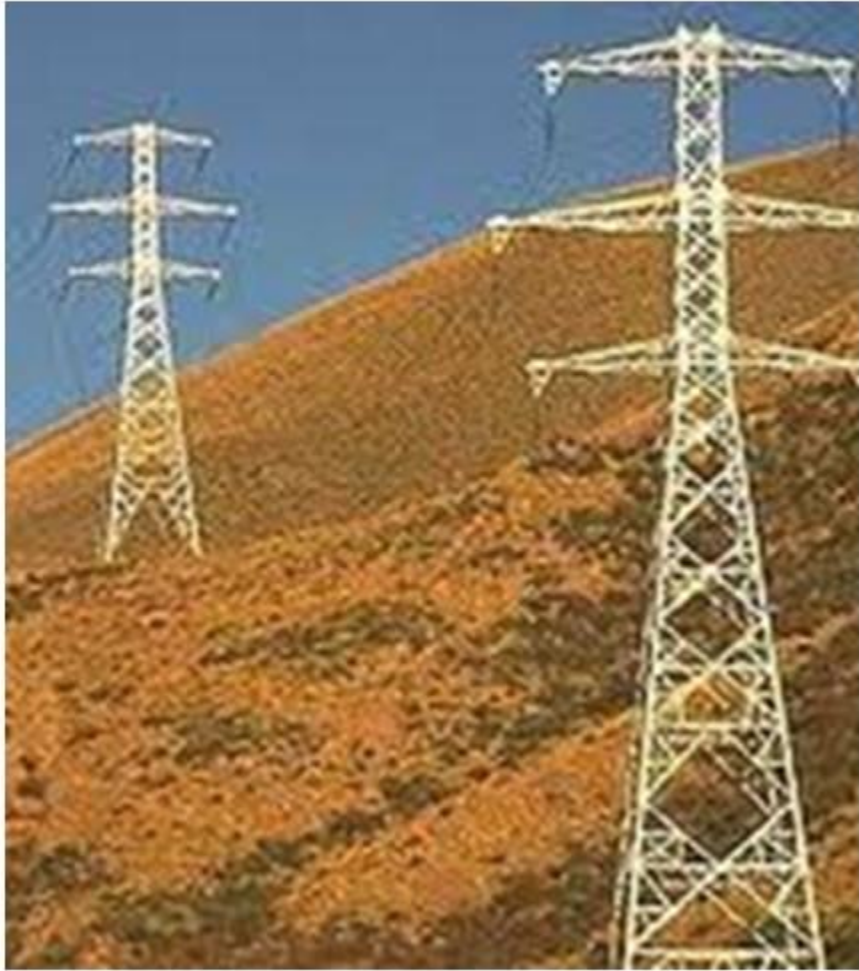


KEELEKTROMAGNETAN



4. KEELEKTROMAGNETAN

4. ELECTROMAGNETISM

4.1 Daya Magnet

4.1 Magnetic Force

A2009

A2013

C2006

4.2 Aruhan Elektromagnet

4.2 Electromagnetic Induction

B2022

C2018

4.3 Transformer

4.3 Transformer

A2021

A2020

A2019

A2014

A2008

B2005

B2004

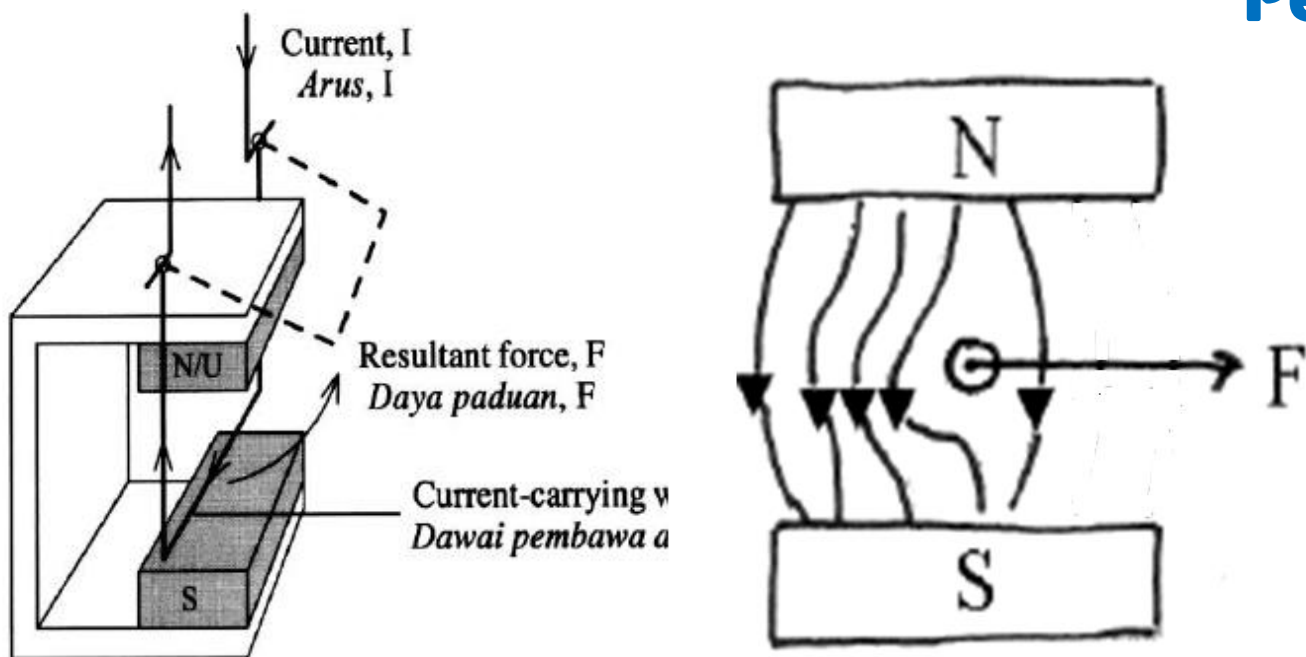
C2015

C2016

Question 7

Diagram 7.1 shows a current-carrying wire placed between two opposite poles of two magnet magnets. The wire swings upwards.

Rajah 7.1 menunjukkan satu dawai pembawa arus yang terletak antara dua magnet magnadur yang berlawanan kutub. Dawai itu berayun ke atas.



- (a) The combination of the magnetic field and the current in the wire produces the resultant force, F .

Kombinasi medan magnet dengan arus di dalam dawai menghasilkan daya paduan, F .

- (i) Name the rule to determine the direction of the force.

Namakan petua yang digunakan untuk menentukan arah daya itu.

Fleming's left hand rule /
Peraturan Tangan kiri Fleming [1 mark]

- (ii) In Diagram 7.2, draw the resultant magnetic field produced. [2 marks]

Pada Rajah 7.2, lukis medan magnet paduan yang terhasil.

- (iii) Using an arrow, show the direction of the resultant force, F , in Diagram 7.2. Menggunakan anak panah, tunjukkan arah daya paduan, F , di Rajah 7.2.

[1 mark]

