQUID *after* it has completely condensed. Measured as: Saturation temperature - Actual liquid temperature. Example: Refrigerant condenses at 40°C. You measure liquid leaving condenser at 35°C. Subcooling = 5°C. Why check? Subcooling ensures that only liquid (not gas) enters the metering device. More subcooling = more cooling capacity.	

Term	Changes state?	Changes temperature?	Measured by?
Sensible Heat	No	Yes	Thermometer
Latent Heat	Yes	No	No change during state change
Superheat	No (already gas)	Yes (gas heating)	Thermometer - Saturation temp
Subcooling	No (already liquid)	Yes (liquid cooling)	Saturation temp - Thermometer

5. Developing Mastery

Activity: "Heat Transfer Sorting"

Sort these scenarios into Sensible Heat, Latent Heat, Superheat, or Subcooling.

Facilitation: Give each group a set of cards with scenarios
onstruction.
Rationale: Application of definitions to concrete examples.

	Sample cards: 1. Water boiling at 100°C (temp constant)" = Latent 2. Copper pipe feels warm" = Sensible 3. Gas leaving evaporator is 15°C hotter than boiling point" = Superheat 4. Liquid leaving condenser is 8°C cooler than condensing point" = Subcooling	
C. Demonstrating Knowledge and Skills	**1. Finding Practical Application** Scenario: You check the refrigerator. The suction line (evaporator outlet) is sweating heavily and has frost. Your thermometer shows that the gas temperature is only 1°C above the boiling point. Is superheating too high or too low? What problem does this indicate? Answer: Superheat is too low. Liquid is not fully evaporating. Possible causes: overcharge of refrigerant, metering device too open, or evaporator fan failure. **2. Making Generalization** Complete this sentence: Without latent heat absorption in the evaporator there would be no _____; superheat tells me if the evaporator is _____. Sample answer: cooling; completely evaporating the refrigerant before it reaches the compressor.	**Facilitation:** Frost on suction line = liquid refrigerant entering the compressor (floodback). Superheat is too low **Rationale:** Direct application of superheat concept to real troubleshooting **Rationale:** Forces connection between abstract heat concepts and system performance.

	3. Evaluating Learning **Multiple Choice (10 pts).** Encircle the letter of the correct answer. 1. Which type of heat changes the temperature of a substance without changing its state? a) Latent heat b) Sensible heat c) Superheat d) Subcooling 2. The heat absorbed when ice melts at 0°C is an example of... a) Sensible heat b) Latent heat c) Conduction d) Superheat 3. Which unit of heat is commonly used in HVAC in the Philippines? a) Joule b) Calorie c) BTU d) Watt 4. Heat transfer through a solid material (like a copper tube) is called... a) Conduction b) Convection c) Radiation d) Sublimation 5. Superheat is measured... a) At the condenser outlet b) At the evaporator outlet c) At the compressor inlet d) Both B and C 6. Subcooling ensures that... a) Only gas enters the compressor b) Only liquid enters the metering device c) Only gas enters the evaporator d) Only liquid enters the condenser 7. Which statement about latent heat is TRUE? a) It changes temperature b) It changes state while temperature is constant c) It cannot be measured d) It only happens with water 8. The method of heat transfer that occurs when warm air rises and cool air sinks is... a) Conduction b) Convection c) Radiation d) Insulation	

	9. If the measured superheat is too high (above target), the system likely has... a) Overcharge of refrigerant b) Undercharge of refrigerant c) Clogged condenser d) Too much airflow 10. One BTU is approximately equal to... a) 1 Joule b) 100 Joules c) 1055 Joules d) 1 million Joules **ANSWER KEY** 1-b, 2-b, 3-c, 4-a, 5-d, 6-b, 7-b, 8-b, 9-b, 10-c **4. Additional Activities** Draw a simple graph showing temperature vs. heat added for ice becoming steam. Label the sensible heat regions (slanted lines) and latent heat regions (flat lines).	
VI. ASSESSMENT	**Performance Task Component:** Using a temperature-pressure chart for R-32 (provided by teacher), calculate the superheat and subcooling from given measurements. **Given measurements:** • Evaporator boiling temperature (from pressure): 5°C • Suction line temperature (at evaporator outlet): 18°C • Condensing temperature (from pressure): 45°C • Liquid line temperature (at condenser outlet): 38°C **Calculate:** 1. Superheat = _____ °C 2. Subcooling = _____ °C	

	Answer Key: Superheat = 13°C; Subcooling = 7°C **Scoring:** 5 pts each = 10 pts total (Passing: 8)
VII. REFLECTION	*This section presents the key highlights and challenges encountered by both teachers and learners during the teaching-learning process throughout the unit. It also includes the adjustments made by the teacher to improve instruction*
VIII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited, and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.

LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**5**

I. OBJECTIVES		
A. Content Standard	The learner understands the concepts and principles of installing domestic refrigeration and air-conditioning units.	
B. Performance Standard	The learner performs the installation of domestic refrigeration and air-conditioning units with safety precautions.	
C. Learning Competencies	Perform pre-installation procedure for domestic air-conditioning unit (Survey site).	
II. REFERENCES and MATERIALS	**References:** TESDA TR - DRAC NC II; ASHRAE Handbook - HVAC Systems and Equipment; PEC 2017 Part 1; Philippine Building Code **Materials:** Sample pre-installation checklist forms, tape measure, laser distance measurer, clipboard, inspection flashlight, sample heat load calculation sheet, tablet/laptop for digital forms	
III. CONTENT	Pre-Installation Procedure - Site Survey	
IV. OBJECTIVES	At the end of the lesson learners should be able to: 1. **Identify** the nine factors to check during a site survey. 2. **Explain** how each factor affects air conditioning performance. 3. **Perform** a mock site survey of a classroom using a checklist. 4. **Compute** a basic heat load estimate using a simplified formula. 5. **Document** survey findings in a standard pre-installation form.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**1. Activating Prior Knowledge** **Teacher Says:** Think of a room that is always hot even with an AC running. What could be wrong?	**Facilitation:** Do this at the front where all can see. Use a clear container.

	Likely answers: Too big room, too small AC, poor insulation, sun hitting directly, open windows, dirty filter, etc. Today we will learn to fix problems before installing the AC. We call this SITE SURVEY. **2. Establishing the Purpose of the Lesson** **Teacher Says:** Imagine you install a 1 HP AC in a 50 sqm room facing the afternoon sun. The customer complains that your AC is defective, but the AC is fine. The problem is your pre-installation assessment. A site survey protects you from callbacks, unhappy customers and wasted money.	**Rationale:** Connects pre-installation to professional liability, customer satisfaction, and business reputation.
B. Instituting New Knowledge	**3. Presenting Examples** **Teacher Says:** I will show two rooms. *Room A:* Small (12 sqm), shaded, 1 person, no appliances, insulated ceiling. *Room B:* Large (30 sqm), afternoon sun, 5 people, 2 computers, 4 lights, thin walls. **Teacher Asks:** Which room needs a larger AC? Why? List the differences. *Students list factors.* **Teacher Says:** Those differences are what we survey. **4. Discussing New Concept** **Teacher Script:** We use the acronym R-H-A-D-I-S-P-M-C to remember the nine factors. Copy this.	**Facilitation:** Use photos or video walkthroughs. **Comparative analysis** helps students identify factors.

	Factor 1: Room size and layout - Measure length, width, height. Compute floor area (sqm). Ceiling height matters: high ceilings = more volume to cool. **Factor 2: Heat load** Sources of heat: - **People:** Each person adds ~200-250 BTU/hr **- Appliances:** Computer (~300 BTU), TV (~200 BTU), refrigerator (~400 BTU) **- Lighting:** Each fluorescent tube ~40-80 BTU **- Solar radiation:** Windows facing west (afternoon sun) add huge heat **- Infiltration:** Doors/windows that leak air Simplified rule: For residential, 1 HP (8000-9000 BTU) per 15-20 sqm of normal room. For high heat load rooms, use 1 HP per 10-12 sqm. **Factor 3: Airflow and ventilation** Check: Is there space for air to enter and exit the condenser? Window types need outdoor space. Split type needs clearance around outdoor unit. *Minimum clearance:* 1-2 feet from wall, 5 feet from obstruction above, no blockage in front. **Factor 4: Drainage** Where will condensate water go? Window-type: Slopes slightly downward outside Split type: Needs drain hose to a drainage point or container **Factor 5: Insulation** Check ceiling, walls, windows. Poor insulation = high heat load. **Factor 6: Power supply** Voltage: 220V or 110V? Check outlet. **Factor 7: Structural and architectural** Can the wall/ceiling support the AC?	**Rationale:** Mnemonic aids memorization of nine factors.

