

MARKING GUIDE (MOCK 2026)

5140, Mechanical Technology (Paper 1 & 2)

Subject code: 7130 (Mechanical Technology 1)																	
Question N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Answer	B	A	D	A	B	B	B	B	B	A	B	C	D	C	C	D	C
Question N°	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Answer	A	C	C	A	B	A	D	C	B	C	B	B	C	A	D	C	D
Question N°	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Answer	D	B	B	C	D	A	B	A	D	A	C	B	D	D	A	D	

Subject code: 5140 (Mechanical Technology 2)

Question 1: PETROL INJECTION

Figure 1 is that of a petrol injection system.

- a- What type of petrol injection system is shown above? (1 mark)
L-Jetronic injection system.

- b- Fill the table below. (3.75 marks)

Ref.	Name of part (0.25mark x 5)	Function (0.25mark x 5)
4	Electronic Control Unit (ECU)	It controls the opening of the injectors based on the input sensors information.
6	Pressure regulator	It returns excess fuel back to the tank.
9	Throttle position valve	It informs the electronic control unit of the throttle position.
10	Air flow sensor	It informs the electronic control unit of the quantity of air entering the engine.
15	Auxiliary air device	It supplies engine with additional air during warm-up phase.

- c- Give two parameters required by the ECU to determine the quantity of fuel to be injected. (1mark x 2 = 2 marks)
- The amount of air flowing into the engine; - The position of the crankshaft; - The engine's temperature.
- d- What is the effect on engine performance if part (11) fails? (1.25 mark)
- Poor or rich air/fuel mixture; - Engine misfires; - Fuel consumption increases;
- CO₂ emission increases; - Loss of power.
- e- Part (2) is the pump. Give any two signs of a malfunctioning fuel pump as the engine runs. (1mark x 2 = 2 marks)
- Hard starting; - Engine stalls; - Engine jerks; - Loss of power.

Question 2: GEARBOX

Figure 2 is the diagram of one type of vehicle manual shift gearbox.

- a- What type of manual gearbox is shown in figure 2 above? (1 mark)
Sliding mesh manual gearbox.

- b- State three (03) requirements of an automobile manual gearbox. (1mark x 3 = 3 marks)
- It must have a neutral point; - It must be able to obtain reverse;
- It must be able to vary the forward gears.

- c- Give the names of parts 1, 2, 3 and 4 of figure 2 above. (2 marks)

N°	Name (0.5mark x 2)	N°	Name (0.5mark x 2)
1	Input shaft	3	Reverse idler
2	Output shaft	4	Lay shaft

- d- What is the major problem with this type of gearbox? (1 mark)
Excessive wear due to the movement of the output shaft gear wheels to obtain gear changing.

- e- State the function of parts 1, 2 and 3. (1mark x 3 = 3 marks)
- Part 1: It transmits torque from the clutch to the gearbox.
 - Part 2: It transmits torque from the gearbox to the transmission.
 - Part 3: It reverses the sense of rotation of the output shaft.

Question 3: DIFFERENTIAL UNIT

Figure 3 is the diagram of a differential unit.

- a- What is the function of the differential unit on a vehicle? (2 marks)
It enables the outer drive wheel to rotate faster than the inner drive wheel during a turn.
- b- During driving, at what time does the differential unit comes into action? (1 mark)
When negotiating (taking) a bend.
- c- Name the components 1, 2, 3, 4 and 5. (2.5 marks)

N°	Name (0.5mark x 3)	N°	Name (0.5mark x 2)
1	Drive pinion	4	Planet gear
2	Crown wheel	5	Differential pinion shaft or planet gear shaft.
3	Differential casing		

- d- Give the function of parts 1, 3 and 5. (1.5mark x 3 = 4.5 marks)
- Part 1: It drives the crown wheel.
 - Part 3: It drives the planet gears via the planet gear shaft.
 - Part 5: It links the planet gears to the differential casing.

Question 4: BRAKING SYSTEM

Figure 4 is that of a car's braking system.

