21.0 ELECTRICITY (448)

Although there was no examination offered in Electricity in the years **2006** and **2007**, the format and syllabus for the two papers did not change when the examination resumed in the year **2008**.

21.1 CANDIDATES' GENERAL PERFORMANCE

The table below shows the candidature and the overall performance of candidates in the Electricity examination in the year **2008.** For purposes of comparison, the statistics for **2003**, **2004** and **2005** have also been given.

Table 25: Candidates' Overall Performance in Electricity for the Years 2008, 2005, 2004 and 2003

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
	1		60	29.57	9.15
	2		40	23.16	5.33
2003	**Overall**	**492**	**100**	**52.63**	**12.63**
	1		60	31.22	9.64
	2		40	24.57	4.59
2004	**Overall**	**515**	**100**	**56.68**	**12.00**
	1		60	36.77	9.76
	2		40	25.43	4.37
2005	**Overall**	**443**	**100**	**62.20**	**12.00**
	1		60	26.67	10.78
	2		40	21.83	6.54
2008	**Overall**	**48**	**100**	**48.53**	**15.29**

From the table above, the following observations can be made:

21.1.1 The candidature declined from ***443*** candidates in the year **2005** to ***48*** candidates in the year **2008.**

21.1.2 The mean score for ***paper 1 (448/1)*** declined by ***10*** marks from ***36.77*** in the year **2005** to ***26.67*** in the year **2008.**

21.1.3 The mean score for ***paper 2 (448/2)*** declined from ***25.43*** in the year **2005** to ***21.83*** in the year **2008**.

21.1.4 The overall mean score for the subject declined significantly from ***62.20*** in the year **2005** to ***48.53*** in the year **2008**.

The drop in candidature and the mean score in all the papers can be attributed to the interruption for the two years when the examination in Electricity was not offered.

21.2 PAPER 1 (448/1)

The questions which were reported to have been poorly done will be analyzed with a view to identify the candidates' weaknesses and offer suggestions on some of the remedial measures to be taken to improve performance in the subject in the future. The questions to be analyzed in paper 1 (448/1) include ***3, 6, 9, 10, 13*** and ***15.***

Question 3

(a) Give **two** reasons why aluminium is preferred to copper for overhead power line cables.

(b) In a 12 volt dc system a 40 watt solar panel is exposed to the sun for six hours daily. Calculate the number of days it will take to fully charge a 60 ampere-hour battery.

The candidates were required to identify the properties of aluminium which make it a better power conductor than copper. In the second part of the question, candidates were expected to do some power related calculations.

Weaknesses

The responses given by the candidates in this question indicated that they had very limited knowledge in materials and calculation of energy.

Expected Responses

(a)

- Are lighter than copper cables.
- Are cheaper than copper cables.
- Are more corrosion resistant than copper.

(b) Current for solar panel is $I+\frac{40w}{12v}$

$\therefore$ rate of charge$=\frac{40}{12} \times 6AH/day$

No of days required for full charge is

$$\frac{60 \text{ A-h}}{\frac{40}{2} \times 6} = \frac{60}{20} = 3 \text{ days}$$

Question 4

(a) Describe the energy conversion sequence in hydro-electric power generation.

(b) An alloy wire whose diameter is 1.0mm and resistivity is 75 μΩm is used to make a 150 ohm resistor. Calculate the length of the wire.

This question required the candidates to outline how energy is converted during generation of hydro electric power and at the same time calculate the size of a prescribed resistor wire.

Weaknesses

The question tested various concepts of fundamentals of electricity which the candidates did not seem to be conversant with.

Expected Responses

(a)

Potential energy → ~~Kinetic energy~~ → ~~mechanical~~

Energy → electrical energy

(b) Length of the wire is given

lu $I=\frac{aR}{P}$

$$A=\pi\left[\frac{D}{2}\right]^2=\frac{\pi D^2}{4}$$

$$\therefore l = \frac{\pi D^2 R}{4P}$$

$$= \frac{3.14x(1.0x10^{-3})x150m}{4x75x10^{-6}}$$

=1.57m

Advice to Teachers

Teachers should cover all the concepts outlined in this very important syllabus topic.

Question 6

(a) Explain why electric power is transmitted at high voltages.

(b) Explain the **three** functions of a switch gear at a domestic consumer's intake point.

The question tested the candidates' knowledge in power transmission and domestic installations.

Weaknesses

Most of the candidates could not articulate why electric power is transmitted at high voltages. The second part of the question called for understanding of the functions of a switch gear which most of the candidates lacked.

