

SECTION A: AUTOMOTIVE TECHNOLOGY

1. a) Two types of automobile engines:

1. Internal Combustion Engine (ICE)
2. External Combustion Engine (ECE)

b) Energy transformation in an automotive engine:

Chemical energy (from fuel) is converted into → Heat energy (during combustion) → Mechanical energy (to move the vehicle).

c) Three types of engines based on cylinder block designs:

1. **Inline Engine:** Cylinders are arranged *in a* single straight line.
2. **V-type Engine:** Cylinders are arranged in two banks, forming a 'V' shape.
3. **Flat/Boxer Engine:** Cylinders are arranged in two opposing banks horizontally.
4. **W-type Engine:** A more complex design that resembles two V-engines joined together.

d) Why earliest steam engines are no longer in use:

1. **Low Efficiency:** They were very inefficient, converting only a small percentage of heat energy into useful work.
2. **Large and Heavy:** They were extremely bulky and heavy for the amount of power they produced.
3. **Slow Start-up:** They required a long time to build up enough steam pressure to operate.
4. **Safety Concerns:** High-pressure steam posed a significant risk of explosion.
5. **Pollution:** They produced large amounts of smoke and ash from burning coal or wood.

2. a) Two classifications of engines used today:

1. Spark Ignition (SI) Engine (e.g., Petrol/Gasoline engines)
2. Compression Ignition (CI) Engine (e.g., Diesel engines)

b) Two vehicles for each engine type:

1. **Spark Ignition (Petrol):** Toyota Corolla, Honda Civic, Ford Mustang, Volkswagen Golf.
2. **Compression Ignition (Diesel):** Ford F-150 (diesel variant), Ram 2500, Mercedes-Benz Sprinter van, large trucks and buses.

c) Four component parts of an engine:

1. Cylinder Block
2. Cylinder Head
3. Piston
4. Crankshaft
5. Connecting Rod
6. Camshaft
7. Valves (Intake and Exhaust)

d) Main purpose of the automobile engine:

The primary purpose of an automobile engine is to convert the chemical energy stored in fuel into mechanical energy. This mechanical energy is then used to create the rotational force (torque) needed to turn the wheels and propel the vehicle.

SECTION B: BUILDING CONSTRUCTION TECHNOLOGY

3. a) Five stakeholders in the construction industry:

1. The Client/Owner
2. The Architect/Designer
3. The Contractor
4. The Quantity Surveyor
5. The Engineer (Civil, Structural, Mechanical, Electrical)
6. Government/Regulatory Agencies
7. Suppliers

b) Duties of professionals:

i) Town Planner:

1. Develops long-term plans for land use and development in urban and rural areas.
2. Ensures that new construction projects comply with zoning laws and regulations.
3. Conducts site analysis and environmental impact assessments.

ii) Architect:

1. Designs the aesthetic and functional aspects of a building.
2. Prepares detailed drawings, plans, and specifications for construction.
3. Supervises the construction process to ensure it aligns with the design.

iii) Quantity Surveyor:

1. Estimates and manages the costs of a construction project.
2. Prepares a Bill of Quantities (BoQ) detailing all materials and labor needed.
3. Manages contracts, valuations, and payments throughout the project.

iv) General Foreman:

1. Supervises all activities and workers on the construction site daily.
2. Ensures safety protocols are followed and quality standards are met.
3. Coordinates the work of different trades (carpenters, masons, electricians, etc.).

v) Contractor:

1. Manages the overall construction project from start to finish.
2. Hires subcontractors and sources materials.
3. Is responsible for completing the project on time, within budget, and to the required quality standards.

4. a) Definition of Mobilization:

Mobilization is the process of assembling and transporting all the necessary resources, including personnel, equipment, materials, and facilities, to the construction site to prepare for the start of the project work.

b) Five major activities in the mobilization stage:

1. **Site Establishment:** Setting up the site office, storage areas, and temporary utilities (water, electricity).
2. **Equipment Transport:** Moving heavy machinery like excavators, cranes, and bulldozers to the site.
3. **Personnel Deployment:** Bringing the project manager, engineers, foremen, and skilled laborers to the site.
4. **Material Procurement:** Ordering and delivering the initial batch of construction materials (e.g., cement, rebar, sand).
5. **Obtaining Permits:** Securing all necessary permits and approvals from local authorities before starting work.
6. **Site Survey and Layout:** Conducting a detailed survey and marking out the building's foundation and layout.

c) One use of the wooden float:

- A wooden float is used to level and smooth the surface of fresh concrete after it has been screeded, helping to embed large aggregates and bring fine cement paste to the surface for a better finish.

