22.0 ELECTRICITY (448)

In the year 2010, Electricity was tested in two papers 1(448/1) and paper 2 (448/2) Paper 1 and paper 2 Paper 1 was a theory paper while Paper 2 was a practical paper which followed the usual setting format as of the previous years.

21.1 GENERAL CANDIDATES PERFORMANCE

The candidate's performance statistics in the KCSE electricity examination since the year 2008 when the syllabus was revised are as shown in the table below.

Table 27: Candidates overall performance in the years 2008 to 2010

Year	Paper	Candidature	Maximum score	Mean score	Standard deviation
2008	1 2 **overall**	**48**	60 40 **100**	26.67 21.83 **48.58**	10.78 6.64 **15.29**
2009	1 2 **overall**	**219**	60 40 **100**	35.47 24.08 **59.55**	9.65 5.66 **13.75**
2010	1 2 **overall**	**161**	60 40 **100**	32.96 28.56 **61.52**	9.53 4.33 **12.56**

From the table it can be observed that:

22.1.1 The candidature reduced to 161 in the year 2010 from 219 in the year 2009.
22.1.2 There was a drop in the performance paper 1 from 35.47 in 2009 to 32.96 in 2010.
22.1.3 Paper 2 registered the best mean in the past three years.
22.1.4 There overall performance of electricity improved from 59.55 to 61.52.

The following is a discussion of some of the questions that were poorly done in the two papers.

22.2 PAPER 1 (448/1)

Poor performance in paper 1 was observed in the following questions.

Question 6

(a) A meter movement system is designed to have a full scale deflection of 50 μA. If it is used as an ohmmeter using 1.5v battery, calculate the value of resistance to give full scale deflection.

(1½ marks)

(b) State **three** advantages of digital measuring instruments over analogue measuring instruments.

(1½ marks)

(c) Describe the **two** methods of identifying faults in electrical equipment.

(4 marks)

The question was testing on meter movement calculations, differentiation between digital and analogue instruments as well as electrical faults identification.

Weaknesses

There was general confusion on using the formula for establishing resistance, and conversion of units.

Expected response

(a) $R_T = \frac{V}{If.s.d} = \frac{1.5}{50 \times 10^{-6}} = 0.03xX106 = 31\Omega$

(b) Advantage of digital measuring instrument
High sensitivity
Easy to read
More lagged and robust (withstands rough handling)
No effect from stray magnetism

(c) Identifying Faults
Physical inspection by looking at the circuit components to determine any change in colour, shape, e.t.c.

Circuit analysis – by taking measurements and comparing with what is in the service manual.

Advice to teachers

- Emphasize on the standardization of units for uniformity in computation.
- Remind learners of items like visual inspection of fault finding as a methodology

Question 9

(a) Explain the term "Zener voltage". (2 marks)

(b) Sketch a schematic circuit diagram of a biased PNP transistor connected in the common-emitter mode. (3 marks)

The question called for the knowledge of the term Zener, as well as analysis of a p-n-p transistor circuit in a given configuration mode.

Weaknesses

- Candidates lacked articulation in the explanation of Zener voltage.
- Many confused the transistor configuration mode.

Expected response

(a) Zener voltage
This is the point at which the zener diode breaks down when connected in reverse bias.
The voltage remains almost constant as the load current varies

(b) PNP Transistor

Advice to teachers

There is need to cover the syllabus fully with emphasis on all terms.

Question 11

Figure 4 shows the isometric view of a towing hook.
Draw, FULL size, in first angle projection:

(a) front elevation in the direction of arrow A;

(b) end elevation in the direction of arrow B. (12 marks)

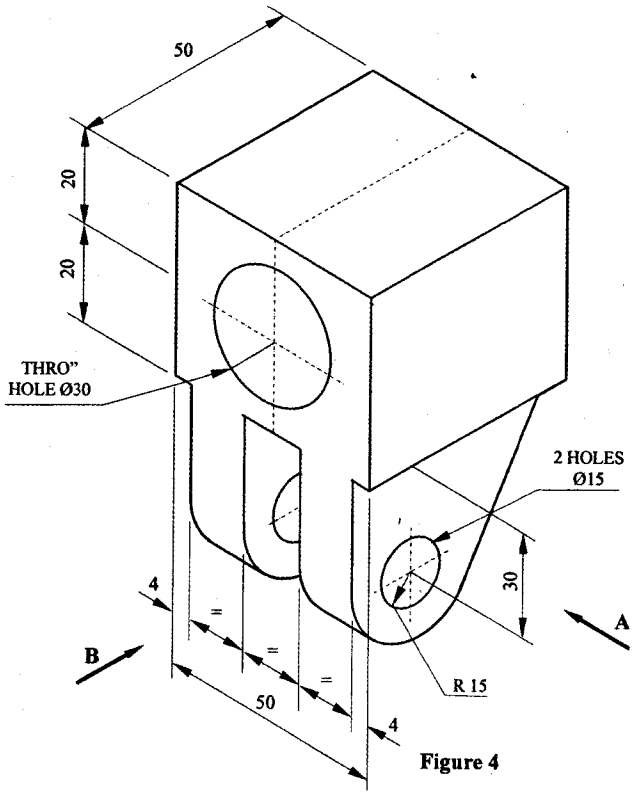
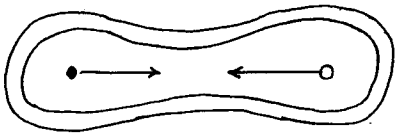