Expected Responses

(a) Electric power is transmitted at high voltage in order to reduce current and therefore reduce cable sizes, power loss and cost.

(b)

- Isolation: switching off all conductors connecting to the supply.
- Circuit protection: automatically disconnects installation when current exceeds normal
- Protection against leakage of current to earth.

Question 9

(a) State **three** methods of increasing the sensitivity of a galvanometer.

(b) An electric pressing iron gets very hot when the temperature control knob is at any position.

(i) State **two** possible causes of the problem.
(ii) List, in correct sequence, the steps taken to identify the fault.

This question was based on servicing of a galvanometer and trouble shooting of a pressing iron which is a very common electrical appliance.

Weaknesses

In order to come up with a satisfactory response, the candidates needed to apply some of the skills acquired in their practicals particularly trouble shooting. Apparently, the majority of the candidates lacked the skills required.

Expected Responses

(a)

- Increasing the number of its coil.
- Using a stronger magnet.
- Using weaker hairspring or a wire suspension.
- Using a long beam of light as a pointer.

(b) (i)

- Loose control knob.
- Faulty thermostat element.
- Incorrect wiring.

(ii)

- Check the temperature control knob for tightness.
- Open the iron box and check the thermostat.
- Check the wiring for correctness.
- Logical sequence.

Question 10

(a) Explain the difference between "detailed drawing" and exploded drawing.

(b) Make a free-hand schematic drawing of an electric circuit showing two cells and one normally-open push button switch in series controlling two bells connected in parallel.

The first part of this question called for interpretation of two terms which apply to types of drawings. The second part of the question required the candidates to convert a given circuit drawing into a schematic drawing.

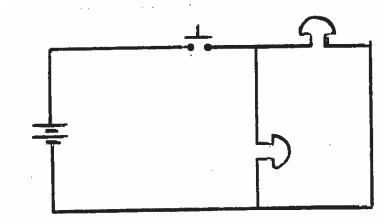
Weaknesses

Although the term *"**detailed**"* and *"**exploded**"* are commonly used in drawing, about ***80%*** of the candidates lacked the correct words to explain what the two terms mean. The use of correct symbols and conventions was lacking in the schematic drawing that was required in part (b) of the question.

Expected Responses

(a) ***Detailed drawing*** shows the parts with their sizes, materials' shapes etc./while ***exploded drawing*** shows the sequence in which all the parts are put together in the final assembly.

(b)



Question 13

(a) Explain the term "stroboscopic effect" with respect to discharge lamps.

(b) (i) Draw a labelled circuit diagram of a starter switch-operated fluorescent lamp.

(ii) Explain the purpose of each of the following features in the circuit in (b)(i) above.

I choke
II fluorescent powder.

Part (a) of this question expected candidates to explain the term ***"Stroboscopic effect"*** with respect to discharge lamps, while part (b) of the question required the candidates to draw and label a typical fluorescent lamp assembly and explain the function of two selected parts.

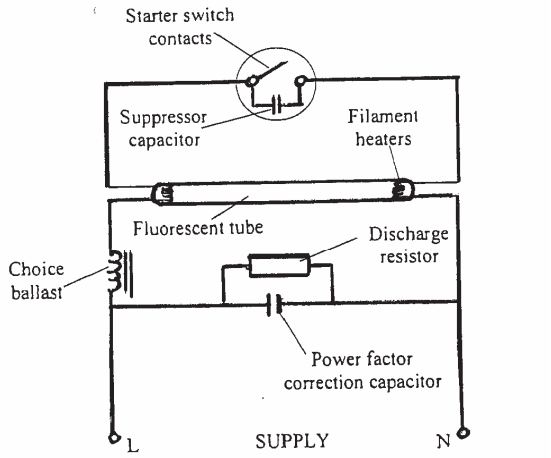
Weaknesses

Most of the drawings presented were incomplete and incorrect. Construction and operation of a fluorescent lamp should be a very familiar topic to the candidates and teachers should ensure that it is thoroughly covered.

Expected Responses

(a) ***Stroboscopic effect*** is a phenomenon whereby reversing discharge of ions and electrons by the lamp coincides with the speed of revolving machines such that the machines appear to be stationary.

(b) (i)



(ii) I ***Choke:*** induces a high voltage which enables a discharge to be initiated between the electrodes of the tube when the starter contacts open. It also keeps the discharge and lamp current at a steady value when the lamp is in operation.