	Window-type: Needs strong windowsill or bracket. Split type: Indoor unit needs strong wall. Outdoors need mounting brackets on concrete wall (not hollow blocks alone). **Factor 8: Maintenance access** Can you reach the unit to clean filters, check compressors, and clean coils? **Factor 9: Codes and permits** PEC requirements: Proper wire sizing, grounding, circuit protection. **Pre-Installation Checklist (Teacher distributes sample form): This** is your tool. Mark each factor as Acceptable, Needs Adjustment, or Reject. If Needs Adjustment, note what must be fixed before installation. **5. Developing Mastery** **Activity: "Classroom Site Survey"** **Teacher Says:** We will survey this classroom as if we are installing a 1.5 HP window-type AC. Use your checklist. Report findings after 10 minutes. *Groups report:* Room size (measure), windows (facing? shading?), power supply (outlet type, voltage), drainage (possible outlet), maintenance access	**Facilitation:** Divide class into 5 groups. Assign each group of 2-3 factors to survey in the classroom. **Rationale:** Hands-on, authentic application. Students practice measurement and documentation.
C. Demonstrating Knowledge and Skills	**1. Finding Practical Application** **Teacher Says:** Scenario: You survey a 25 sqm bedroom. West-facing window (no curtain). 2 people. 1 computer. 4 LED lights. Ceiling is galvanized iron (no insulation). What AC capacity would you recommend and why? *Answer:* Recommend 2.0 HP, OR advise customers to install blackout curtains and ceiling insulation then use 1.5 HP.	**Facilitation:** Guide calculation: 25 sqm normal = 1.5 HP. But west sun + no insulation + computer = high heat load. Recommend 2.0 HP or suggest adding insulation/curtains first. **Rationale:** Professional ethics - honest recommendation, not just selling bigger

	2. Making Generalization Complete this sentence: A proper site survey prevents _____ by identifying _____ before installation Sample answer: ...customer complaints; problems like insufficient power, poor drainage and wrong AC sizing. **3. Evaluating Learning** **Multiple Choice (10 pts).** Encircle the letter with the correct answer. 1. Which factor refers to the ability of the wall to hold the AC unit? a) Power supply b) Structural integrity c) Airflow d) Drainage 2. How many BTU per hour does an average person add to heat load? a) 50 BTU b) 200-250 BTU c) 1000 BTU d) 5000 BTU 3. Which window orientation adds the MOST heat load in the Philippines? a) North b) East c) South d) West 4. What is the minimum clearance typically recommended for a condenser unit? a) 0 feet b) 1-2 feet c) 5 feet d) 10 feet 5. Which factor checks if water from the AC has a place to go? a) Insulation b) Power supply c) Drainage d) Codes and permits 6. For a normal residential room, 1 HP of cooling is typically sufficient for how many square meters? a) 5-10 sqm b) 15-20 sqm c) 30-40 sqm d) 50-60 sqm	**Rationale:** Emphasizes the preventative nature of site surveys.

	7. Which appliance adds significant heat to a room? a) LED light b) Ceiling fan c) Desktop computer d) Wooden chair 8. A west-facing window without curtains is a problem for which factor? a) Power supply b) Heat load (solar radiation) c) Maintenance access d) Codes 9. Why is a dedicated electrical line recommended for AC units? a) Saves electricity b) Prevents circuit overloading c) Makes AC colder d) Required by barangay 10. Which of the following is a code requirement? a) AC must be 2 HP b) Proper grounding of AC c) AC must be split-type d) Drainage to street Answers: 1-b, 2-b, 3-d, 4-b, 5-c, 6-b, 7-c, 8-b, 9-b, 10-b 11-False, 12-True, 13-False, 14-False, 15-True **4. Additional Activities** Draw a simple site survey checklist with 9 factors. Write one question you would ask the customer for each factor.	
VI. ASSESSMENT	**Performance Task:** Complete a **Pre-Installation Survey Form** for a room of your choice (at home or in school). Include: 1. Drawing/ sketch of room layout with dimensions 2. Checklist of 9 factors with findings (Acceptable/Needs Adjustment/Reject) 3. Heat load estimate (list all sources) 4. Recommended AC capacity (HP or BTU) 5. Recommendations for any needed corrections	

	Rubric:			
	Criteria	Excellent (5)	Satisfactory (3)	Needs Improvement (1)
	Complete dimensions	All 3 (L, W, H) measured	2 measured	1 or none
	Nine factors addressed	All 9 with specific notes	6-8 factors	Below 6
	Heat load calculation	All sources listed, computed	Some sources	No calculation
	Recommendation	Specific HP, with justification	HP only	No recommendation
	Professional documentation	Neat, organized, readable	Some organization	Unclear
	Total: 25 pts (Passing: 20)			
VII. REFLECTION	*This section presents the key highlights and challenges encountered by both teachers and learners during the teaching-learning process throughout the unit. It also includes the adjustments made by the teacher to improve instruction*			
VIII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited, and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.			

LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**6**

I. OBJECTIVES		
A. Content Standard	The learner understands the concepts and principles of installing domestic refrigeration and AC units.	
B. Performance Standard	The learner performs installation with safety precautions.	
C. Learning Competencies	Perform procedures installing a window-type air-conditioning unit (Cavity works, mounting support, positioning, electrical, insulation, condensate drain).	
II. REFERENCES and MATERIALS	**References:** TESDA TR - DRAC NC II; Manufacturer installation manuals (e.g., Carrier, Kolin, LG) **Materials:** Actual window-type AC (for demo), bracket, level, drill, screwdriver, insulation foam, PVC drain hose, electrical tools, safety gear (gloves, goggles)	
III. CONTENT	Window-Type Air Conditioning Unit Installation Procedure	
IV. OBJECTIVES	At the end of the lesson learners should be able to: 1. **Sequence** the 6 major steps of window-type AC installation. 2. **Demonstrate** proper leveling of an AC unit. 3. **Explain** why the unit must slope slightly downward outside. 4. **Install** a condensate drain line correctly. 5. **Perform** a complete window-type AC installation simulation following OHS.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**1. Activating Prior Knowledge** **Teacher Says:** Look at this photo. A customer window-type AC is dripping water inside the room, and the wall has black mold. What went wrong?	***Facilitation:*** *Show a clear photo or drawing of an incorrectly installed unit*

	Students answer: No slope outward, no drain hose, no insulation. **Teacher Says:** Today we learn the correct sequence, so you never cause these problems. **2. Establishing the Purpose of the Lesson** **Teacher Says:** This is not just screw and plug. A wrong installation can: (1) make the unit fall and injure someone, (2) cause electrical fire, (3) flood the room, (4) waste electricity, and (5) destroy your reputation. Follow the sequence. Skip one step = liable for damages.	– *sloping inward, no sealant, cord dangling.* ***Rationale:*** *Engages error analysis and diagnostic thinking before instruction.* ***Rationale:*** *High-stakes framing emphasizes professionalism, safety, and legal responsibility.*
B. Instituting New Knowledge	**3. Presenting Examples** Teacher Says: I will show two 30-second clips. Clip A: A professional installer measuring the cavity, installing a bracket, leveling, and sealing. Clip B: A kanto installer using no bracket, no level, no sealant. Write two differences you see. *Students share observations.* Teacher Says: We will follow Clip A's method exactly. **4. Discussing New Concept** **Teacher Script:** Copy this six-step procedure. I will demonstrate each step while you take notes.	**Facilitation:** Pause after each clip. Ask: Which one will last longer? Which one is safer?