Figure 4

The question called for real interpretation of the isometric drawing, and analysis to get the front elevation and end elevation. Inclusion of all features including hidden details was necessary.
There was need to place the views in conformity with the 1st angle projection.

Weaknesses
Candidates confused basic terms like proper placement of views in the 1st angle projection.
Many omitted the hidden details due to lack of proper tuition.

Expected response



Advice to teachers
There is need to cover the syllabus fully with emphasis on all angles of projection

Question 12

(a) State **two** differences in construction between power transistor and general purpose transistor. (2 marks)

(b) Explain the meaning of each of the following transistor ratios;

(i) dc alpha;

(ii) ac beta. (4 marks)

(c) Figure 5 shows an amplifier circuit whose current gain is 100.

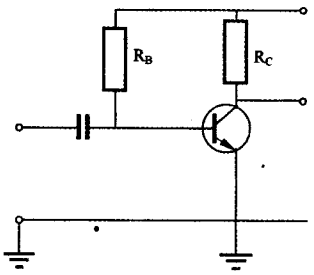


Figure 5

If VCE is 10v, VBE is 0.7v and IC is 10mA, calculate the value of:

(i) R_B;
(ii) R_C. (6 marks)

Weaknesses

Candidates confused dc-alpha and ac-beta. Most were unable to calculate the required values. Many were unable to apply the concepts.

Expected response

(a) Transistor
Power transistors are larger in size and usually have a heat sinks.

(b) Transistor ratio
DC ALPHA is the ratio of the emitter current to the collector current in a dc circuit.

AC BETA is the ac current gained in a common emitter amplifier. It is the ratio of the change in the output (collector) current to the change in the input (base) current.

(c)

$$\beta = \frac{IC}{IB} \Rightarrow 100 = \frac{10mA}{IB}$$

$$\therefore IB = \frac{10mA}{100} = 0.0001mA \text{ or } 100\mu A$$

From the diagram:
$V_{CC} = I_B R_B + V_{BE}$ $20V = I_B R_B + 0.7V$
$I_B R_B = (20 - 0.7) = 19.3V$

$$RB = \frac{19.3}{IB} = \frac{19.3}{100\mu A} = 193k\Omega$$

$$I_c R_c = V_{cc} - V_{CE}$$

$$RC = \frac{V_{CC} - V_{CE}}{I}$$

$$= \left(\frac{20 - 10}{0.01A}\right) = \frac{10}{0.01} = 1K\Omega$$

1

Advice to teachers

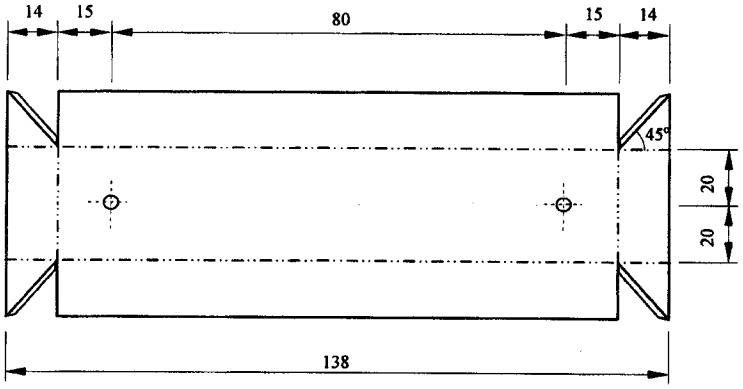
There is need to cover transistors' fully on operational concepts as required by the syllabus.

22.3 PAPER 2 (448/2)

Question 2

Using the materials, tools and equipment provided, make the model of a fluorescent lamp rain guard as shown in figure 2.

