

MARKING SCHEME

SECTION A: [30 MARKS]

1.

(a) Career Opportunities:

Locomotive Engineer (Abdi's interest in trains).

Agricultural Machinery Technician (Bakari's interest in tractors).

Plant Maintenance Engineer / Automotive Assembly Technician (Chantal's interest in manufacturing).

(b) Importance in Agriculture: It ensures the efficient maintenance and operation of farm machinery (tractors, irrigation pumps, harvesters), which increases food production and reduces manual labor.

2.

(a) Sign Identification:

Mandatory Sign: (e.g., "Wear Eye Protection") – Blue background, white symbol.

Warning Sign: (e.g., "High Voltage" or "Crush Zone") – Yellow triangle, black border.

(b) PPE for Chassis Work: Safety goggles (to protect eyes from falling debris), overalls (to protect skin), and safety boots (to protect feet from falling parts).

(c) Answer: False (A screwdriver is a precision tool; using it as a chisel ruins the tip and can cause it to shatter).

3.

(a) Locus: The path traced by a point as it moves according to a specific geometric rule or constraint.

(b) Method: External Tangent (The tangent touches the outside of the two circles).

(c) Locus Shape: Cycloid.

(d) Application: The path of the connecting rod as it turns the crankshaft, or the movement of a valve opening and closing.

4.

(a) Interpretation:

R: Radial Construction (the direction of the ply cords).

16: The diameter of the wheel rim in **inches**.

(b) Ply Orientation: Radial Ply (Cords run at 90 degrees to the direction of travel).

(c) Functions: Supports the vehicle's weight, provides traction/grip on the road, and absorbs road shocks.

(d) Distinction: A **tube tire** relies on an internal rubber bladder to hold air, whereas a **tubeless tire** creates an airtight seal directly against the rim of the wheel.

5.

(a) Parts Identification:

P: Piston.

Q: Cylinder Block (or Engine Block).

R: Crankshaft.

(b) Bore: The internal diameter of the engine cylinder.

(c) Calculation:

Formula: $\text{Volume} = \pi \times r^2 \times \text{stroke}$

Radius (r) = $80\text{mm}/2 = 40\text{mm} = 4\text{cm}$. Stroke = $90\text{mm} = 9\text{cm}$.

$$V = 3.142 \times (4)^2 \times 9$$

Answer: 452.45 cm³.

(d) Position: TDC (Top Dead Centre).

SECTION B: [50 MARKS]**6.**

- (a) Sketching:** Marks awarded for grouping the Office/Entrance together and keeping Workbenches away from high-traffic Passage Ways.
- (b) Storage Separation:** To prevent unauthorized access to expensive tools, reduce clutter in the work area, and ensure flammable materials (oil/grease) are kept away from sparks.
- (c) Passage Ways:** Essential for the safe movement of heavy components (like engines on cranes) and for clear evacuation routes during a fire or accident.

7.

- (a) Components: A:** Camshaft, **B:** Valve (Intake/Exhaust), **C:** Connecting Rod.
- (b) Function:** The Camshaft has "lobes" that rotate and push against the valves (or rocker arms) to open them at the precise time required for the intake or exhaust strokes.

(c) Matching:

Piston Rings → (iv) Prevents compression leakage.

Crankshaft → (i) Converts reciprocating motion to rotary motion.

Connecting Rod → (ii) Connects the piston to the crankshaft.

Cylinder Block → (iii) Houses the cooling water jackets.

(d) Sump Importance: It acts as a reservoir for engine oil, helps dissipate heat from the oil to the atmosphere, and protects the crankshaft from external damage.

8.

(a) Locking Device: Split Pin (or Cotter Pin).

(b) Riveting Process: A hole is drilled through both metal sheets; the rivet is inserted, and a rivet gun "upsets" or flattens the tail end to squeeze the sheets together permanently.

(c) Comparison: Adhesives provide a permanent, lightweight bond and a smooth finish (no visible holes), while **Bolts and Nuts** are temporary/semi-permanent, allowing for easy disassembly for repairs.

(d) **Interior Parts:** Dashboard, passenger seats, floor mats, and interior door handles.

9.

(a) **Tool: Outside Micrometer.**

(b) **Piston Ring Gap:** Insert the ring into the cylinder, use a piston to square it up, then insert a **feeler gauge** into the gap between the ring ends to check for wear.

(c) **Distinction: Cylinder Bore** is the actual width of the cylinder hole; **Cylinder Clearance** is the tiny gap between the piston skirt and the cylinder wall to allow for thermal expansion.

(d) **Journal Discussion:** If the journal is "out-of-round" or worn down, it will not hold oil pressure correctly, leading to "knocking" and eventual engine seizure. Precision measurement ensures the correct size of replacement bearings is used.