	Step 1: Cavity Preparation Measure the opening (width x height. Standard window-type chassis needs opening ½" to 1" larger than unit dimensions. Example: If the unit is 500mm wide, the opening should be 525mm. Clean debris, remove obstacles. Check for pests or old wiring. **Step 2: Mounting Support** Install a heavy-duty bracket or support frame. Must be rated for 3x the unit weight (safety factor). Use concrete anchors – not ordinary wood screws. Check with spirit level: LEVEL side-to-side. If the bracket is tilted, the unit will be tilted. **Step 3: Positioning** Slide the unit into the cavity. Crucial: The unit must slope 5 to 10 degrees DOWNWARD toward the outside – about ¼" drop for every 12" of depth. Why? So, condensate water flows out, not inside. Use shims if needed. Re-check level. **Step 4: Electrical** Plug into a dedicated outlet. If no outlet exists, install a new circuit per Lesson 6 (PEC). No extension cords – they overheat and cause fire. Ensure grounding: three-prong plug with functional ground. Test voltage before turning on. **Step 5: Insulation**	**Rationale:** Step-by-step demonstration with physical unit maximizes retention. **Rationale:** Safety factor and anchor selection directly affect structural integrity. *Demonstration: Place a small bubble level on top of the unit. Show the tilt.* ***Rationale:*** *Direct link to previous lesson reinforces PEC compliance.*

	Apply foam sealant or pre-cut insulation strips around all gaps between the unit and the wall/window frame. Prevents: (a) hot air infiltration, (b) insects/rodents, (c) rain leaks, (d) noise. **Step 6: Condensate Drain** Some units have a rubber drain plug at the rear bottom. Attach a PVC or rubber hose (½" or ¾"). Route the hose downward continuously – no dips or kinks – to a drainage point or container. Test by pouring water into the base pan; verify it flows out. **5. Developing Mastery** **Activity: "Installation Sequence Relay"** Teacher Says: Arrange the cards in the correct order. Then, for each step, one group member must act out or explain the most critical safety check. First group with correct order and clear explanation wins.	***Facilitation:*** *Show before/after photos of sealed vs. unsealed units.* ***Rationale:*** *Prevents "dripping on sidewalk" violations and customer complaints.* ***Facilitation:*** *Divide class into 4 groups. Give each group 6 large cards with step names (jumbled).* ***Rationale:*** *Kinesthetic + verbal rehearsal strengthens memory.*
C. Demonstrating Knowledge and Skills	**1. Finding Practical Application** Scenario: You arrive at a customer's house. The wall opening is 2 inches wider than the AC. No bracket is available. The customer says, 'Just stuff rags in the gaps and prop it with wood.' What do you do?	**Facilitation:** Guide calculation: 25 sqm normal = 1.5 HP. But west sun + no insulation + computer = high heat load. Recommend 2.0 HP or suggest adding insulation/curtains first. **Rationale:** Professional ethics - honest recommendation, not just selling bigger

	Answer: Refuse unsafe installation. Explain that rags are fire hazards, and wood can shift. Recommend proper bracket and proper filler (foam sealant + L-bracket extender or frame modification). **2. Making Generalization** **Teacher Says:** Complete this sentence: The difference between a professional window-type AC installation and a temporary one is _____. *Sample answers:* -following all six steps without skipping. -using the right bracket, slope and sealant. -documenting the work. **3. Evaluating Learning** **Multiple Choice (10 pts).** Encircle the letter with the correct answer. 11. What is the correct slope direction for a window-type AC? a) Level (no slope) b) Downward inside c) Downward outside d) Upward outside	**Rationale:** Synthesis of quality, safety, and durability.

	12. The support bracket must be rated for at least how many times the unit weighs? a) 1x b) 2x c) 3x d) 5x 13. Why are extension cords prohibited for window-type AC? a) They are expensive b) They cause voltage drop and fire hazard c) They are short d) The customer might trip 14. Which tool is used to check if the bracket is level side-to-side? a) Tape measure b) Clamp meter c) Spirit level d) Thermometer 15. What material is typically used to seal gaps around the AC unit? a) Duct tape b) Foam sealant or insulation strips c) Cardboard d) Plastic bag 16. Where should condensate water flow? a) Inside the room b) Into a bucket inside c) Outside or into a proper drain d) Into the electrical panel 17. If the AC slopes inward, what happens? a) Better cooling b) Water drips inside c) Compressor runs faster d) Filter cleans itself 18. Before sliding the unit into the cavity, you must: a) Plug it in first b) Clean debris and measure c) Turn it on high cool d) Remove the compressor 19. Insufficient insulation around the AC leads to: a) Higher electricity bill b) Insect entry c) Hot air infiltration d) All of the above	

	20. After installation, you should test the drain by: a) Blowing into the hose b) Pouring water into the base pan c) Ignoring it d) Taping the drain closed Answers: 1-c, 2-c, 3-b, 4-c, 5-b, 6-c, 7-b, 8-b, 9-d, 10-b **4. Additional Activities** Draw a simple flowchart of the 6 steps. Besides each step, write ONE possible mistake and their consequences.	
VI. ASSESSMENT	**Performance Task:** Each student will install a window-type AC (or simulator) following a Practical Exam Checklist. Drawing/ sketch of room layout with dimensions Step — Task — Pass/Fail 1 — Measures opening correctly (within ½–1" tolerance) 2 — Installs bracket level and secure with proper anchors 3 — Positions unit with correct outward slope (5–10°) 4 — Makes proper electrical connection (grounded, no extension cord) 5 — Seals gaps with insulation foam or strips 6 — Installs drain line without kinks, tests with water 7 — Follows OHS (gloves, goggles, ladder safety, no loose wires) **Passing:** All 7 steps PASS.	

VII. REFLECTION	*This section presents the key highlights and challenges encountered by both teachers and learners during the teaching-learning process throughout the unit. It also includes the adjustments made by the teacher to improve instruction*
VIII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited, and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.

LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**7**

I. OBJECTIVES	
D. Content Standard	The learner understands the concepts and principles of maintaining domestic refrigeration and window-type air-conditioning units.
E. Performance Standard	The learner performs the maintenance of domestic refrigeration and window-type air-conditioning units with safety precautions.
F. Learning Competencies	Perform maintenance of window-type air-conditioning units (Cleaning procedure of the air filter - Types, Specs, Restricted airflow effects.
II. REFERENCES and MATERIALS	• **References:** TESDA TR - DRAC NC II Unit of Competency: Maintain Window-Type Air Conditioning Units; Manufacturer service manuals (Carrier, Kolin, LG, Panasonic); ASHRAE Handbook - HVAC Systems • **Materials:** Actual window-type AC unit (for demonstration), different types of air filters (washable foam, electrostatic, carbon, HEPA), dirty filter sample, clean filter sample, vacuum cleaner, soft brush, mild detergent, water hose, basin, microfiber cloth, magnifying glass, flashlight • **Tech Integration:** Time-lapse video showing airflow reduction from dirty filter, YouTube "How to Clean Window AC Filter - Step by Step", digital checklist app (Google Forms), QR code linking to manufacturer filter specs
III. CONTENT	**Title:** Maintenance of Window-Type AC - Air Filter Cleaning **Sub-topics:** 1. Types of air filters used in window-type AC (Foam, Mesh, Electrostatic, Carbon, HEPA) 2. Filter specifications (Size, MERV rating, washable vs. disposable)

	3. Effects of restricted airflow (Frozen evaporator, reduced cooling, high electric bill, compressor damage) 4. Step-by-step filter cleaning procedure 5. How often to clean filters (Frequency schedule) Safety precautions when cleaning filters	
IV. OBJECTIVES	At the end of the lesson, learners should be able to: 1. **Identify** at least three types of air filters used in window-type ACs. 2. **Explain** what happens to an AC when the air filter is clogged. 3. **Demonstrate** the proper procedure for removing, cleaning, and reinstalling a washable air filter. 4. **Differentiate** between washable and disposable filters. 5. **Determine** the correct cleaning frequency based on usage conditions. 6. **Follow** safety precautions (unplugging unit, handling wet components).	
V. PROCEDURES		**ANNOTATIONS**
D. Activating Prior Knowledge	**1. Activating Prior Knowledge** **Activating Prior Knowledge (5 mins)** • **Teacher Says:** "Good morning, class! Let me ask you a simple question. Who here has ever cleaned the air filter of their air conditioner at home? Raise your hand." *The teacher pauses.*	**Facilitation:** Count hands. Most students likely have NOT cleaned filters. **Rationale:** Reveals the gap between awareness and practice. Creates a "teachable moment."

