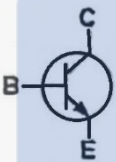
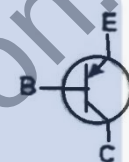


MARKING GUIDE (MOCK 2026)**5135, Electrical and Electronic Technology (Paper 1 & 2)**

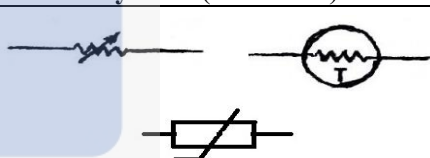
Subject code: 7130 (Electrical and Electronic Technology 1)																	
Question N°	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Answer	C	B	C	C	B	A	C	B	D	D	A	D	C	C	A	C	D
Question N°	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
Answer	C	B	A	D	A	B	B	D	D	C	B	D	D	B	C	B	A
Question N°	35	36	37	38	39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

Subject code: 5135 (Electrical and Electronic Technology 2)**Question 1: FUNDAMENTALS OF ELECTRONIC**

Figure 1a and 1b below indicate two symbol of transistors types used in transistorized ignition system to prevent the burning of contact breaker points.

	
Figure 1a: NPN transistor.	Figure 1b: PNP transistor.

- a- Name figures 1a and 1b. (0.5mark x 2 = 1 mark)
- b- Give the function of the following electronic components and draw their symbols. (6 marks)

Component	Function (1mark x 3)	Symbol (1mark x 3)
Thermistor	A thermistor is a temperature sensing device used for coolant and intake manifold air temperature.	
Phototransistor	A phototransistor is a semi-conductor that uses light energy to turn on the base of the transistor.	
Photodiode	A photodiode is a semi-conductor that converts light energy into electrical current. It is uses in an automatic headlight and steering wheel control for transmitting, tuning, volume, etc...	

- c- What is the function of a DC converter used in hybrid electric vehicles? (1 mark)
A DC converter is an electronic device that transforms one level of DC voltage to another higher or lower level. i.e. used in hybrid electrical vehicles to transform 12V to 14V for accessories power voltage.
- d- What is the meaning of ECU and its role in the engine management system of a vehicle? (2 marks)
ECU means: Electronic Control Unit. This is a central controller and heart of the engine.

Question 2: BATTERY

Figure 2 shows parts of an exploded automobile battery.

- a- State the main reason why car batteries are placed very close to the starter motor. (1.5 mark)
Lead acid batteries are placed very close to starter motor to reduce energy losses and improve on starter torque. It also minimize resistance.

b- Name the parts numbered 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10. (5 marks)

N°	Name (0.5mark x 5)	N°	Name (0.5mark x 5)
1	Separators	6	Negative plate
2	Positive plate pack	7	Negative pole
3	Electrolyte light sealing ring	8	Negative plate pack
4	Negative cell connection	9	Terminal
5	Positive plate	10	Battery casing

c- Elaborate in not more than three (03) lines, how to prepare the electrolyte of this battery. (1.5 mark)

- So much heat is released that the mixture may boil out very violently if we add water into acid. So add acid into water always to obtain distilled solution.
- Measure the required amt of acid and distilled water (60 to 64%);
- Pour acid into water;
- Ensure that mixture is well mixed.

d- Cite two (02) advantages of the maintenance free batteries over the classical battery. (0.5mark x 2 = 1 mark)

- Less maintenance;
- Durable.

e- Identify these elements as found in the batteries: PbO_2 and H_2SO_4 . (0.5mark x 2 = 1 mark)

- PbO_2 : Lead peroxide
- H_2SO_4 : Sulphuric acid.