II ***Fluorescent Powder:*** converts the ultra violet light emitted by the discharge and melting mercury to drop to a shadowless or coloured light.

Question 15

Figure 5 shows a Printed Circuit Board (PCB).

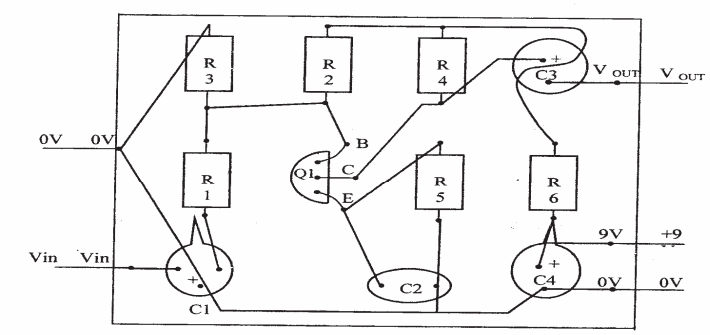


Figure 5

(a) Outline the procedure of constructing the PCB.

(b) Given that Q_1 is an NPN transistor, draw the schematic diagram of the circuit on the PCB and label all the components.

This question required the candidates to describe how printed circuit boards are constructed and also come up with a schematic diagram of the printed circuit presented.

Weaknesses

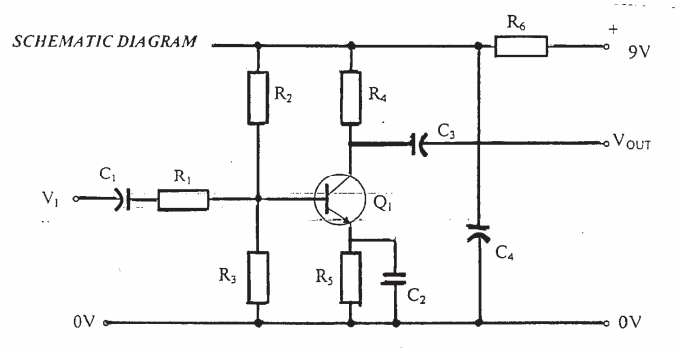
Despite handling numerous printed circuit boards particularly during the practicals, very many candidates did not seem to know how a PCB is constructed. Even presenting the given circuit in a different form proved to be a very difficult task for most of the candidates.

Expected Responses

(a)

(i) Draw the schematic diagram of the circuit.
(ii) Draw the PCB artwork.
(iii) Transfer the artwork to copper side of the board.
(iv) Etch the board.
(v) Drill holes for the component.
(vi) Position the components and connectors.
(vii) Solder the components and connectors.
(viii) Dress the PCB i.e. cut out the tails and close PCB surface.

(b)



21.3 PAPER 2 (448/2)

This practical paper was composed of five equally weighted exercises and the tasks incorporated included the following:

21.3.1 Connecting two different circuits.

21.3.2 Setting instruments to obtain specified readings.

21.3.3 Reading and recording various data.

21.3.4 Plotting graphs from the values obtained.

21.3.5 Fabricating sheet metal parts and assembling them.

21.3.6 Analyzing a fabricated circuit and determining its application.

21.3.7 Mounting components on domestic installation board.

21.3.8 Fixing and terminating conduits.

21.3.9 Terminating conductors at various components.

Weaknesses

The performance in this paper as reflected by the mean score was poorer than any of the previous years. The following weaknesses were noted as the candidates carried out the exercises:

- Inability to connect various circuits from given diagrams.
- Inability to manipulate the apparatus to obtain desired readings.
- Failure to complete the required tasks.
- Failure to read various instruments accurately.
- Misinterpretation of readings.

21.4 ADVICE TO TEACHERS AND STUDENTS

21.4.1 Teachers should ensure that the entire syllabus is adequately covered in good time.

21.4.2 Students should be exposed to all the relevant practical exercises in order to reinforce the theory leant.

21.4.3 Candidates should not be subjected to unfamiliar apparatus or equipment during the practical examination.

21.4.4 Candidates should:

21.4.4.1 Read carefully and follow all the instructions given in each exercise.

21.4.4.2 Be involved individually in performing various experiments.

21.4.4.3 Practise repeatedly how to perform common experiments stipulated in the syllabus.

21.4.4.4 Practise reading various instruments and meters accurately.

21.4.4.5 Learn how to interpret data and make appropriate deductions.

21.4.4.6 Master common fabrication skills that are relevant to electricity.