education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

ELECTRICAL TECHNOLOGY

EXEMPLAR 2006

MARKS: 200

TIME: 3 hours

This question paper consists of 13 pages and a 1-page formula sheet.

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INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Sketches and diagrams must be large, neat and fully labelled.
3. ALL calculations must be shown and correct to TWO decimal places.
4. Answers must be numbered correctly according to the numbering system used in this question paper.
5. Non-programmable calculators may be used.

QUESTION 1: TECHNOLOGY, SOCIETY AND THE ENVIRONMENT

1.1 Different sources of energy are used to generate electricity in Southern Africa. The main energy sources are:

* Coal-fired power stations
* Nuclear-driven power stations
* Hydro-electrical power stations

Give ONE advantage and ONE disadvantage of each type of power station with specific consideration of environmental and economical factors. (6)

1.2 HIV/aids is a dangerous disease and a person can also be infected through the sharing of blood. In the electrical workshop, somebody might get injured in such a way that they might bleed.

Why should you not touch the blood of an injured person in the workshop? (2)

1.3 The purpose of learning how to design technological products, systems and services, is also to empower people to become entrepreneurs.

After completing designing and making, what should you do with the technological product? (2)

[10]

QUESTION 2: THE TECHNOLOGICAL PROCESS

In order to design and make a technological product, system or service, the designer follows the technological design process.

Briefly describe, with the aid of examples, the major steps to be followed when designing technological products, systems or services. **[10]**

QUESTION 3: OCCUPATIONAL HEALTH AND SAFETY

The health and safety of factory workers are of the utmost importance, not only for the purpose of keeping individuals safe, but also because of the resultant cost factor in the case of an accident.

When workers in a factory are injured, the supervisor needs to determine whether the injury was as a result of unsafe working conditions, or due to negligence by the worker in question.

As a supervisor, you need to distinguish between unsafe acts and unsafe conditions.

3.1 List THREE unsafe actions in an electrical workshop. (3)

3.2 List THREE unsafe conditions that may exist within an unsafe workshop. (3)

3.3 Describe the main distinguishing factor that determines unsafe acts as opposed to unsafe conditions. (2)

3.4 List TWO consequences of accidents to the employer if an employee is in an accident while on duty. (2)
[10]

QUESTION 4: USE AND CARE OF TOOLS AND INSTRUMENTS

4.1 Describe how a multimeter would be utilised to test the continuity of an electrical circuit. (4)

4.2 Why is it dangerous to connect an ammeter in parallel with a load? (4)

4.3 List TWO considerations when caring for hand tools. (2)
[10]

QUESTION 5: THE PRINCIPLES OF MAGNETISM

A scrap metal company named Mohlodi Scrap Metals makes use of a crane to load the scrap materials onto a truck before it is taken for recycling. The crane uses electro-magnets to lift the scrap metal from the ground. Heavier pieces of metal sometimes fall off when they are suspended above the ground. This is due to the magnetic field of the lifting magnet not being strong enough to lift the heavier pieces of metal.

5.1 Name FOUR characteristics of magnetic lines of force. (4)

5.2 Explain the difference between *permanent magnets* and *electromagnets*. (4)

5.3 Explain how it is possible for the lifting magnet to release the magnetised scrap metal when it is above the truck. (3)

5.4 Explain how the magnetic field strength can be increased to make the lifting magnet stronger. (4)

[15]