(20 marks)



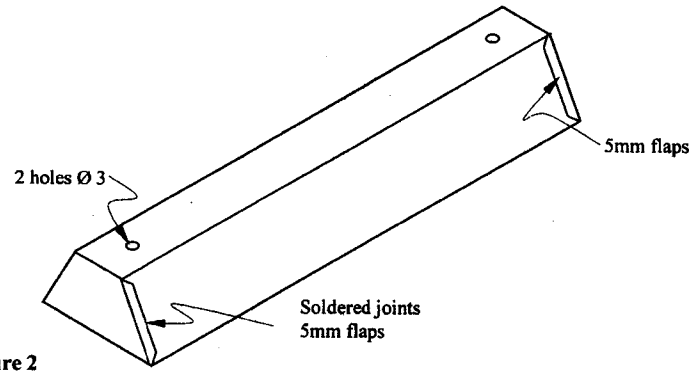


Figure 2

The question tested fabrication of metalwork, a component of electricity in the syllabus to help candidates make electrical undertakings.

The skills tested in the project were to enable the candidates to come up with the rain guard for a fluorescent tube.

Weaknesses

Most candidates were not able to make the complete rain guard.

Expected response

Candicates were expected to perform the following operations:

- Marking
- Cutting
- Folding/bending
- Locating holes
- Driling holes
- Creating flaps
- Soldering
- Deburring

All these skills done on the project were to enable the candidates to come up with a finished product of the rain guard for a flourescent tube.

Advice to teachers

There is need to improve on the teaching of metal fabrication as they form part of electrical undertaking. Candidates should be guided on the time requirements of the project work.

Question 5

Figure 5 shows the layout of a power final circuit. Using PVC sheathed wiring system, install the circuit such that the sockets are connected in radial. (20 marks)

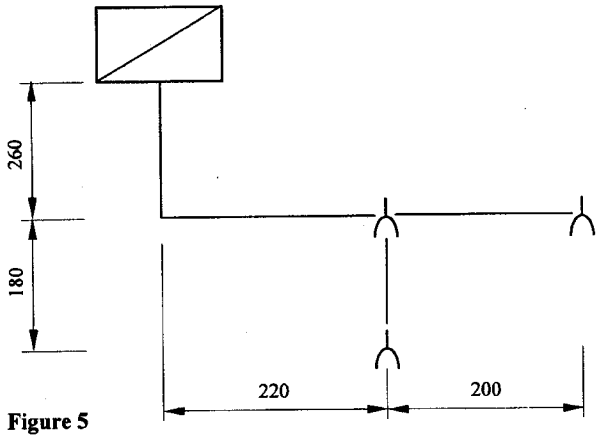


Figure 5

Weaknesses

Candidates were too slow though they knew the tasks.

Expected response

- Measuring and marking points to locate components
- Fixing components firm and level
- Fixing the sheathed cable (horizontal and vertical)
- Firm fixing of cables using appropriate clips
- Terminating wires appropriately (firm and correct colour coding)
- Testing of the wiring system functionality.

Advice to teachers

Teachers should let learners develop speed in their practical work.
The use of unfamiliar tools and equipment during examinations should be avoided. Learners should be exposed to the tools in good time.

29.20 ELECTRICITY (448)

29.20.1 Electricity Paper 1 (448/1)

SECTION A (52 marks)

*Answer **all** the questions in this section.*

1 (a) Outline the procedure of rescuing a person in contact with a live conductor in a workshop. (3 marks)

(b) State **four** duties of an electrical technician in a large company. (2 marks)

2 (a) Outline the procedure of drilling a hole in a metal work piece. (2 marks)

(b) Describe the construction of each of the following parts of a lead acid battery:

(i) positive plate;
(ii) seperator;
(iii) casing. (3 marks)

3 (a) List **four** methods of generating electricity for the national grid. (2 marks)

(b) Distinguish between self induction and mutual induction. (3 marks)

(c) Calculate the total charge in the capacitors shown in figure 1. (3 marks)

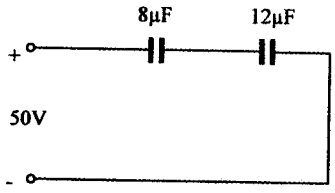


Figure 1

4 (a) Define Rc time constant. (1 mark)

(b) Four resistors are connected as shown in figure 2.

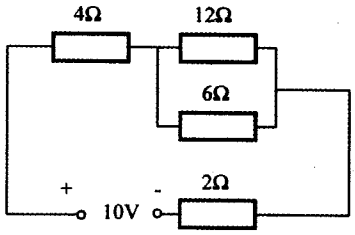


Figure 2

Calculate: (i) the total circuit resistance
(ii) power dissipated in the 2Ω resistor (4 marks)

5 (a) Name the **two** types of ac machines. (1 mark)

(b) List **four** parts of a three-phase induction motor. (2 marks)

(c) An alternator is operated at a speed of 1500 rpm to generate a voltage of 50 Hz. Calculate the number of pair poles. (2 marks)

6 (a) A meter movement system is designed to have a full scale deflection of 50 μA. If it is used as an ohmmeter using 1.5v battery, calculate the value of resistance to give full scale deflection.

(1½ marks)

(b) State **three** advantages of digital measuring instruments over analogue measuring instruments.