- a- Fill the table below in relation to figure 4 above. (5 marks)

Ref.	Name of part (0.5mark x 5)	Function (0.5mark x 5)
1	Brake pedal	It transmits driver's foot force to the braking system.
2	Brake booster	It multiplies driver's effort.
3	Master cylinder	It exerts fluid pressure to the wheels.
4	Fuel tank	It stores brake fluid.
5	Brake disc	It provides the surface for the braking forces to be applied.

- b- What will be the effect in this system if part 2 is faulty? (1 mark)
- Stiff brake pedal action; - Increase in the stopping distance.
- c- Give two (02) consequences if air enters this hydraulic system. (1mark x 2 = 2 marks)
- Brake pedal feels spongy when the pedal is depressed; - Increased braking distance.
- d- State two (02) consequences of the presence of oil on the brake linings. (1mark x 2 = 2 marks)
- Lose of friction; - Increased braking distance. - Vibration of the brake pedal during braking.

Question 5: SUSPENSION SYSTEM

Figure 5a and 5b below show two suspension systems.

- a- Give two (02) functions of the suspension system. (0.5mark x 2 = 1 mark)
- It prevents the vehicle body and frame from road shocks; - It gives stability of the vehicle;
- It safeguards the passengers and goods from road shocks; - It gives cushioning effect;
- It gives a good road holding while driving cornering and braking.
- b- Identify the type of suspension system in figure 5a above. (1 mark)
Independent wishbone type.
- c- How many sub-systems are shown in figure 5b above? (1 mark)
Three (03) sub-systems.

- d- Specify the name of each sub-system. (1 mark)
 - Lower and upper wishbone arm; - Mac- Pherson; - Stabilizer or torsion arm.

- e- Identify the numbered parts 1, 2, 3, 4, 5 and 6. (1.5 mark)

N°	Name (0.25mark x 3)	N°	Name (0.25mark x 3)
1	Upper wishbone arm	4	Damper
2	Stabilizer or torsion arm	5	Coil spring
3	Lower wishbone arm	6	Track rod

- f- What is the function of? (0.5mark x 2 = 1 mark)
 ▪ Damper: It absorbs every oscillation after two or three rebounds of the vehicle body.
 ▪ Track rod: It connects the steering drive from the drop arm to the wheels.

- g- State two (02) requirements of the suspension system. (0.5mark x 2 = 1 mark)
 - Minimum deflection; - Low initial cost; - Minimum weight; - Minimum tyre wear;
 - Low maintenance and low operating cost.

- h- Shortlist two (02) advantages of the independent suspension system. (0.5mark x 2 = 1 mark)
 - Shocks incur by one wheel does not affect another; - Enhance more comfort

- i- Cite two suspension faults that can cause the vehicle to pull to one side though on straight ahead driving. (1 mark)
 - Pulling vehicle to one side on straight ahead drive; - Incorrect wheel alignment;
 - Imbalanced tyre inflation; - Leaked damper broken spring; - Incorrect steering geometry.

- j- Which organ of the suspension system is responsible for passenger's comfort after encountering a bump? (1 mark)
 It's a damper.

SECTION B
PROFESSIONAL CALCULATION AND SCIENCE
 (Answer any TWO questions from this section)

Question 6: ENGINE SIZE

- a- Define the following:
 i) Swept volume. (1 mark)
 It is the space swept by the piston from TDC to BDC.
 ii) Clearance volume. (1 mark)
 It is the space on top of the piston when the piston is at TDC.
 iii) Total volume. (1 mark)
 It is the sum of the clearance volume and swept volume.
- b- What is the S.I unit of cylinder volume? (1 mark)
 It's Liter or cm³.
- c- A single cylinder has a bore of 70mm, a height of 3mm above the piston when it is at TDC, with a stroke of 80mm. Calculate:

- i) The clearance volume V_c in cm³. (2 marks)

$$V_c = h \cdot \pi \cdot b^2 / 4 \quad V_c = 3 \times 3.14 \times 70 \times 70 / 4 = 11539.5 \text{ mm}^3 \quad \underline{V_c = 11.54 \text{ cm}^3}.$$