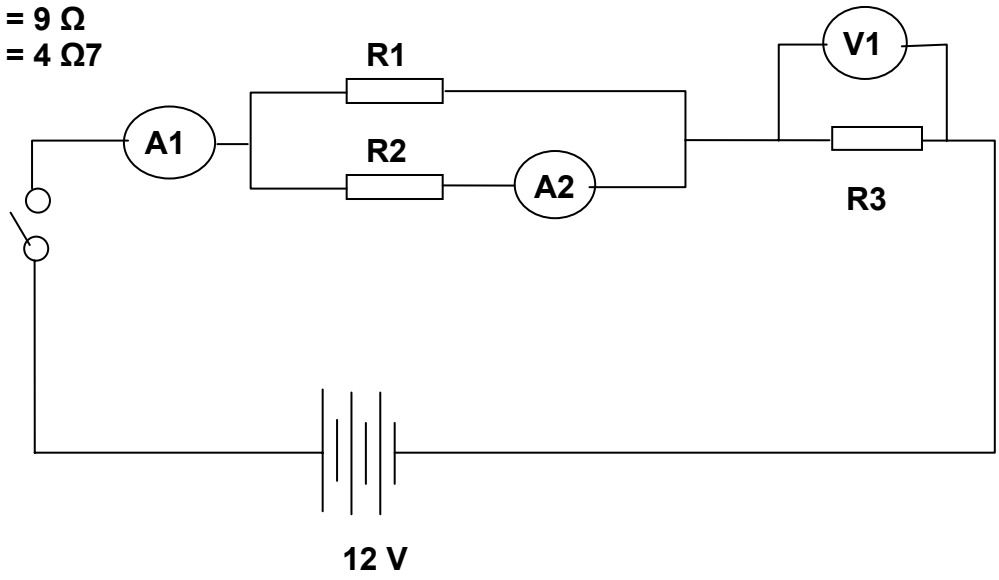
QUESTION 6: THE PRINCIPLES OF ELECTRICITY

6.1 State Ohm's law. (4)

6.2 Briefly explain, in your own words, the term *temperature coefficient* with specific reference to resistance. (3)

6.3 Answer the following questions with reference to the circuit shown below:

R1 = 12 Ω
R2 = 9 Ω
R3 = 4 Ω7



6.3.1 Calculate the total resistance of the circuit. (6)

6.3.2 Calculate the reading on each of the following meters:

(a) A1 (3)
(b) V1 (3)
(c) A2 (5)

6.3.3 What must the minimum power rating of R3 be to ensure that it is not destroyed? (4)

6.4 If R1 was removed from the circuit, how would this affect the total resistance of the circuit? Explain your answer. (2)
[30]

QUESTION 7: PRINCIPLES OF ELECTROSTATICS

For the purpose of experimentation, you have been instructed to build a simple electronic circuit that is equivalent to the RC circuit, shown in FIGURE 7.1.

Switch S1 can be placed in either position 1 or position 2. In position 1, the battery (B1) charges the capacitor (C) to full capacity.

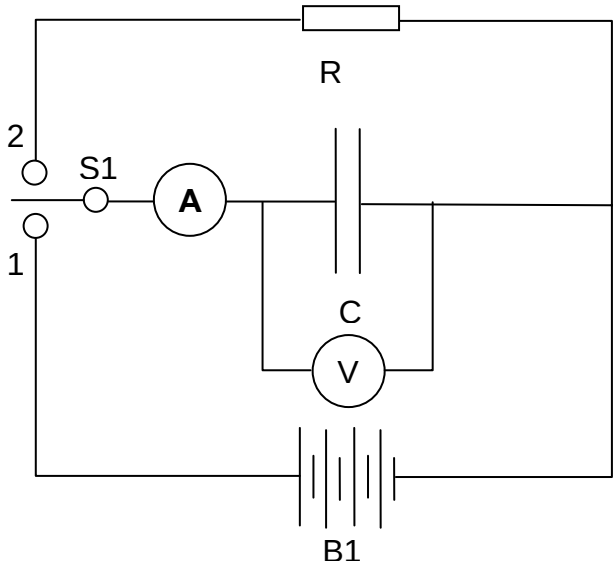


FIGURE 7.1: RC Circuit

7.1 Make use of TWO graphs to illustrate the flow of current through the ammeter (A) and the voltage across the capacitor (C) when S1 is placed in position 1. (4)

NOTE:	When the switch S1 in FIGURE 7.1 is placed in position 2, the accumulated charge in the capacitor will discharge through the resistor (R).