Question 3: CHARGING SYSTEM

Figure 3a below is an exploded view of an alternator.

a- What is the function of the charging system in a motor vehicle? (2 marks)

It keeps the battery fully charged and supplies current to the vehicle electrical accessories when the engine is running.

b- State two (02) factors that determine the alternator's output. (0.5mark x 2 = 1 mark)

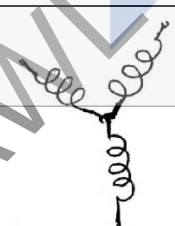
- Speed of rotation;
- Number of conductors in the stator windings;
- Strength of the magnetic field;
- Length of stator winding.

c- The alternator stator is usually coupled in star or delta windings.

i) What advantage does a delta stator winding have over the star winding? (1 mark)

- Simple protection;
- More reliable;
- Lower resistance;
- Higher current output at high rpm.

ii) With the help of sketches, differentiate between the star and the delta stator windings. (1mark x 2 = 2 marks)

Star connected stator	Delta connected stator
	

d- Give the name and function of parts 4, 5 and 9. (1.5 mark)

Ref.	Name of part (0.25mar x 3)	Function (0.25mar x 3)
4	Stator	It is the element that produces alternating current.
5	Rotor	It creates the magnetic field of the alternator.
9	Rectifier	It converts the input alternating current into a DC current output.

e- Modern day alternators come with built-in electronic voltage regulators.

i) Give one (01) advantage of this type of regulators. (1 mark)

- Simplified installation;
- It is more compact;
- Very little or no maintenance;
- Improved reliability;
- Better voltage regulation;
- Easier troubleshooting.

ii) Figure 3b below shows the charging circuit with an electromagnetic regulator.

Complete the wiring of the diagram to make it functional.

(1 mark)

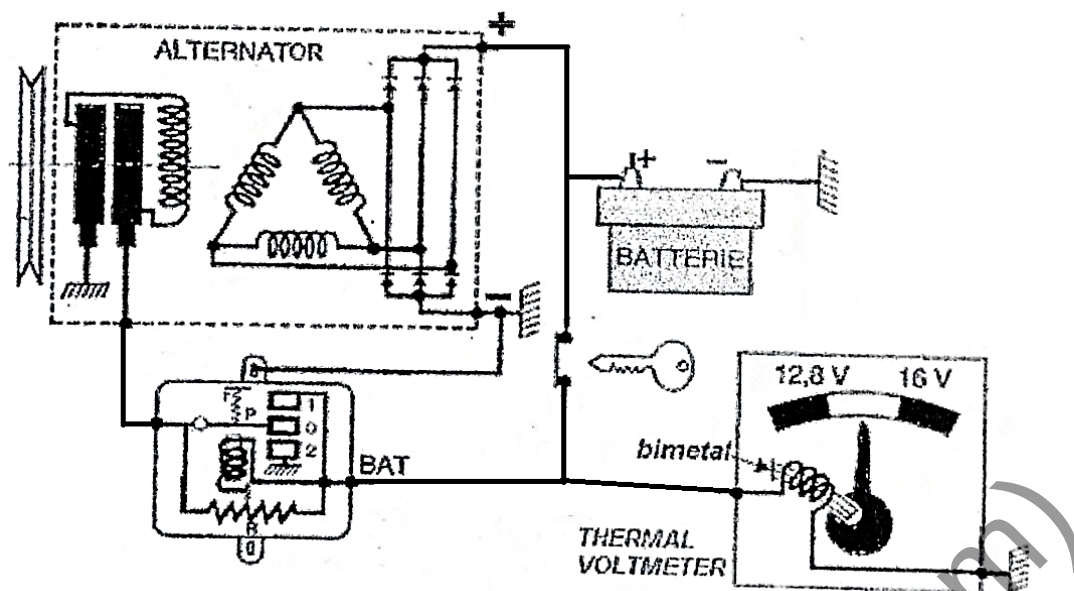


Figure 3b

iii) Indicate the control of continuity of the stator winding in figure 3c below.