	Teacher Says: "For those who raised hands—how often do you clean it? For those who didn't—what do you think happens if you NEVER clean the filter?" (Call 2-3 students.) **Teacher Says:** "Today, I will show you why a dirty air filter is the #1 cause of 'mahina ang lamig' complaints. And the best part? Cleaning it takes only 10 minutes, requires almost no tools, and can save your customer thousands of pesos on electric bills and repair costs. This is the easiest money you will make as a technician." **Teacher Says:** "I have two AC units here (or pictures). Watch this demonstration *Teacher shows:* A fan blowing through a clean filter (strong airflow). Then a fan blows through a dirty, clogged filter (weak airflow). **Teacher Says:** "What did you observe? (Airflow was blocked by the dirty filter). Now imagine your AC trying to pull air through that for months. The fan works harder; the evaporator gets too cold, ice forms, and the compressor struggles. That is what we prevent **Teacher Says:** "Now let me show you actual filters from real ACs Brand new clean foam filter Dirty filter (gray, clogged with dust, maybe mold) Disposable filter (paper/cardboard frame) Carbon filter (black, thin)	**Rationale:** Connects a simple task to customer satisfaction, energy savings, and technician income. Motivates learning. **Facilitation:** Use a clear plastic tube or vacuum demonstration. Or show time-lapse videos. **Rationale:** Visual, dramatic comparison. Students SEE the difference instantly.

E. Instituting New Knowledge	**Activating Prior Knowledge (5 mins)** **Teacher Says:** "Good morning, class! Let me ask you a simple question. Who here has ever cleaned the air filter of their air conditioner at home? Raise your hand "For those who raised hands—how often do you clean it? For those who didn't—what do you think happens if you NEVER clean the filter?" (Call 2-3 students.) **Establishing the Purpose (3 mins)** **Teacher Says:** "Today, I will show you why a dirty air filter is the #1 cause of 'mahina ang lamig' complaints. And the best part? Cleaning it takes only 10 minutes, requires almost no tools, and can save your customer thousands of pesos on electric bills and repair costs. This is the easiest money you will make as a technician. **Presenting Examples (10 mins)** **Teacher Says:** "I have two AC units here (or pictures). Watch this demonstration. *Teacher shows:* A fan blowing through a clean filter (strong airflow). Then a fan blows through a dirty, clogged filter (weak airflow). **Teacher Says:** "What did you observe? (Airflow was blocked by the dirty filter). Now imagine your AC trying to pull air through that for months. The fan works harder; the evaporator gets too cold, ice forms, and the compressor struggles. That is what we prevent.	**Facilitation:** Count hands. Most students likely have NOT cleaned filters. **Rationale:** Reveals the gap between awareness and practice. Creates "teachable moment **Rationale:** Connects a simple task to customer satisfaction, energy savings, and technician income. Motivates learning. **Facilitation:** Use a clear plastic tube or vacuum demonstration. Or show time-lapse video **Rationale:** Visual, dramatic comparison. Students SEE the difference instantly.

	Teacher Says: "Now let me show you actual filters from real ACs." *Teacher passes around:* Brand new clean foam filter Dirty filter (gray, clogged with dust, maybe mold) Carbon filter (black, thin) **Topic A: Types of Air Filters** 1. Foam/Mesh Filter (Most Common in Window-Type AC 2. Electrostatic Filter 3. Carbon Filter 4. HEPA Filter (High Efficiency Particulate Air) Topic B: Filter Specifications Effect #2: Frozen Evaporator Coils Effect #3: High Electric Bill Effect #4: Compressor Damage (Expensive Repair!) Topic D: Step-by-Step Filter Cleaning Procedure Step 1: Safety First 2.Remove the Front Grille 3. Remove the Filter 4. Inspect the Filter 5. Clean the Filter (For Washable Filters) 6. Clean the Filter Housing Area 7. Reinstall the Filter 8. Close the Grille and Test 9. Document and Educate the Customer	**Rationale: Engaging** title keeps attention.

F. Demonstrating Knowledge and Skills	**Activity: "Hands-On Filter Cleaning"** **Teacher Says:** "Now you will do it. Follow the steps I just taught you. I will observe and give feedback." *Teacher circulates, checks:* - Did they wear gloves? - Did they vacuum first? Did they use mild soap? Did they rinse thoroughly? Are they letting it dry properly? **Finding Practical Application (7 mins)** **Teacher Says:** "Scenario: You are called to a customer's house. Complaint: 'My AC is running but the room is not getting cold. It used to be cold. You check the filter. It is gray and clogged. You clean it. The customer asks, 'How much do I owe you?' What do you charge? And what do you tell the customer to prevent this problem from happening again?" *Answer:* Charge your service fee (e.g., ₱300-500). Tell the customer: "The filter was completely blocked. This prevented airflow. Your AC will cool properly now. To prevent this, clean the filter every 2 weeks. You can do it yourself—I can show you how." **Teacher Says:** "Complete this sentence: 'A dirty air filter is like _____ because _____. *Sample answers* "...a clogged nose because you cannot breathe properly." a mask with no holes because air cannot pass through a closed window because no fresh air enters	Facilitation: Divide class into 5 groups. Each group gets a dirty filter and a basin with soapy water. **Rationale:** Kinesthetic learning. Skills are built through DOING, not just listening. **Facilitation:** Discuss pricing. Typical service call + filter cleaning in the Philippines: ₱300-500. **Rationale:** Teaches customer education and preventive maintenance—good for repeat business. **Rationale:** Analogy construction deepens understanding.

	Evaluating Learning: QUIZ (10 mins) **Additional Activities (2 mins)** **Remediation:** Draw a before-and-after diagram showing airflow through a clean filter vs. a dirty filter. Label the direction of air.	
VI. ASSESSMENT	The learners' understanding will be evaluated through **written, performance-based, and oral assessments**. **EVALUATING LEARNING: QUIZ** **I. Multiple Choice (10 pts).** Encircle the letter with the best answer. 1. Which type of air filter is MOST common in standard window-type air conditioners? a) HEPA b) Carbon c) Foam/Mesh d) Fiberglass 2. What is the #1 effect of a severely clogged air filter on cooling performance? a) Louder noise b) Reduced cooling (mahina ang lamig) c) Water spraying d) Remote control stops working 3. How often should a filter be cleaned for a daily-used window-type AC? a) Everyday b) Every 2 weeks c) Every 6 months d) Once a year 4. Why should you NEVER install a wet filter back into the AC? a) It will short-circuit b) It promotes mold growth c) It will freeze immediately d) It will tear easily 5. What tool is best for removing loose dust from a filter BEFORE washing? a) Hammer b) Wire brush c) Vacuum cleaner with brush attachment d) Hair dryer 6. What does restrict airflow cause to happen on the evaporator coils? a) Overheating b) Freezing / ice buildup c) Rusting d) Compressor stops 7. Which filter type is designed to remove ODORS (smoke, cooking smells)? a) Foam b) Mesh c) Carbon d) HEPA 8. What should you do if you encounter a disposable filter that is dirty? a) Wash it with soap and water b) Replace it with a new one c) Shake it and reinstall d) Tell the customer it is fine 9. A filter that allows light to pass through is considered: a) Severely clogged b) Moderately clogged c) Clean or slightly dirty d) Broken 10. What is the FIRST step before removing any AC filter? a) Remove the front grille b) Unplug the AC c) Prepare soap and water d) Wear a face mask	

II. Matching (5 pts). Match the effect to the description.

Effect	**Description**
11. Frozen evaporator	A. AC runs longer, uses more electricity
12. Reduced cooling	B. Ice forms on coils, blocks airflow completely
13. High electric bill	C. The room never reaches the set temperature
14. Compressor damage	D. Oil breaks down, compressor seizes
15. Water leakage	E. Ice melts and drips inside the room

Performance Task (Hands-On Demonstration):
Each student will demonstrate the complete filter cleaning procedure on a training AC unit or simulator.

Practical Exam Checklist (20 points total):

Step	Task	Points	Pass/Fail
1	Unplugs unit before starting	2	
2	Wears gloves	1	
3	Removes front grille correctly	2	
4	Removes filter without tearing	1	
5	Vacuum removes loose dust first	2	
6	Uses mild soap (not harsh chemicals)	2	
7	Rinses until water runs clear	2	

	8	Allows filter to dry completely (or uses dry spare)	2
	9	Reinstalls filter in correct orientation	2
	10	Reattaches grille and tests unit	2
	11	Documents the service	2
	Passing Score: 16/20 (80%)		
VII. REFLECTION	**REFLECTION** • **Highlights:** • **Challenges:** • **Adjustments:**		
VIII. USE OF GENERATIVE AI	In preparing this Learning Exemplar (LE), the author used Generative AI to assist in structuring and drafting instructional content and assessment items. The author reviewed, edited, and finalized the writing of the content to ensure alignment with curriculum standards and contextual relevance. The author takes full responsibility for the final content of this LE.		

LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**8**

I. OBJECTIVES	
A. Content Standard	The learner understands the concepts and principles of maintaining domestic refrigeration and window-type air-conditioning units.
B. Performance Standard	The learner performs the maintenance of domestic refrigeration and window-type air-conditioning units with safety precautions.
C. Learning Competencies	Perform cleaning methods of the mechanical system (Tools and equipment, assembling and disassembling, cleaning chemical agents and dent effects.
II. REFERENCES and MATERIALS	**References:** TESDA TR - DRAC NC II; Manufacturer service manuals; Material Safety Data Sheets (MSDS) for coil cleaners; ASHRAE Handbook **Materials:** Window-type AC unit (for disassembly demonstration), screwdrivers (flat and Phillips), nut drivers, wrench set, pliers, soft brush, fin comb, coil cleaner spray (alkaline and non-acidic), water sprayer, protective cover for electrical parts, microfiber cloths, gloves, safety goggles, N95 mask **Tech Integration:** Video "Deep Cleaning a Window AC - Complete Disassembly", QR code linking to MSDS of coil cleaners, interactive parts labeling tool
III. CONTENT	Cleaning Methods of the Mechanical System **Sub-topics:** 1. Tools and equipment for mechanical system cleaning 2. Step-by-step disassembly of window-type AC (removing casing, accessing evaporator, condenser, blower wheel) 3. Cleaning chemical agents (Types: alkaline coil cleaner, self-rinse, no-rinse, foaming vs. non-foaming) 4. Application of cleaning agents (Dilution ratios, contact time, rinsing) 5. Effects of kinks and dents in condenser and evaporator coils (Reduced heat transfer, high pressures, compressor failure)

	6. Proper reassembly and testing	
IV. OBJECTIVES	At the end of the lesson, learners should be able to: 1. **Identify** the tools needed for deep cleaning a window-type AC. 2. **Disassemble** a window-type AC to access the mechanical components. 3. **Select** the appropriate cleaning chemical for evaporator vs. condenser coils. 4. **Explain** why kinks and dents in coils reduce AC performance. 5. **Demonstrate** proper application of coil cleaner without damaging fins or electrical parts. 6. **Reassemble** the unit correctly and test operation.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**Activating Prior Knowledge** **Teacher Says:** "Last lesson, we learned how to clean the air filter. But is that enough? What if the AC still has poor cooling even after a clean filter? **Teacher Says:** "Exactly. Today, we went to DEEPER. We open the AC and clean the parts the customer never sees—the evaporator, condenser, and blower wheel **Establishing the Purpose (3 mins)** **Teacher Says:** "A customer calls you and says, 'I cleaned the filter myself, but my AC still isn't cold.' This is where you make real money. A deep mechanical cleaning (what we call 'general cleaning') costs ₱800-1,500. And it takes 1-2 hours. Today, you learned that skill." **Presenting Examples (10 mins)** **Teacher Says:** "Watch this 2-minute video of a severely clogged evaporator coil *Play videos.*	**Facilitation:** Call on students. Elicit: "The coils are dirty," "The fan is dirty," "The inside is clogged. **Rationale:** Builds on Lesson 1. Shows progression from basic to advanced maintenance **Rationale:** Establishes market value of the skill. Connects to income potential. **Facilitation:** Play video showing a coil packed with dust and lint. **Rationale:** Visual demonstration of "hidden dirt." Students cannot see this without disassembly.

	Teacher Says: "Now look at these two coils *Teacher shows:* Clean coil (shiny metal, fins straight, air passes through easily) -Dirty coil (gray/black, fins clogged, looks like felt) **-Teacher Asks:** "Which coil transfers heat better? Why?	
B. Instituting New Knowledge	**Discussing New Concept** **Teacher Script:** "Take notes. This is the 'General Cleaning' procedure that separates amateurs from professionals **Topic A: Tools and Equipment for Mechanical Cleaning** You need these tools. Check them off as I show them 1. **Hand Tools (for disassembly** 2. **Cleaning Tools** 3. **. Personal Protective Equipment (PPE) – REQUIRED** **Topic B: Disassembly Procedure (Accessing the Mechanical System)** **Steps** 1: Prepare the Unit 2: Remove the Control Panel 4. Remove the Top Cover 5. Remove the Front Casing (Wrapper) 6. Remove the Rear Grille (if needed to access condenser) 7. Cleaning Chemical Agents	**Rationale:** Professional identity building.

	Recommended Coil Cleaners For EVAPORATOR COILS (indoor, aluminum) **Topic D: Application of Cleaning Agents** Step-by-Step Cleaning - Evaporator Coils Teacher should create Step by Step in cleaning procedure in cleaning window type air conditioner evaporator.	
C. Demonstrating Knowledge and Skills	**Developing Mastery** **Activity: "Hands-On Partial Disassembly** **Teacher Says:** "In your groups, disassemble the unit until you can see the evaporator coils and blower wheel. DO NOT remove the casing entirely yet—just enough to see. I will come around to check *Teacher circulates, checks:* Did they unplug at first? Did they take photos? Did they label wires? Did they protect electrical parts? **Finding Practical Application** **Teacher Says:** "Scenario: You are cleaning a window-type AC. The evaporator coils are very dirty packed with lint. You apply coil cleaner	Facilitation: Divide class into groups of 4-5. Each group gets one training AC unit. **Rationale:** Team-based, low-risk practice before independent skill demonstration **Facilitation:** Guide to discussion. Condenser may look clean on the outside but can be dirty between the fins

	The customer asks, 'Will you also clean the condenser?' The condenser looks clean from outside. Do you still clean it? Why or why not? *Answer:* Yes, you should still clean the condenser if you have already disassembled the unit. The customer is paying for complete general cleaning. It takes an extra 5 minutes and ensures full system performance	**Rationale:** Professional ethics—do the complete job, not just what is visible
VI. ASSESSMENT	**Teacher Activity:** **Additional Activities (2 mins)** **Remediation:** Draw a simple diagram of a window-type AC. Label: Evaporator coil, Condenser coil, Blower wheel, Compressor, Control panel **Enrichment:** Research: What is the difference between "no-rinse" coil cleaner and "rinse-required" coil cleaner? When would you use each? Write 3 sentences **EVALUATING LEARNING: QUIZ** **I. Multiple Choice (10 pts).** Encircle the letter. 1. Which tool is used to straighten bent aluminum fins on a coil? a) Hammer b) Fin comb c) Wire brush d) Screwdriver 2. What type of chemical should NEVER be used to clean AC coils? a) Alkaline coil cleaner b) Muriatic acid c) Foaming coil cleaner d) Self-rinse cleaner 3. What is a kink in a copper tube? a) A bend that restricts flow b) A type of connector c) A cleaning tool d) A fan blade 4. Why should you cover electrical components before spraying water or chemicals? a) To keep them clean b) To prevent short circuits and damage c) To save water d) To make the unit heavier	

5. What is the correct order of disassembly? a) Casing → Filter → Grille → Control panel b) Filter → Grille → Control panel → Casing c) Grille → Filter → Control panel → Casing d) Control panel → Casing → Filter → Grille
6. Which component moves air across the evaporator coil? a) Compressor b) Blower wheel c) Condenser fan d) Capillary tube
7. A dented area on a coil causes: a) Improved cooling b) Reduced airflow and heat transfer c) Lower electricity use d) Faster compressor speed
8. What PPE is REQUIRED when using coil cleaner spray? a) Sunglasses only b) Goggles, gloves, and mask c) Just gloves d) Nothing, it is safe
9. How long should the coil cleaner be left on the coils (contact time) before rinsing? a) 30 seconds b) 5-10 minutes c) 1 hour d) Overnight
10. What should you do immediately if the coil cleaner gets into your eyes? a) Rub your eyes b) Rinse with water for 15 minutes and seek medical help c) Ignore it d) Apply more cleaner

II. True or False (5 pts). Write TRUE or FALSE.

11._____ Dish soap is an excellent cleaner for AC coils.
12._____ You should take photos during disassembly to help with reassembly.
13._____ A kinked copper tube can be simply bent back to fix it.
14._____ The condenser coil is located at the FRONT of a window-type AC (facing the room).
15._____ High-pressure washers are safe to use on AC coils.