7.2 Describe the principle of operation on which capacitors rely to retain charge, even after the supply voltage has been removed. (6)
[10]

QUESTION 8: ELECTRONIC COMPONENTS

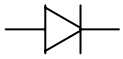
8.1 Write the values of the resistors with the following colour coding:

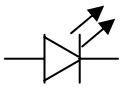
8.1.1 Brown, grey, yellow, gold (2)

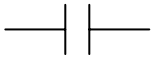
8.1.2 Yellow, violet, red, gold (2)

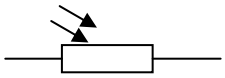
8.2 Identify the following components:

8.2.1  (1)

8.2.2  (1)

8.2.3  (1)

8.2.4  (1)

8.2.5  (1)

8.3 List the main characteristics of the following components:

8.3.1 A PN-junction diode (2)

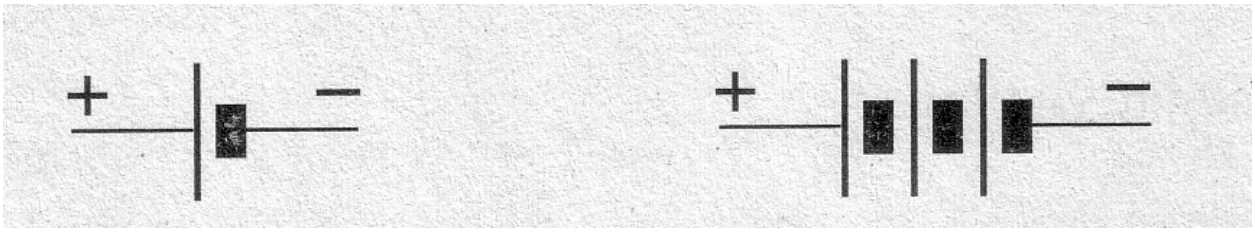
8.3.2 A light-dependent resistor (2)

[13]

QUESTION 9: POWER SOURCES

9.1 Identify the following symbols:

9.1.1 9.1.2



(2)

9.2 Refer to the graph in FIGURE 9.1 below and then answer the following questions:

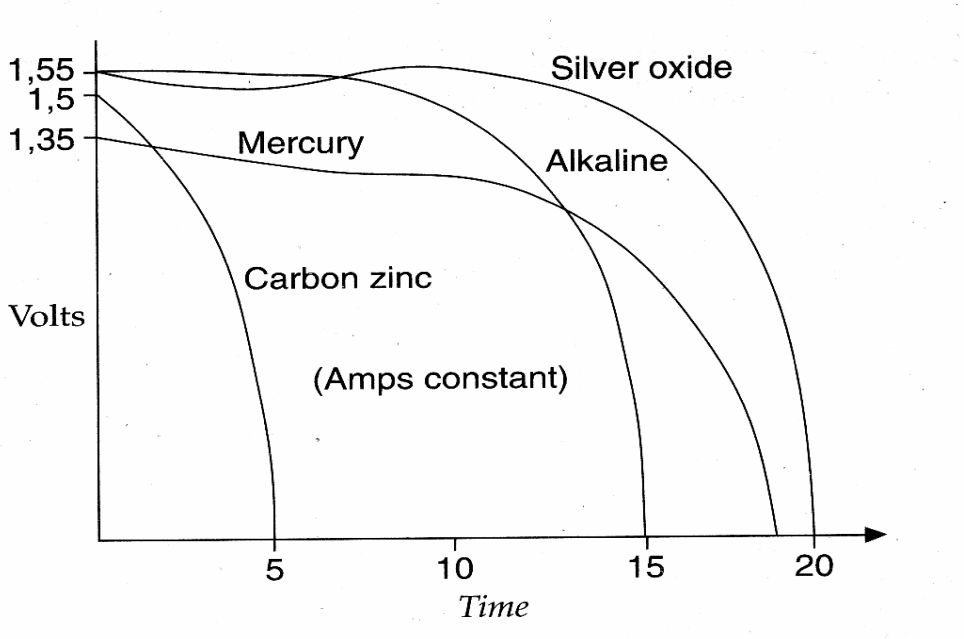


FIGURE 9.1: Performance Graph of Primary Cells

9.2.1 Indicate which primary cell will last the longest. (1)

9.2.2 List the primary cell that will last for five hours continuously. (1)

9.2.3 List the primary cells with the highest voltage rating. (2)

9.2.4 Indicate which primary cell you suspect to be the cheapest. (1)

9.2.5 Indicate which primary cell you would rather buy, and substantiate your answer. (3)

9.3 Make use of a table and compare at least TWO advantages and TWO disadvantages of primary cells and secondary cells. (8)

9.4 Explain the difference between *electromotive force* (EMF) and *potential difference* (pd). (4)

9.5 A small transistor radio uses three AAA 1,5 volt cells to give an EMF of 4,5 volts. When the radio is switched on, the voltage drops to 4,34 volts in total. The current measurement is 400 mA.