(1½ marks)

(c) Describe the **two** methods of identifying faults in electrical equipment.

(4 marks)

7 Draw a sketch of the magnetic flux around two parallel conductor carrying current in the same direction. Indicate the direction of force between the conductors.

(3 marks)

8 (a) State the meaning of the term "final circuit". (1 mark)

(b) Outline **four** regulations regarding ring final circuits that supply 13A socker outlets.

(4 marks)

9 (a) Explain the term "Zener voltage". (2 marks)

(b) Sketch a schematic circuit diagram of a biased PNP transistor connected in the common-emitter mode. (3 marks)

10 Figure 3 shows two orthographic views of a component.

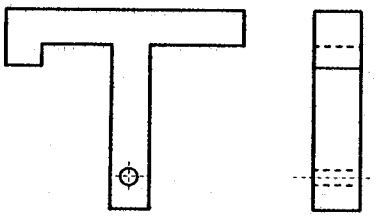


Figure 3

Sketch in good proportion the oblique view of the component. (4 marks)

SECTION B (48 marks)

*Answer any **four** questions from this section.*

11 Figure 4 shows the isometric view of a towing hook.
Draw, FULL size, in first angle projection:

(a) front elevation in the direction of arrow A;

(b) end elevation in the direction of arrow B. (12 marks)

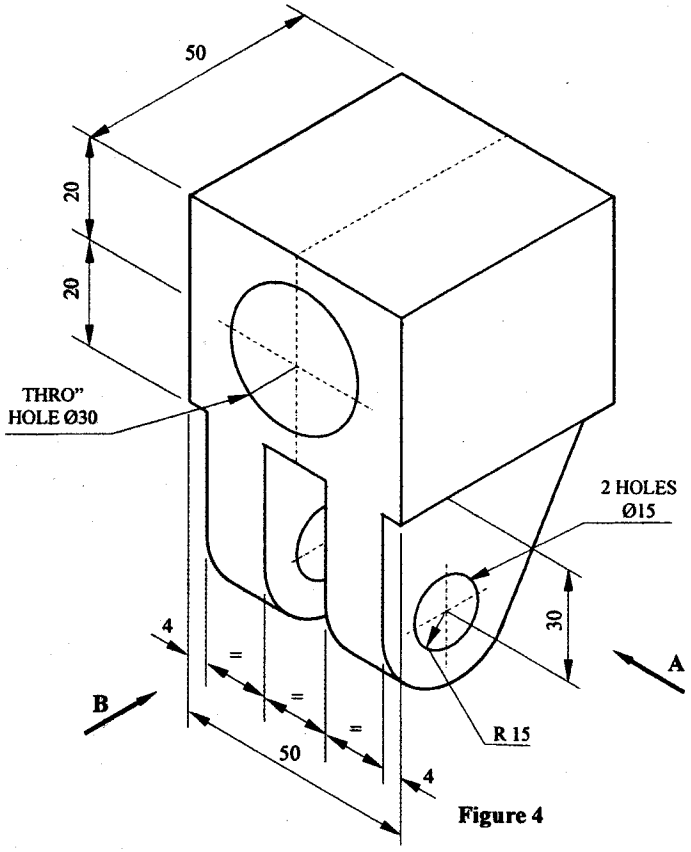


Figure 4

12 (a) State **two** differences in construction between power transistor and general purpose transistor. (2 marks)

(b) Explain the meaning of each of the following transistor ratios;

(i) dc alpha;

(ii) ac beta. (4 marks)

(c) Figure 5 shows an amplifier circuit whose current gain is 100.

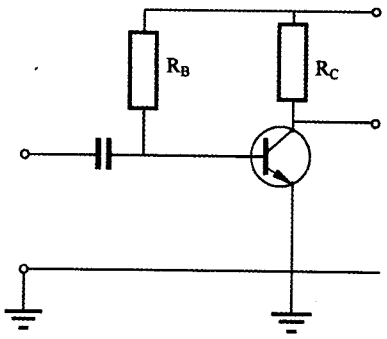


Figure 5

If VCE is 10v, VBE is 0.7v and IC is 10mA, calculate the value of:

(i) R_B;
(ii) R_C. (6 marks)

13 (a) (i) Differentiate between fusing current and current rating of a fuse.

(ii) State **two** disadvantages of rewirable fuses.

(4 marks)

(b) Draw a labelled diagram of a single-stroke electric bell and explain how it operates.

(8 marks)

14 (a) A sine wave has a period of 100ms. Calculate its frequency. (1½ marks)

(b) Figure 6 shows a parallel RL circuit.

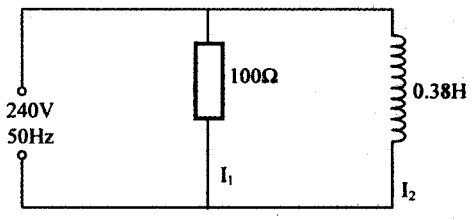


Figure 6

(i) Calculate:

- current I_1 and I_2;
- total current;
- power factor;
- phase angle.