(0.5 mark)

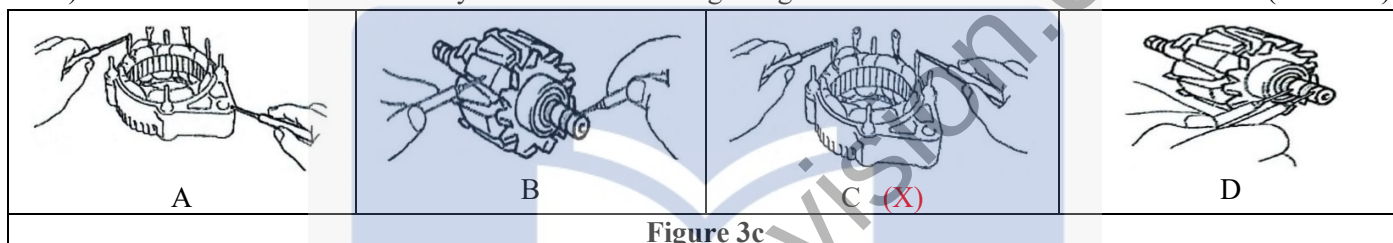


Figure 3c

Question 4: IGNITION SYSTEM

Figure 4 below shows an electronic ignition system.

a- List three (03) advantages of electronic ignition system over the classical system.

(1mark x 3 = 3 marks)

- Wear of the contact breaker points and moving parts altering ignition timing;
- Reduce coil output due to bouncing of the contact breaker at high speed;
- There is corrosion of contact breaker with time, altering the dwell angle;
- Regular servicing is required; - Less maintenance; - Use of solid state devices.

b- Fill the table below by stating the name of a reference part and giving its function.

(5 marks)

Ref.	Name (0.5mar x 5)	Function (0.5mar x 5)
1	Trigger vane	It rotates with the cam, creates and breaks the magnetic field.
2	Vane switch	It receives information from the trigger vane and sends to the ECU.
3	Rotor arm	It distributes high voltage current to the different spark plugs.
6	Ignition coil	It transforms 12V to about 20000V.
9	Electronic Control Unit (ECU)	It ensures ignition timing by controlling the primary circuit.

c- One of your regular customers whose car is equipped with type of ignition system above, comes to your workshop and complains that the power output of his engine has dropped and even the sound of the engine too has changed. What could be the cause of this problem? Propose a remedy.

(2 marks)

Fault	Possible cause (0.5mark x 2)	Remedy (0.5mark x 2)
Power output of his engine has dropped and even the sound of the engine too has changed.	1- Incorrect ignition timing; - Weak spark	- Retime the ignition; - Replace;
	2- Dirty or badly adjusted plugs are defect associated with low power.	- Properly adjust spark plugs.

Question 5: DASHBOARD ELECTRICAL CIRCUITS

Figure 5 shows a vehicle dashboard instrument panel.

- a- What is the function of a dashboard in an automobile vehicle? (1 mark)
It informs and cautions the driver on the operating condition of the various vehicle systems.
- b- Fill the table below by stating the name of a reference part and giving its function. (5 marks)

Ref.	Name (0.5mar x 5)	Function (0.5mar x 5)
6	Tachometer	It indicates engine revolutions per minute.
9	Speedometer	It indicates the speed of the vehicle.
10	Right turn indicator	It indicates that the car will turn right.
13	Engine malfunction indicator lamp	It indicates that there is an internal engine problem.
27	Low fuel indicator	It indicates that there is low level of fuel in the tank.

- c- In the course of testing a car in your workshop, you notice that the indicator (3) in figure 5 above is "ON".
- i) Identify indicator (1). (1 mark)
Brake indicator.
- ii) State two (02) probable causes of the indicator coming "ON". (1mark x 2 = 2 marks)
- Hand brake not released; - Short circuited connection.
- iii) What would you do to make it go "OFF"? (0.5mark x 2 = 1 mark)
- Released handbrake; - Rectify connection.

SECTION A ELECTRICAL CALCULATION (Answer any TWO questions from this section)

Question 6: FUNDAMENTALS OF ELECTRONIC

- a- Define the following and give two (02) examples for each.

Term	Definition	Examples
Conductor	It is a material with less than four atoms in its valence ring.	1- Copper; 2- Gold and silver.
Insulator	It is a material with more than four atoms in its valence ring.	1- Wood; 2- Rubber and plastic.
Semiconductor	It is a material with exactly four atoms in its valence ring.	1- Silicon; 2- Germanium and carbon.