III. Essay (5 pts). You are training a new helper. He wants to use muriatic acid to clean a dirty condenser coil because "it cleans faster." How do you explain why this is dangerous and wrong?

ANSWER KEY

1-b, 2-b, 3-a, 4-b, 5-c, 6-b, 7-b, 8-b, 9-b, 10-b
11-False, 12-True, 13-False, 14-False, 15-False

Essay Sample:

"Muriatic acid will destroy the aluminum fins. It causes rapid corrosion—the fins will turn into white powder and fall off. Without fins, the coil cannot transfer heat. The AC will never cool again. Use only alkaline coil cleaners made specifically for HVAC coils. Also, muriatic acid is dangerous to your skin, eyes, and lungs. Never use it on AC equipment.

A. Written Assessment (Knowledge Check)

Performance Task (Hands-On Demonstration):
Each student will perform a **complete mechanical cleaning** on a training AC unit following a checklist.

Practical Exam Checklist (30 points total):

Step	Task	Points	Pass/ Fail
1	Unplugs unit and removes filter/grille	2	
2	Disassembles to access evaporator correctly	3	
3	Covers electrical parts before cleaning	2	
4	Vacuums loose debris from coils	2	
5	Applies appropriate coil cleaner correctly	3	
6	Allows proper contact time	2	
7	Rinses with low-pressure water only	3	
8	Cleans blower wheel with brush	2	
9	Checks for kinks or dents (reports findings)	2	

	10	Dries components before reassembly	2
	11	Reassembles in correct order	3
	12	Tests unit operation after reassembly	2
	13	Follows all safety (PPE, unplugging)	2
	Passing Score: 24/30 (80%)		
VII. REFLECTION	**REFLECTION** • **Highlights:** • **Challenges:** • **Adjustments:** • **Learners for remediation**		
VIII. USE OF GENERATIVE AI	Proper maintenance of Air Conditioner fan motor involves cleaning, inspection, lubrication, and basic troubleshooting. These methods are important to ensure efficient operation, prevent damage, promote safety, and extend the lifespan of the appliance. Applying these practices in real-life situations helps reduce repair costs and improve appliance performance.		

LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**9**

I. OBJECTIVES	
A. Content Standard	The learner understands the concepts and principles of maintaining domestic refrigeration and window-type air-conditioning units.
B. Performance Standard	The learner performs the maintenance of domestic refrigeration and window-type air-conditioning units with safety precautions.
C. Learning Competencies	Discuss maintenance methods of the fan motor (Types, operation, voltage requirements, fan blade/blower types, lubrication, mounting support and alignment
II. REFERENCES and MATERIALS	**REFERENCES and MATERIALS** • **References:** TESDA TR - DRAC NC II; Motor maintenance manuals; Manufacturer service bulletins • **Materials:** Different fan motor types (shaded pole, PSC, capacitor start), multimeter, lubrication oil (electric motor oil - NOT WD-40), fan blades (propeller, blower wheel, axial), mounting brackets, spirit level, tachometer (for RPM check), screwdrivers, wrench set • **Tech Integration:** Video "How to Lubricate a Fan Motor - Correct Way", QR code linking to motor wiring diagrams, sound recording of bearing noise vs. normal motor sound
III. CONTENT	**Title:** Maintenance Methods of the Fan Motor **Sub-topics:** 1. Types of fan motors used in window-type AC (Shaded pole, PSC - Permanent Split Capacitor) 2. Motor operation principles (How they start and run) 3. Voltage requirements (220V vs. 110V, checking nameplate) 4. Fan blade/blower types (Propeller for condenser, Squirrel cage blower for evaporator) 5. Lubrication procedures (When, where, what oil to use) 6. Mounting support and alignment (Preventing vibration and noise) 7. Signs of motor failure (Humming but not spinning, noisy bearings, burnt smell)
IV. OBJECTIVES	At the end of the lesson, learners should be able to: 1. **Identify** the two main types of fan motors used in window-type ACs. 2. **Explain** why lubrication is important for motor longevity. 3. **Demonstrate** proper lubrication of a motor with oil ports.

	4. **Check** motor mounting alignment to prevent vibration. 5. **Measure** voltage supply to a fan motor. 6. **Replace** a fan blade without damaging the motor shaft.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**Activating Prior Knowledge** **Teacher Says:** "In Lesson 2, we cleaned the blower wheel. What turns that blower wheel? What makes it spin? **Teacher Says:** "Yes. The fan motor. And what happens when a fan motor stops working?" (No airflow, evaporator freezes, no cooling **Establishing the Purpose** **Teacher Says:** "A fan motor that is noisy, slow, or not spinning is a common service call. A new motor costs ₱1,500-3,500. But sometimes, the motor just needs LUBRICATION or cleaning. Today, you learn how to tell the difference and how to make a motor last longer. That saves your customer money and builds your reputation. **Teacher Says:** "Listen to these two sounds *Sound 1:* Quiet hum, smooth airflow (good motor). *Sound 2:* Grinding, squealing, rattling (bad bearing or loose mount). **Teacher Says:** "Which sound means trouble? (Sound 2). Today, you learn to fix that before the motor fails completely. **Teacher also shows:** -Shaded pole motor (small, no capacitor, common for evaporator fan) -PSC motor (slightly larger, has a capacitor)	**Facilitation:** Call on students. "The motor," "The fan motor **Rationale:** Links back to previous lesson. Build continuity. **Rationale:** Shows value of preventive maintenance vs. replacement. Build diagnostic skills. **Facilitation:** Play audio clips or demonstrate with actual motors. **Rationale:** Trains for diagnosis.

	-Bad bearing (wobbly shaft) -Burnt motor (wires discolored, smell)	
B. Instituting New Knowledge	**Discussing New Concept** **Teacher Script:** "Title: 'Fan Motor Maintenance - Keeping the Air Moving. **Topic A: Types of Fan Motors** **1. Shaded Pole Motor** - Most common in window-type ACs for the evaporator fan (indoor blower) -Simple construction: No capacitor, no start switch -Low starting torque (cannot push heavy loads) - Speed is controlled by voltage (lower voltage = slower speed) -Usually, 2-4 speeds in window ACs *-Advantage:* Cheap, reliable - *Disadvantage:* Inefficient (runs hot), cannot be used for heavy fans - *Identification:* Look for copper shading rings around the stator poles - *Wiring:* Usually 3-5 wires (common, high speed, medium speed, low speed) **2. PSC Motor (Permanent Split Capacitor)** - Used in larger window ACs and split-type outdoor fans - Has a run capacitor (always in circuit) - Higher starting torque than shaded pole - More efficient, runs cooler - *Identification:* Has a capacitor connected to the motor (usually oval or round cylinder) - *Common failure:* Capacitor goes bad (motor hums but does not start)	**Rationale:** Clear, action-oriented title.

	Topic B: Motor Operation and Voltage Requirements **How a fan motor works (simplified):** -Electricity flows through the windings (coils of copper wire) - This creates a magnetic field - The magnetic field causes the rotor (the spinning part) to turn - The shaft spins the fan blade - Air moves **Voltage Requirements** - Check the motor nameplate (metal sticker on the motor body) - Common voltages in the Philippines: 220V (most common) or 110V (older units) - Using a 110V motor on 220V = burnout in seconds - Using a 220V motor on 110V = motor runs slow or not at all - *Action:* Always verify voltage with a multimeter before connecting	
C. Demonstrating Knowledge and Skills	**Developing Mastery** **Teacher Says:** "Each group will receive a motor. Your task: (1) Identify if it can be lubricated, (2) Locate the oil ports, (3) Demonstrate the lubrication procedure using oil (or simulate with water for practice). I will check *Teacher circulates, checks:* - Did they identify oil ports correctly? - Did they use the correct oil (or simulated)? - Did they avoid over-oiling?	**Rationale:** Hands-on skill practice in a low-risk environment.