(ii) Draw the phaser diagram. (10½ marks)

15 (a) Use labelled diagrams to show the construction of each of the following types of transformer:

(i) core;
(ii) shell. (6 marks)

(b) A transformer rated 240/12v and 96% efficiency supplies a 10-watt load.

Calculate:

(i) primary current;
(ii) power loss in the transformer. (6 marks)

EXERCISE 1

Using the materials, equipment and measuring instruments provided, perform the following tasks:

(a) Connect the circuit as shown in figure 1.

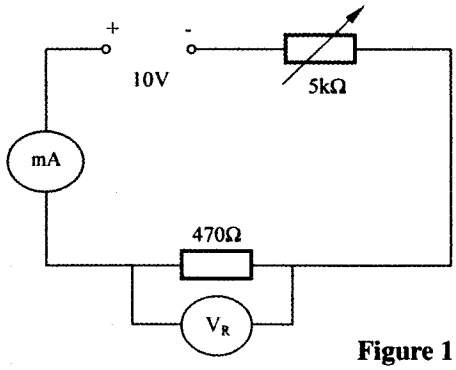


Figure 1

Let the examiner check your work. (1½ marks)

(b) Connect the circuit to the power supply. (½ marks)

(c) Turn the power on and adjust the potentiometer to obtain each of the voltages (V_R) shown in table 1. In each case read and record the corresponding current I.

V_R (volts)	I (mA)	POWER (mW)
3		
4		
5		
6		
8		

Table 1 (7½ marks)

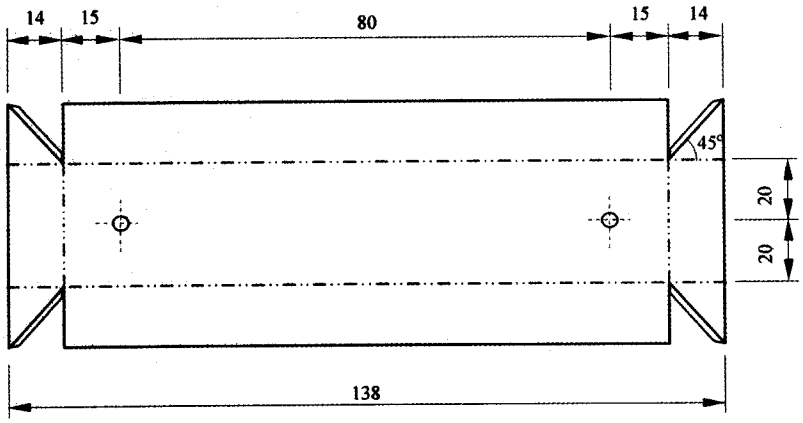
(d) For each value of V_R, calculate the power dissipated in the 470 Ω resistor and complete the table. (5 marks)

(e) Using the values in table 1 draw the graph of power against voltage V_R. (5½ marks)

EXERCISE 2

Using the materials, tools and equipment provided, make the model of a fluorescent lamp rain guard as shown in figure 2.

(20 marks)



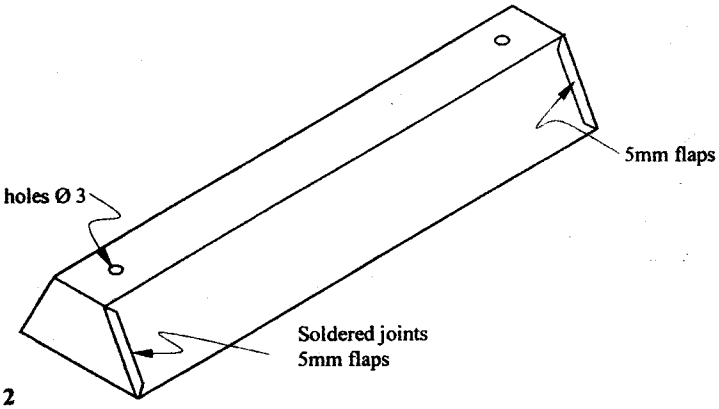


Figure 2

EXERCISE 3

(a) Using the given equipment and components, connect the circuit shown in figure 3.

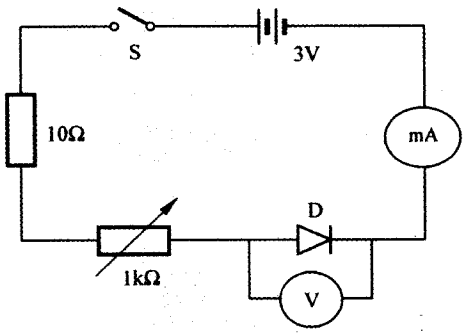


Figure 3

Let the examiner check your work. (3½ marks)

(b) Close switch S.