Draw the circuit diagram and calculate the internal resistance of the battery. (8)
[30]

QUESTION 10: LOGIC CONCEPTS

10.1 Binary number systems rely on two numbers, namely 1 and 0. Different values are displayed as a combination of 1 and 0. Make use of TABLE 10.1 below and derive the missing value of each entry.

	Binary Value	**Decimal Value**
Example	0100_2	4_{10}
10.1.1	0011_2	
10.1.2	10101_2	
10.1.3		25_{10}

TABLE 10.1: Binary and Decimal Numbers

(6)

10.2 In electronic circuits, the binary 1 and 0 are represented as a value in volts. In positive logic systems, the use of 5 V for logic 1 and 0 volt for logic 0, is accepted practice.

With reference to this information, determine the possible combinations for the circuit shown in FIGURE 10.2: Logic Circuit. Record your answer in the form of a truth table and identify the equivalent logic gate.

A closed switch = 1
An open switch = 0

Light when lit = 1
Light when non-lit = 0

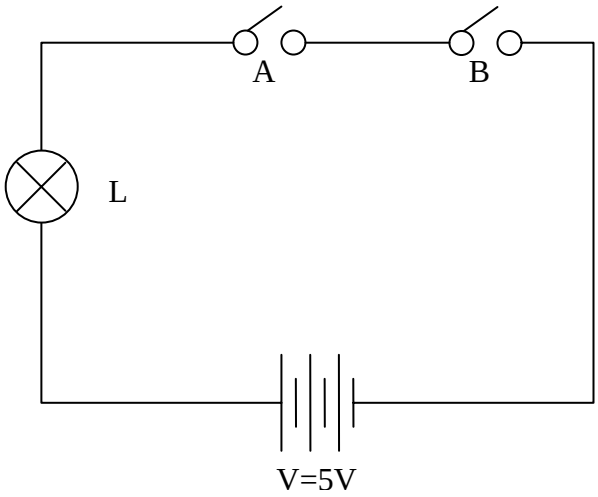


FIGURE 10.2: Logic Circuit

(5)

10.3 Derive the Boolean algebra equation that would be equivalent to the circuit shown in FIGURE 10.3: Boolen equations at each of the indicated steps.

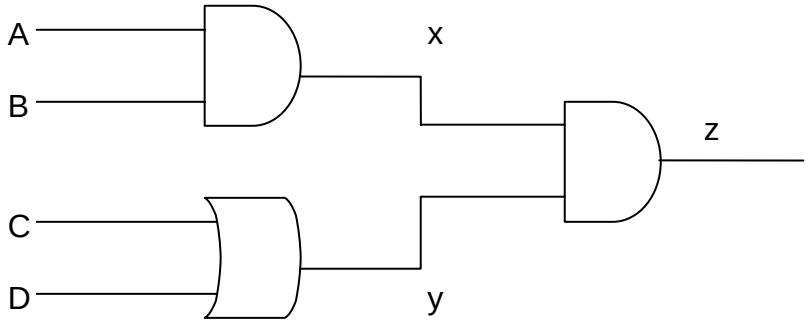


FIGURE 10.3: Boolean Equations

(6)

[17]