	Teacher Says: "Scenario: A customer says, 'My AC makes a scraping noise when it runs. It started last week. It still cools fine. You open the unit. The blower wheel is loose on the motor shaft. What is the cause? How do you fix it? *Answer:* The setscrew that holds the blower wheel to the motor shaft has loosened. Fix: Loosen the screw, reposition the wheel (not rubbing), tighten the screw securely. **Making Generalization** **Teacher Says:** "Complete this sentence: 'A well-maintained fan motor is _____, but a neglected motor will _____. *Sample answer:* "...quiet and efficient; will make noise, draw high current, and eventually fail. **Evaluating Learning: QUIZ** **Remediation:** Draw a simple fan motor. Label: Shaft, Windings (draw as coils), Bearing area, Oil port (if applicable). **Enrichment:** Research: What is the difference between a sleeve bearing and a ball bearing motor? Which is more common in window-type ACs? Write 3 sentences. **EVALUATING LEARNING: QUIZ** **I. Multiple Choice (10 pts).** Encircle the letter. 1. Which type of fan motor is MOST common for the evaporator blower in window-type ACs? a) PSC motor b) Shaded pole motor c) Three-phase motor d) DC brushless motor	*Answer:* The setscrew that holds the blower wheel to the motor shaft has loosened. Fix: Loosen the screw, reposition the wheel (not rubbing), tighten the screw securely. **Rationale:** Realistic troubleshooting. Teaches that make noise often have simple mechanical fixes. **Rationale:** Contrasts preventive vs. reactive maintenance.

	2. What type of oil should be used to lubricate a fan motor bearing? a) WD-40 b) Cooking oil c) Electric motor oil d) Engine oil 10W-40 3. What happens if you use a 110V fan motor on a 220V supply? a) It runs faster and better b) It burns out quickly c) It runs slower d) Nothing, voltage doesn't matter 4. What is the correct number of oil drops to apply per oil port? a) 1 drop b) 3-5 drops c) Half a cup d) As much as possible 5. Which fan type is used for the condenser (outdoor section) of a window-type AC? a) Squirrel cage blower b) Propeller fan c) Axial vane fan d) Crossflow fan 6. What does a grinding noise from a fan motor usually indicate? a) Dirty filter b) Bad bearing c) Low refrigerant d) Normal operation 7. Which component helps a PSC motor start? a) Start relay b) Run capacitor c) Overload protector d) Thermostat 8. Why is WD-40 NOT recommended for motor lubrication? a) It is too expensive b) It is a solvent that removes existing oil c) It is too thick d) It conducts electricity 9. How often should a fan motor be lubricated for daily use of AC? a) Never b) Every 6-12 months c) Every 5 years d) Only when it stops working 10. What should you check first if a blower wheel is making a scraping noise? a) Replace the motor b) Check alignment and setscrew tightness c) Add more refrigerant d) Clean the filter 11. _____ A motor with a burnt smell should be lubricated to fix it. 12. _____ Rubber isolation grommets reduce motor vibration.	

	13._____ The evaporator fan motor turns the blower wheel. 14._____ You can use any oil for motor lubrication as long as it is liquid. 15._____ A PSC motor has a capacitor that stays in the circuit while running. **III. Essay (5 pts).** You are servicing an AC. The fan motor hums but does not spin. You manually spin the blower wheel with a stick, and the motor starts running. What is the likely problem? Explain your answer. **ANSWER KEY** 1-b, 2-c, 3-b, 4-b, 5-b, 6-b, 7-b, 8-b, 9-b, 10-b 11-False, 12-True, 13-True, 14-False, 15-True **Essay Sample:** *The problem is likely a bad start capacitor (if PSC motor) or a shaded pole motor that is failing. A shaded pole motor should start on its own. If it needs a manual spin, the bearings are likely dry or worn, or the motor windings have a weak starting coil. For a PSC motor, the capacitor may have lost capacitance, reducing starting torque. Test the capacitor with a multimeter and check for lubrication.* (Note: Shaded pole motors do not use capacitors, so teacher should clarify depending on motor type **Performance Task (Hands-On Demonstration):** Each student will demonstrate **fan motor inspection and lubrication** on a training motor.	

<table>
<tr>
<td>VI. ASSESSMENT</td>
<td>
Performance Task (Hands-On Demonstration):
Each student will demonstrate fan motor inspection and lubrication on a training motor.
Practical Exam Checklist (20 points total):
<table>
<tr><th>Step</th><th>Task</th><th>Points</th><th>Pass/Fail</th></tr>
<tr><td>1</td><td>Unplugs unit before accessing motor</td><td>2</td><td></td></tr>
<tr><td>2</td><td>Identifies motor type (shaded pole or PSC)</td><td>2</td><td></td></tr>
<tr><td>3</td><td>Locates oil ports (or identifies sealed motor)</td><td>2</td><td></td></tr>
<tr><td>4</td><td>Uses correct type of oil (electric motor oil)</td><td>2</td><td></td></tr>
<tr><td>5</td><td>Applies 3-5 drops per port (not over-oiling)</td><td>2</td><td></td></tr>
<tr><td>6</td><td>Manually rotates shaft to distribute oil</td><td>2</td><td></td></tr>
<tr><td>7</td><td>Checks mounting screws for tightness</td><td>2</td><td></td></tr>
<tr><td>8</td><td>Checks blower wheel alignment (if applicable)</td><td>2</td><td></td></tr>
<tr><td>9</td><td>Verifies voltage supply matches nameplate</td><td>2</td><td></td></tr>
<tr><td>10</td><td>Tests motor operation after maintenance</td><td>2</td><td></td></tr>
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Passing Score: 16/20 (80%)
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<tr>
<td>VII. REFLECTION</td>
<td>

Highlights:
Challenges:
Adjustments:
Learners for remediation:

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VIII. USE OF GENERATIVE AI	Proper maintenance of Air Conditioner fan motor involves cleaning, inspection, lubrication, and basic troubleshooting. These methods are important to ensure efficient operation, prevent damage, promote safety, and extend the lifespan of the appliance. Applying these practices in real-life situations helps reduce repair costs and improve appliance performance.

LESSON EXEMPLAR			
Learning Area	DOMESTIC REFRIGERATION AND AIR-CONDITIONING SERVICING	**Lesson Exemplar**	**10**

I. OBJECTIVES	
A. Content Standard	The learner understands the concepts and principles of maintaining domestic refrigeration and window-type air-conditioning units.
B. Performance Standard	The learner performs the maintenance of domestic refrigeration and window-type air-conditioning units with safety precautions.
C. Learning Competencies	Discuss maintenance of service power (Electrical controls/devices, circuit connections, power source, insulation resistance).
II. REFERENCES and MATERIALS	**REFERENCES and MATERIALS** • **References:** TESDA TR - DRAC NC II; Philippine Electrical Code (PEC) 2017 Articles 4.2, 5.1; Manufacturer wiring diagrams • **Materials:** Multimeter (digital), clamp meter, insulation resistance tester (megohmmeter/megger), sample electrical controls (selector switch, thermostat, relay, capacitor), wiring diagram of window-type AC, wire samples (various gauges), circuit breaker, outlet, safety gloves, safety goggles **Tech Integration:** PEC app (digital), video "How to Megger a Motor", QR code linking to wire sizing table, electrical symbol flashcard app
III. CONTENT	**Title:** Maintenance of Service Power **Sub-topics:** 1. Electrical controls and devices in window-type AC (Selector switch, thermostat, compressor relay, overload protector, capacitor) 2. Reading and interpreting circuit connections (Wiring diagrams) 3. Power source verification (Voltage, frequency, phase, dedicated line requirement) 4. Insulation resistance testing (Megger test - motor windings to ground) 5. Common electrical faults (Open circuit, short circuit, ground fault) 6. Safety procedures for electrical maintenance
IV. OBJECTIVES	At the end of the lesson, learners should be able to: 1. **Identify** the electrical control devices in a window-type AC. 2. **Read** a basic wiring diagram for a window-type AC.

	3. **Measure** voltage, amperage, and resistance using a multimeter. 4. **Perform** an insulation resistance test using a megger. 5. **Explain** the importance of a dedicated power line for AC units. 6. **Follow** lock-out/tag-out safety procedures when working on electrical systems.	
V. PROCEDURES		**ANNOTATIONS**
A. Activating Prior Knowledge	**Activating Prior Knowledge** **Teacher Says:** "In our previous lessons, we cleaned filters, coils, and motors. But what makes all of this work? What gives them power? **Teacher Says:** "Correct. Today, we focus on the ELECTRICAL system. Because a perfectly clean AC with a dead motor or no power is useless." **Establishing the Purpose (3 mins)** **Teacher Says:** "Electrical problems are the second most common service call after dirty filters. A customer says, 'My AC does not turn on at all.' If you cannot diagnose electrical issues, you lose that customer. Today, you learn to check power, test components, and find where the electricity stopped. **Presenting Examples (10 mins)** **Teacher Says:** "I will show you a window-type AC that is 'dead' (not turning on). Watch how I diagnose it. *Teacher demonstrates:* 1. Checks outlet with multimeter (0V) 2. Resets breaker (now 220V) 3. AC turns on	**Facilitation:** Call on students. "Electricity," "The outlet," "The power source **Rationale:** Transitions from mechanical maintenance to electrical maintenance. Shows interconnectedness. **Rationale:** Connects electrical skills to job competency and customer retention. **Facilitation:** Use a training unit with a simulated fault (e.g., unplugged, or tripped breaker, or bad thermostat). **Rationale:** Demonstrates the diagnostic process before teaching theory.