- b- Figure 6 shows a parallel connection of two lamps.

Given that the resistances of the lamps are $R_1 = 2 \Omega$ (for lamp 1) and $R_2 = 6 \Omega$ (for lamp 2). The voltage supplied by the battery is 12 V. Neglecting the resistances of the cables when the switch is closed, calculate:

- i) The total resistance R_T offered by the lamps. (2 marks)

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2} \quad R_T = \frac{2 \times 6}{2 + 6} = \frac{12}{8} = 1.5\Omega \quad \underline{R_T = 1.5\Omega}$$

- ii) The total current I_T flowing in the circuit. (2 marks)

$$I_T = I_1 + I_2 \quad I_T = \frac{V}{R_1} + \frac{V}{R_2} \quad I_T = \frac{12}{2} + \frac{12}{6} = 6 + 2 = 8A \quad \underline{I_T = 8A.}$$

Question 7: BATTERY

The vehicle battery is the single most important electrical component in today's vehicles.

- a- Briefly explain the chemical changes which take place during the charge and discharge process of a conventional lead acid battery. (1.5mark x 2 = 3 marks)
- During discharging:
The positive plate lead dioxide (PbO_2) combines with the SO_4 to form PbSO_4 from the electrolyte and releases its O_2 into the electrolyte forming H_2O_4 . The positive plate also combines with SO_4 from the electrolyte and becomes lead sulphate (PbSO_4).
 - During charging:
The sulphate from the acid leaves both the positive and the negative plates and returns to the electrolyte where it becomes normal sulphuric acid. The positive plate becomes lead dioxide (PbO_2). The negative plate becomes pure lead (Pb) and the electrolyte becomes H_2SO_4 .
- b- Explain what tests you would carry out on a 12V 90AH 250A lead acid battery in order to determine its serviceability. (1mark x 3 = 3 marks)
- Test the specific gravity of the electrolyte;
 - Test voltage output;
 - Test current output;
 - Test the internal resistance of the battery.
- c- State two (02) factors which influence the capacity of a lead acid battery. (1mark x 2 = 2 marks)
- Type of material used;
 - Size of the plate;
 - Amount of electrolyte;
 - Strength of electrolyte;
 - Application;
 - Maintenance.
- d- A 500W electric motor is supplied with current from a 12V supply via an electric solenoid switch. Calculate the current flow through the motor when the solenoid is activated. (2 marks)

$$P = U.I = V.I \quad I = P/V \quad I = 500/12 = 41.66\text{A} \quad \underline{\underline{A = 41.66 \text{ A.}}}$$

Question 8: CHARGING SYSTEM

- a- An engine supplies a torque of 200Nm to the alternator at a speed of 2000rev/min.
- i) Deduce the angular velocity (ω) of the alternator in radians per second. (2 marks)
- $$\omega = \frac{\pi.N}{30} \quad \omega = \frac{3.14 \times 2000}{30} = 209.33\text{rd/sec} \quad \underline{\underline{\omega = 209.33\text{rd/sec.}}}$$
- ii) Calculate the power consumed by the alternator. (2 marks)
- $$P = T. \omega \quad P = 200 \times 209.33 = 41866.66 \text{ watts} \quad \underline{\underline{P = 41866.66 \text{ watts} = 41.866 \text{ kwatts.}}}$$
- b- If the alternator has an output of 13V and a resistance $R = 3 \Omega$;
- i) Calculate the output current (I). (2 marks)
- $$V = I.R \quad I = V/R \quad I = 13/3 = 4.33\text{A} \quad \underline{\underline{I = 4.33 \text{ A.}}}$$
- ii) Determine the power output of the alternator?. (2 marks)
- $$P = U.I = V.I \quad P = 13 \times 4.33 = 56.29 \text{ watts} \quad \underline{\underline{P = 56.29 \text{ watts.}}}$$
- c- What will be the reaction of the battery if the alternator output is less than the vehicle electrical needs? (2 marks)
- The battery will quickly discharge;
 - The battery will not have sufficient power to start again the engine.