- ii) The swept volume V_s in cm³. (2 marks)

$$V_s = S \cdot \pi \cdot b^2 / 4 \quad V_s = 80 \times 3.14 \times 70 \times 70 / 4 = 307720 \text{ mm}^3 \quad \underline{V_s = 307.72 \text{ cm}^3}.$$

- iii) The total volume V_t in litres (L). (2 marks)

$$V_t = V_s + V_c \quad V_t = 307.72 + 11.54 = 319.26 \text{ cm}^3 \quad \underline{V_t = 319.26 \text{ cm}^3}.$$

Question 7: FRICTION

- a- Define friction. (1 mark)
It is the resistance that occurs when two substances move over one another.
- b- State three (03) components in a car that need friction for their operation. (1mark x 3 = 3 marks)
- Clutches; - Brakes; - Road wheels.
- c- List two (02) components in the car that don't need friction for their operation. (1mark x 2 = 2 marks)
- Pistons; - Crankshafts; - Cylinder walls.
- d- A brake pad is pressed against a disc by a force of 400N. If the coefficient of friction (μ) is 0.4 and the pad acts at a radius of 150mm. Calculate:
- i) The frictional force (F_f) . (2 marks)

$$\mu = \frac{F_f}{f} = \frac{\text{Frictional force}}{\text{force between surfaces}} \quad F = \mu \cdot f$$

$$F_f = 0.4 \times 400 = 160 \quad \underline{\underline{F_f = 160 \text{ N.}}}$$

- ii) The braking torque (T_b) given by the pad. (2 marks)

$$T_b = F_f \cdot \text{radius} \quad T_b = 160 \times 0.15 = 24 \text{ N/m} \quad \underline{\underline{T_b = 24 \text{ N/m.}}}$$

Question 8: MOTION

- a- Define the following terms: (1mark x 3 = 3 marks)
- Velocity: - It is rate of change in displacement in a particular direction;
- It is how fast or slow an object moves in a particular direction.
 - Kinetic energy: It's the energy a body possesses due to its motion.
 - Braking efficiency: It's the braking force produced as a percentage of total weight of a vehicle.
- b- A car of mass 1200kg moves from rest and travels with a velocity of 15m/s and an acceleration of 3m/s².
- i) Calculate the force (F) with which the car is traveling with. (1 mark)

$$F = m \cdot a \quad F = 1200 \times 3 = 3600 \text{ N} \quad \underline{\underline{F = 3600 \text{ N.}}}$$

- ii) Evaluate the time taken. (1 mark)

$$V = U + at \quad at = V - U \quad t = \frac{V - U}{a}$$

$$t = \frac{15 - 0}{3} = 5 \text{ sec.} \quad \underline{\underline{t = 5 \text{ sec.}}}$$

- iii) Determine the kinetic energy (K_e) with which the vehicle is traveling with. (1 mark)

$$K_e = m \cdot V^2 / 2 \quad K_e = \frac{1}{2} \times 1200 \times (15)^2 = 135000 \text{ J} \quad \underline{\underline{K_e = 135000 \text{ J} = 135 \text{ kJ.}}}$$

- iv) After applying the brakes, the car decelerates at a rate of 2.8m/s². Calculate the braking efficiency. (2 marks)

$$\text{Braking efficiency } (\eta) = \frac{\text{Braking force (BF)} \times 100}{\text{Vehicle weight (Vw)}} \quad \text{with } BF = F \cdot a = 1200 \times 2.8 = 3360 \text{ N}$$

$$Vw = 1200 \text{ kg} = 12000 \text{ N.}$$

$$\eta = \frac{BF \times 100}{Vw} \quad \eta = \frac{3360 \times 100}{12000} = 28\% \quad \underline{\underline{\eta = 28\%}}$$

- c- A certain engine develops a brake power of 120kw at a speed of 300rev/min, knowing that the indicated power (i.p) of the engine is 140kw, calculate the mechanical efficiency of this engine at this speed. (2 marks)

$$\text{Mechanical efficiency (ME)} = \frac{Bp \times 100}{ip} \quad ME = \frac{120 \times 100}{140} = 85.71\% \quad \underline{\underline{ME = 85.71\%}}$$