	Teacher Says: "Simple. But what if the outlet has power, but the AC still does not turn on? Then we go deeper.	
B. Instituting New Knowledge	**Discussing New Concept** **Teacher Script:** "Title: Electrical Maintenance - Following the Path of Power. **Topic A: Electrical Controls and Devices in Window-Type AC** **1. Selector Switch (Mode Switch)** - The knob you turn to select Off, Fan Only, Low Cool, Med Cool, High Cool - Connects power to different circuits: fan motor, compressor, or both - *Failure mode:* Contacts burn out → AC does not respond to some settings - *Test:* Continuity check between terminals with switch in different positions **2. Thermostat (Temperature Control)** - Senses room temperature and turns compressor ON/OFF - Contains a bimetal strip or thermistor - *Failure mode:* Stuck closed (compressor runs constantly), stuck open (compressor never runs) - *Test:* Continuity check when turned to coldest setting (should be closed) **3. Compressor Relay (Start Relay)** -Connects the start winding of the compressor during startup, then disconnects - Types: PTC (Positive Temperature Coefficient - most common in modern units) or current relay (older)	**Rationale:** Metaphor helps students visualize electrical flow as a path.

	- *Test:* Check resistance across terminals (PTC should show low resistance when cool, high when hot)" **4. Overload Protector** - Safety device that shuts off compressor if it overheats or draws too much current - Located on the compressor terminal cover -*Test:* Continuity check (should show continuity when cool **5. Capacitors** - Run capacitor (for compressor and sometimes fan motor) - *Failure mode:* Loss of capacitance, bulging, leaking oil, shorted - *Test:* Use a capacitor tester or multimeter with capacitance setting - *Safety:* DISCHARGE capacitors before touching (short terminals with insulated screwdriver) **Topic A: Reading Circuit Connections (Wiring Diagrams)** **Why learn wiring diagrams?** Because every AC has one glued inside the control panel. If you can read it, you can fix ANY unit—even one you have never seen before. **Topic C: Power Source Verification** **Before calling an AC 'broken,' check the power source** **Step 1: Check the outlet** **Step 2: Check the circuit breaker** **Step 3: Check for dedicated line** **Step 4: Check the plug and cord**	**Rationale:** Empowers students with transferable skills.

C. Demonstrating Knowledge and Skills	**Developing Mastery** **Teacher Says:** "Rotate through the stations. At each station, use your multimeter to diagnose the fault. Write your findings *Station 1:* No power outlet (simulated) — Student must check outlet voltage and trace to breaker. *Station 2:* Thermostat stuck open — Student must find out why the compressor does not run. *Station 3:* Bad capacitor — Student measures capacitance. *Station 4:* Motor with low insulation resistance — Student performs megger tests. **Finding Practical Application** **Teacher Says:** "Scenario: You arrive at a customer's house. The customer says, 'My AC stopped working. I tried to plug it into a different outlet, but it still won't turn on. You test the outlet—it has 220V. You open the AC and check it out. What are the NEXT THREE electrical components you test in order? *Answer:* 1. Selector switch (is it sending power?), 2. Thermostat (is it closed/calling for cooling?), 3. Compressor relay (is it sending power to compressor? **Making Generalization (5 mins)** **Teacher Says:** "Complete this sentence: 'Electrical troubleshooting is like following a _____ because _____. *Sample answer:* "...a treasure map because you start at the power source and follow the path until you find where the 'treasure' (electricity) stops	**Rationale:** Active learning simulates real service calls. Builds diagnostic speed. **Facilitation:** Guide: After verifying power, check the simplest components first. **Rationale:** Logical troubleshooting sequence. Avoid skipping steps.

	Remediation: Draw a simple series circuit with: Power source → Switch → Load (compressor) → Return to source. Label for each part. **EVALUATING LEARNING: QUIZ** **I. Multiple Choice (10 pts).** Encircle the letter. 1. What instrument is used to test insulation resistance (leakage to ground)? a) Multimeter b) Clamp meter c) Megger (insulation tester) d) Thermometer 2. What is the acceptable minimum insulation resistance for a compressor motor? a) 1 ohm b) 100 ohms c) 1,000 ohms d) 1,000,000 ohms (1 MΩ) 3. What voltage should a properly working outlet for a window-type AC in the Philippines measure? a) 110V b) 220V ±10% c) 12V d) 440V 4. If a compressor hums but does not start, which component is the most likely cause? a) Thermostat b) Start relay or capacitor c) Overload protector d) Selector switch 5. What safety steps MUST be done before touching capacitor terminals? a) Paint them b) Discharge them (short terminals) c) Spray with water d) Cover with tape 6. A breaker that trips immediately when the AC is plugged in indicates a) Dirty filter b) Short circuit c) Low refrigerant d) Normal operation 7. Which electrical component senses room temperature and turns the compressor on/off? a) Selector switch b) Thermostat c) Relay d) Overload 8. What does an open circuit mean? a) A complete path for electricity b) A break in the path, no current flows c) Too much current flows d) Voltage is too high 9. When using a megger, what voltage is typically used for a 220V compressor? a) 12V b) 50V c) 500V d) 5000V	**Rationale:** Metaphor reinforces a systematic approach.

	10. A PTC relay has _____ resistance when cool and _____ resistance when hot. a) high; low b) low; high c) zero; infinite d) infinite; zero **II. Matching (5 pts).** Match the symptom to the likely faulty component. **Symptom** 11. AC does not respond to mode selector (only Off works) 12. Compressor runs constantly, never shuts off 13. Compressor tries to start but clicks off after 1-2 seconds 14. Compressor is hot but not running, then starts after 30 minutes 15. AC works but fan motor vibrates **III. Essay (5 pts).** Explain the step-by-step process you would use to check why a window-type AC has no power (does not turn on at all). Include at least 4 checks. **ANSWER KEY** 1-c, 2-d, 3-b, 4-b, 5-b, 6-b, 7-b, 8-b, 9-c, 10-b 11-B, 12-C, 13-D, 14-A, 15-E **Essay Sample:** *1. Check the outlet voltage with a multimeter (should be 220V). 2. Check the circuit breaker — reset if tripped. 3. Inspect the plug and cord for damage. 4. Open the AC and check the selector switch for continuity (should pass power to fan/compressor). 5. Check the thermostat continuity (turn to coldest, should be closed). 6. Check the compressor relay and overload protector.	

VI. ASSESSMENT

Performance Task (Hands-On Demonstration):
Each student will perform an **electrical diagnostic check** on a training AC unit with a simulated fault.

Practical Exam Checklist (25 points total):

Step	Task	Points	Pass/ Fail
1	Unplugs unit before opening electrical panel	2	
2	Checks outlet voltage correctly	2	
3	Identifies all electrical components (selector, thermostat, relay, overload, capacitor)	3	
4	Reads wiring diagram to understand circuit	2	
5	Tests selector switch continuity	2	
6	Tests thermostat continuity	2	
7	Tests overload protector continuity	2	
8	Tests compressor relay (PTC resistance or current relay)	2	
9	Discharges and tests capacitor (capacitance)	3	
10	Performs megger test on fan motor or compressor (or simulation)	3	
11	Identifies the fault correctly	2	

Passing Score: 20/25 (80%)

VII. REFLECTION	• **Highlights:** • **Challenges:** • **Adjustments:** • **Learners for remediation:**
VIII. USE OF GENERATIVE AI	Proper maintenance of Air Conditioner fan motor involves cleaning, inspection, lubrication, and basic troubleshooting. These methods are important to ensure efficient operation, prevent damage, promote safety, and extend the lifespan of the appliance. Applying these practices in real-life situations helps reduce repair costs and improve appliance performance.