(d) Adjust the potentiometer to obtain the values given in table 2. In each case, measure and record the corresponding currents.

VOLTAGE (V)	CURRENT (mA)
0.2	
0.5	
0.6	
0.7	
0.8	

(10 marks)

Table 2

(e) Using the values in table 2, plot a graph of current against voltage. (6½ marks)

(d) From the given circuit:

(i) Identify the devices labelled:

F _____

G _____

H _____

(ii) Determine the values of the resistors labelled:

R1 _____

R2 _____

R3 _____ (6 marks)

EXERCISE 4

Figure 4 shows a block diagram of the electronic circuit provided.

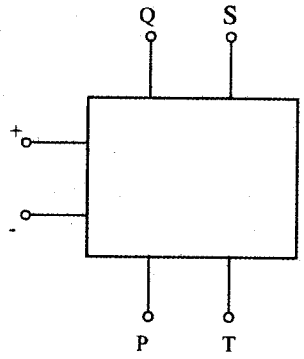


Figure 4

Carry out the following tasks:

(a) With the power supply off:

(i) Connect the milliameter between Q and S.
(ii) Connect the circuit to the power supply.
Let the examiner check your work. (2 marks)

(b) Turn on the power supply and adjust it to obtain the given voltages, E_S in table 3.
For each value of Es, measure and record the corresponding values of:

(i) voltage across P and T
(ii) current through QS. (10 marks)

E_S	E_{P-T}	I_{Q-S}
2		
5		
6		
8		
10		

Table 3

(c) From the results obtained, state **one** practical application of the circuit. (2 marks)

EXERCISE 5

Figure 5 shows the layout of a power final circuit. Using PVC sheathed wiring system, install the circuit such that the sockets are connected in radial. (20 marks)

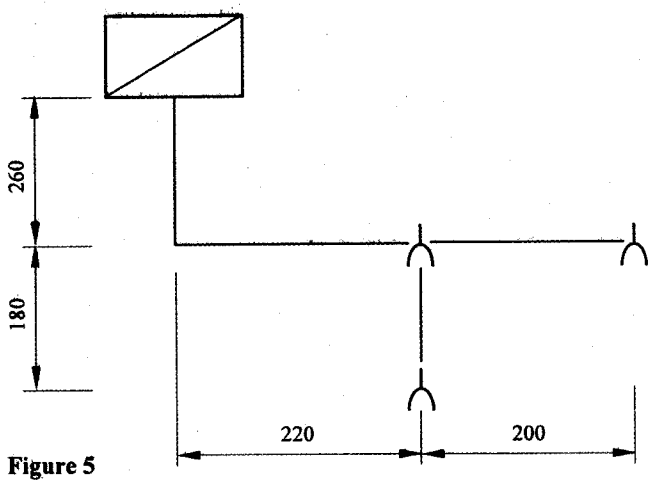


Figure 5

30.20 ELECTRICITY (448)
30.20.1 Electricity Paper 1 (448/1)

1. (a) PROCEDURE
Switch off the supply or use a non-conductor to remove the victim from live conductor.
Place the victim in a comfortable position.
Call for medical assistance.
Apply first aid if necessary. 4 x ½ = 2 marks
Sequence =1

(b) ELECTRICAL TECHNICIAN
Supervises those below him
Trains those below him
Manages workshop production line
Assist workers when they encounter challenges
Any 4 x ½ .

2. (a) DRILLING A HOLE
Measure and mark the position of the hole.
Centre punch the hole.
Mount the work firmly in a vice.
Using the correct size of drill to drill the hole. 4 x ½

(b) PARTS OF A BATTERY
Positive plates consist of lattice type of grid of cast antimony lead alloy covered with lead peroxide.
Separators are thin sheets of porous insulators placed between positive and negative plates.
Casing made of vulcanized rubber, ebonite, plastic etc molded into partitioned container.
3 x 1

3. (a) METHOD OF GENERATING ELECTRICITY
Hydro
Geothermal
Diesel engines
Thermal 4 x 2

(b) Self inductance comprises one coil changing current which induces emf in itself while in mutual induction, 2 coils which are close changes current in one induced emf into the other.
(1½ x 2)

(c) Total charge $CT=\frac{C_1C_2}{C_1+C_2}=\frac{8\times12}{12\times8}=4.8\mu F$ (1½ marks)Ω

$Q = C_T x V = 50 \times 4.8 \times 10^{-6} = 240\mu C$ (1½ marks)

4. (a) RC Time Constant
Is the time taken to charge the capacitor to 63.2% of the charging voltage.
(1 mark)

(b) (i) $RT = 4 + 2 + \frac{12 \times 6}{12 + 6} = 6+4=10\Omega$ (2)