QUESTION 11: PROTECTIVE DEVICES

11.1 Refer to FIGURE 11.1 and identify the parts of the miniature circuit breaker (MCB).

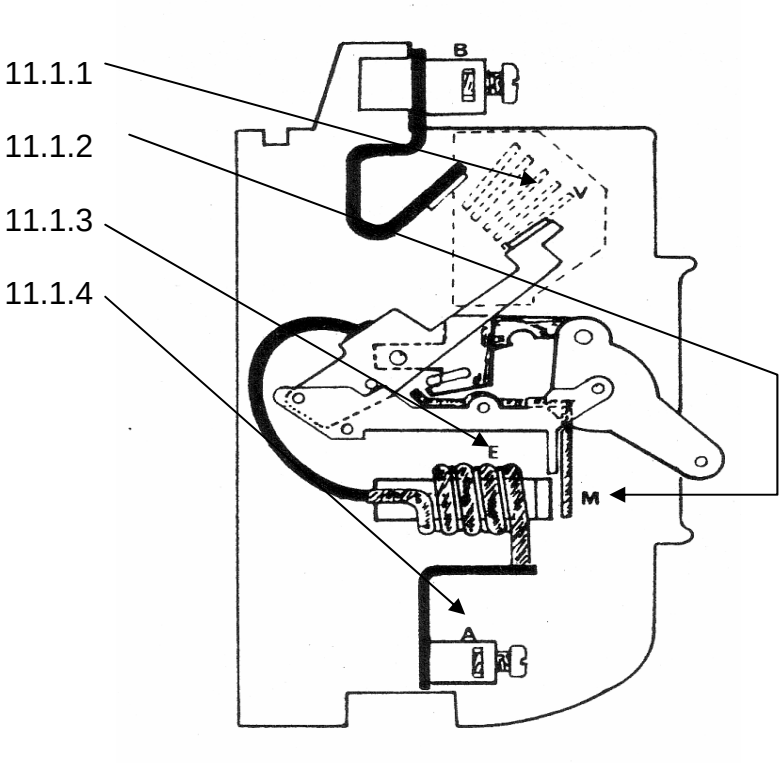


FIGURE 11.1: MCB

(4)

11.2 Explain the purpose of protective devices. (3)

11.3 Identify the protective device in FIGURE 11.2 and explain its working principle.

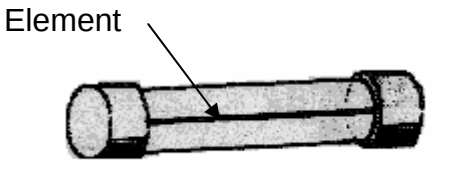


FIGURE 11.2: Protective Device

(3)
[10]

QUESTION 12: SINGLE-PHASE CIRCUITS

12.1 The electrical wiring of premises must be connected to a distribution board. Show, by means of a circuit diagram, how you would connect the installations of the following circuits to a distribution board:

12.1.1 TWO light circuits (5)

12.1.2 TWO socket outlet circuits (5)

12.2 What is the purpose of a distribution board in the electrical wiring of buildings? (5)

12.3 Explain how the heating elements of a stove should be connected when a three-heat switching is used. (5)

12.4 Explain the function of a thermostat. (5)
[25]

QUESTION 13: COMMUNICATION SYSTEMS

13.1 Cellular phones are convenient modern-day commodities. In essence, a cell-phone is a low-powered, two-way radio, capable of transmitting and receiving radio signals, thus enabling wireless operation.

Make use of a simple block diagram to illustrate the FM transmitter stage of a cellular phone. (8)

13.2 Morse code is one of the simplest ways to communicate without having to speak. Morse code can be sent using light, sound or even radio waves.

Make use of the components provided to show how you would go about constructing a simple Morse code signal unit.

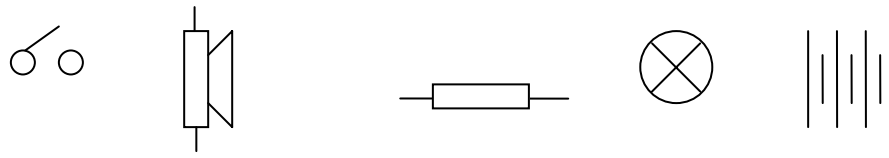


FIGURE 13.2: Electronic Components

(2)
[10]

TOTAL: 200

ELECTRICAL TECHNOLOGY GRADE 10

FORMULA SHEET FORMULEBLAD

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + ...\frac{1}{Rn}$$

$$Rs = R1 + R2 + R3 + ...Rn$$

$$I = \frac{V}{R}$$

$$R = \frac{V}{I}$$

$$V = I \times R$$

$$P = V \times I$$

$$P = I^2 \times R$$

$$P = \frac{V^2}{R}$$

$$R_t = R_o(1 + \infty_o t)$$

$$R = \frac{\rho l}{a}$$