SECTION C: ELECTRICAL AND ELECTRONIC TECHNOLOGY

5. a) Four methods of generating electrical power:

1. Hydroelectric (using water and dams)
2. Thermal (burning fossil fuels)
3. Solar (using photovoltaic panels)
4. Wind (using turbines)
5. Nuclear (using nuclear fission)
6. Geothermal (using heat from the earth)

b) Companies responsible for electricity in Ghana:

i) Electrical Power Generation: Volta River Authority (VRA), Bui Power Authority, Independent Power Producers (IPPs).

ii) Electrical Power Transmission: Ghana Grid Company (GRIDCo).

iii) Electrical Power Distribution in the Northern Sector: Northern Electricity Distribution Company (NEDCo).

c) Five behaviours defined as illegal connections by the ECG:

1. **Direct Tapping:** Connecting directly to overhead power lines without a meter.
2. **Meter Bypass:** Altering the wiring to go around the official meter so that consumption is not recorded.
3. **Meter Tampering:** Illegally opening and altering the meter to slow it down or stop it.
4. **Using Foreign Objects:** Inserting objects into the meter to interfere with its recording mechanism.
5. **Unauthorized Self-Reconnection:** Reconnecting power after being officially disconnected for non-payment.
6. **Sharing Power:** Illegally extending power from a metered property to an unmetered one.

6. a) Definition of "electrical circuit":

- An electrical circuit is a complete, closed path through which an electric current can flow. It typically includes a power source, conductors, a load, and a control device.

b) Four types of diodes:

- Light Emitting Diode (LED)
- Zener Diode
- Rectifier Diode
- Schottky Diode
- Photodiode
- Varactor Diode

c)



d) How a mobile phone battery is charged from an AC source:

1. The 240V AC from the wall socket first enters a charger (adapter), which contains a **step-down transformer** to reduce the high AC voltage to a much lower AC voltage (e.g., 5V or 9V).
2. This low-voltage AC is then passed through a **rectifier circuit** (usually a bridge rectifier made of diodes) which converts the alternating current (AC) into direct current (DC).
3. The resulting DC is not smooth, so it is passed through a **filter** (capacitors) to smoothen out the ripples.
4. Finally, a **voltage regulator** ensures a stable and constant DC voltage is supplied to the phone's charging circuit to safely charge the DC battery.

SECTION D: WOOD WORK TECHNOLOGY

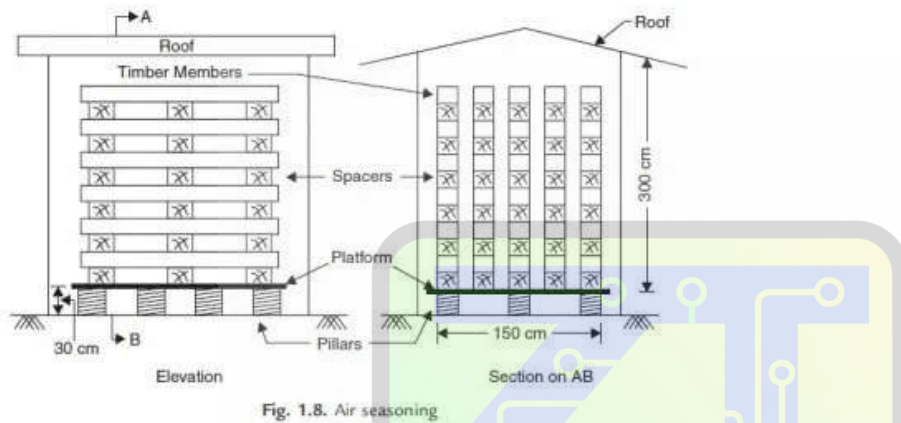
7. a) Three processing phases of timber:

1. Felling and Extraction
2. Conversion (Sawing into usable sections)
3. Seasoning (Drying)

b) Meaning of conversion of timber:

Conversion is the process of sawing a felled log into smaller, usable pieces of timber such as planks, boards, and beams. This process is done at a sawmill and aims to maximize the yield of high-quality timber from the log while minimizing waste.

c) Natural method of seasoning (with diagram):



Description: Natural or air seasoning is a method of drying timber by stacking it in a way that allows air to circulate freely around all surfaces of each piece. The timber is stacked on raised foundations, with small stickers (pieces of wood) placed between each layer to create air gaps. A roof is placed over the stack to protect it from direct sun and rain.

8. a) What is a manufactured board? Smart Learning Tools

A manufactured board is a man-made, wood-based sheet material produced by bonding together wood veneers, particles, fibers, or strands with an adhesive under heat and pressure. They are engineered to have specific properties and are often more stable and available in larger sizes than solid wood.

b) Five manufactured boards:

1. Plywood
2. Medium-Density Fibreboard (MDF)
3. Particleboard (Chipboard)
4. Oriented Strand Board (OSB)
5. Blockboard
6. Hardboard

c) Three advantages of manufactured boards over solid wood:

1. **Dimensional Stability:** They are less prone to warping, twisting, and splitting with changes in humidity.
2. **Availability in Large Sizes:** They can be produced in large, uniform sheets, which is difficult with solid wood.
3. **Cost-Effective:** They are often cheaper than solid timber of the same dimension.
4. **Consistency:** They have a uniform structure without knots or grain defects.