$TT=\frac{V}{R}=\frac{10}{10}=1Amp$ (1)

$P=1^2R=1^2 \times 20=2w$ (1)

5. (a) Ac Machines Types
Revolving armature
Revolving field 2 x ½

(b) Parts of Induction motor
Startor
Winding
Squrrel cage rator
Bearing

Frame/Yoke/Bod

(c) No. of pairs=$\frac{60F}{rpm}=\frac{60 \times 50}{1500}$ = 2 pairs

Any 4 x ½

6. (a) $R_T=\frac{V}{If.s.d}=\frac{1.5}{50 \times 10^{-6}}$ =0.03xX106=31Ω

(b) Advantage of digital measuring instrument
High sensitivity
Easy to read
More lagged and robust (withstands rough handling)
No effect from stray magnetism

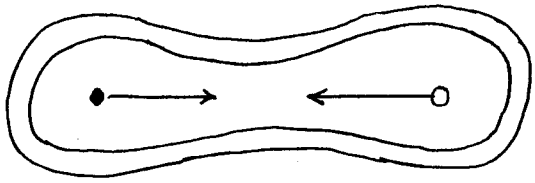
Any 3 x ½

(c) Identifying Faults
Physical inspection by looking at the circuit components to determine any change in colour, shape, e.t.c.

Circuit analysis – by taking measurements and comparing with what is in the service manual.

2 x 1

7. Magnetic flux



Polarity = 1
Pattern = 1
Force direction = 1

8. (a) Final Circuit
Outgoing circuit in a consumer unit (CU) to supply electrical directly via socket outlet.

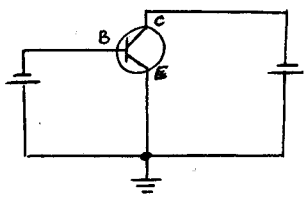
(1 mark)

(b) Regulations
(i) The total number of spurs stationery appliances shall not exceed the total number of socket outlets.
(ii) The rating of fuse or circuit breaker should be 30A.
(iii) Maximum floor area should be 100m2.
(iv) No standar 13A socket installed inside the bathroom
(v) Only 2.5mm2 cables should supply the 13A socket.

Any 4 x 1

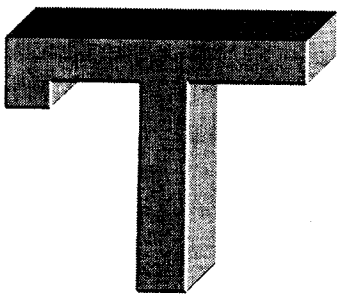
9. (a) Zener voltage
This is the point at which the zener diode breaks down when connected in reverse bias.
The voltage remains almost constant as the load current varies 2 x 1

(b) PNP Transistor



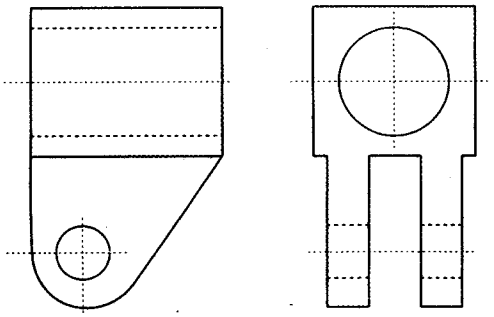
Correct PNP symbol = 1
"Terminal connections = 1½
Grounding/earthing =½

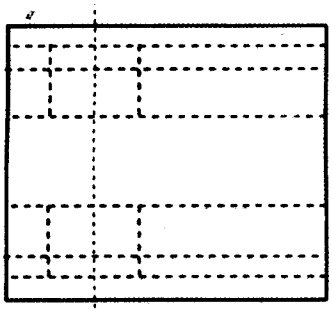
10.



Correct sketch= 2
Oblique=1
Proportion =1
1

11.





FE		
Faces (3 x 1)	=	3
Hidden details	=	1
EE		
Faces (3 x 1)	=	3
Hidden details	=	1
Centre lines	=	2
First angle projection	=	1
Neatness	=	1
		12

12. (a) Transistor
Power transistors are larger in size and usually have a heat sinks. 2 x 1

(b) Transistor ratio
DC ALPHA is the ratio of the emitter current to the collector current in a dc circuit.
2 x 1

AC BETA is the ac current gained in a common emitter amplifier. It is the ratio of the change in the output (collector) current to the change in the input (base) current.

2 x 1

(c) $\beta = \frac{IC}{IB} \Rightarrow 100 = \frac{10mA}{IB}$ (1)

$\therefore IB = \frac{10mA}{100} = 0.0001$ mA or $100\mu A$

From the diagram.

Vcc=IBRB +VBE 20V=IBRB + 0.7v

IBRB=(20 – 0.7)=19.3v

$RB = \frac{19.3}{IB} = \frac{19.3}{100\mu A} = 193K\Omega$

$I_C R_C = v_{cc} - V_{CE}$

$RC = \frac{Vcc - VcE}{I}$

$= \left(\frac{20-10}{0.01A}\right) = \frac{10}{0.01} = 1K\Omega$

13. (a) Fusing Current is the minimum current that will cause the fuse element to melt or blow while

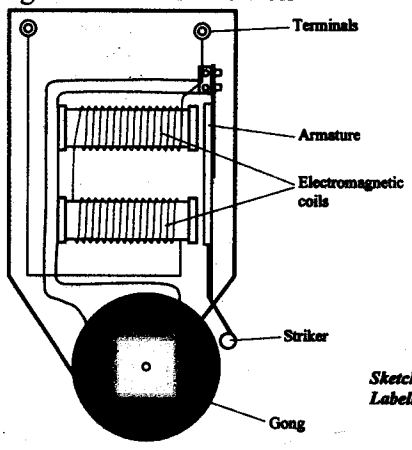
Current Rating is the maximum current the fuse is designed to carry for indefinite period without deterioration of its element. 2 x 1

(a) Disadvantages

Oxidation of fuse element
Dangers of replacing with incorrect wire
Unreliable – takes time to melt
Higher fire risk due to concentration of heat
Doesn't discriminate high transient current and continuous high current.

Any 2 x 1

(b) Single Stroke Electric Bell



Sketching = 2
Labelling (4x ½ = 2

Operation

When the push button is pressed, the circuit is completed and current flows to energize electromagnetic coil. The coil creates a magnetic field around it and attracts the soft iron armature.

The armature moves towards the electromagnets to the gong and remains in that position until the push button is released.

4 x 1

14. (a) Sine Wave

$f=\frac{1}{T}=\frac{1}{100\times10^{-3}}=\frac{10^3}{100}=10Hz$ (1½ marks)

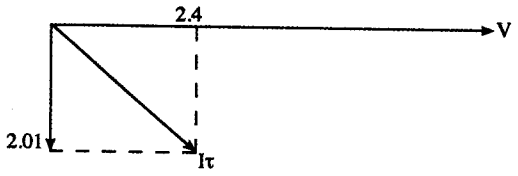
(b) Current 1, and 1_2

$X_L=2JI\ fL=2JI \times 50 \times 0.38 = 119.d\Omega$ (1½ marks)

$I_1=\underline{V}=\underline{240}=2.4A$ (1½ marks)
R 100

$I_2V=\underline{240}=2.01A$ (1½ marks)
X_2 119.3

Phaser Diagram

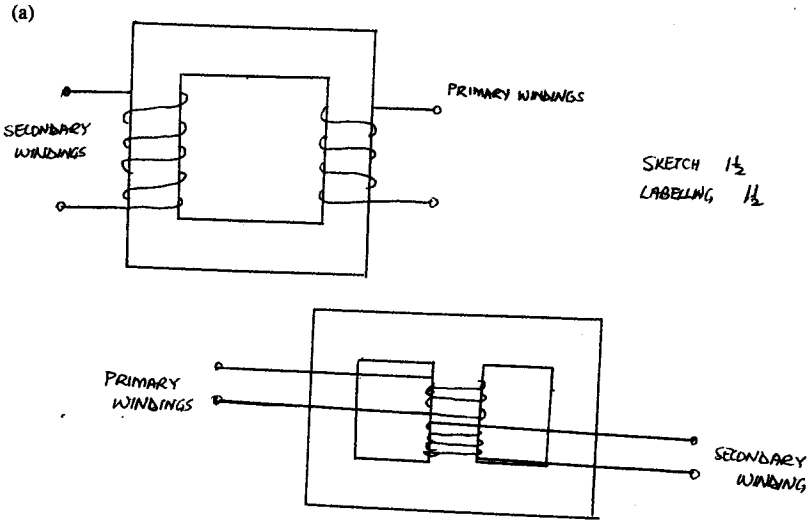


$I_T=\sqrt{2.4^2+2.01^2}+=\sqrt{5.76+4.040=3.3A}$ (2 marks)

Power factor Pf= $\frac{IR}{IT}=\frac{2.4}{3.13}=0.766$ (1 mark)

Phase angle $=CO^{-1}\ 0.766=40^\circ$ (1 mark)

15.



1

(b) (i) $Is\frac{P}{V_s}=\frac{10}{12}A$

$Is\frac{P}{V_s}=\frac{10}{12}A$

$I_p=\frac{V_S}{V_P}$ x $\frac{Is}{efficient}$

$=\frac{12}{40}x\frac{10}{12}\ x\frac{100}{96}$

=0.0434A

=43mA

1:

½½

|(ii) Input power = V x I =240 x 0.0434

=10.42w

Power loss = input power – output power

= 10.42 – 10

= 0.42w

1½1

1½1