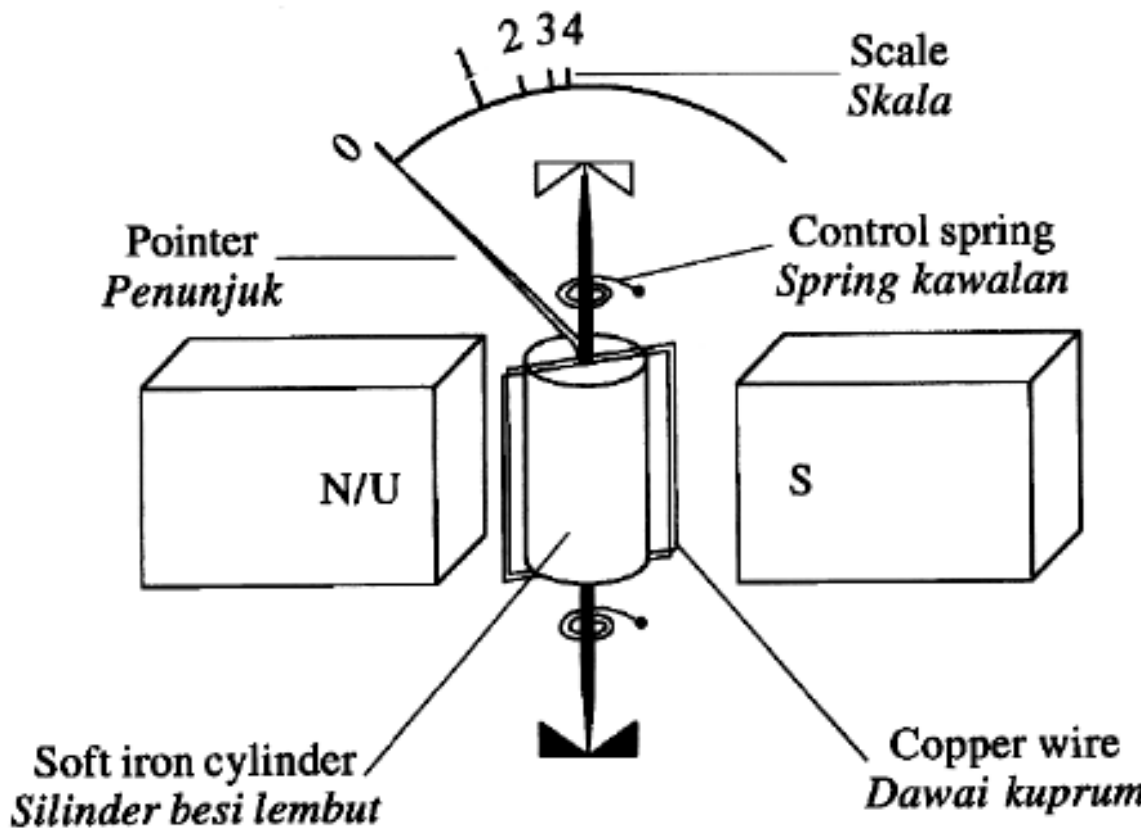
Key:
Kekunci:



Current out of the paper
Arus keluar dari kertas



- (b) Diagram 7.3 shows a moving-coil ammeter.
Rajah 7.3 menunjukkan sebuah ammeter gelung bergerak.



The scale of the ammeter in Diagram 7.3 is not uniform due to the incorrect shape of the magnet used.

Skala ammeter dalam Rajah 7.3 tidak seragam disebabkan oleh kesilapan bentuk magnet yang digunakan.

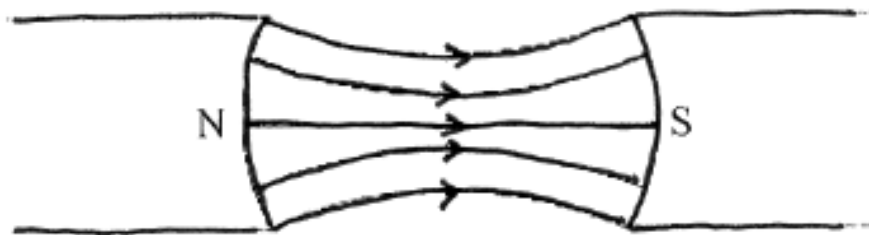
- (i) In the space below, draw the correct shape of the magnet and the pattern of the magnetic field produced when this magnet is used.

Pada ruang di bawah, lukis bentuk magnet yang betul dan corak medan magnet yang terhasil apabila magnet ini digunakan.

[3 marks]

- (ii) Give one reason why the magnet should have the shape as suggested in 7(b)(i).

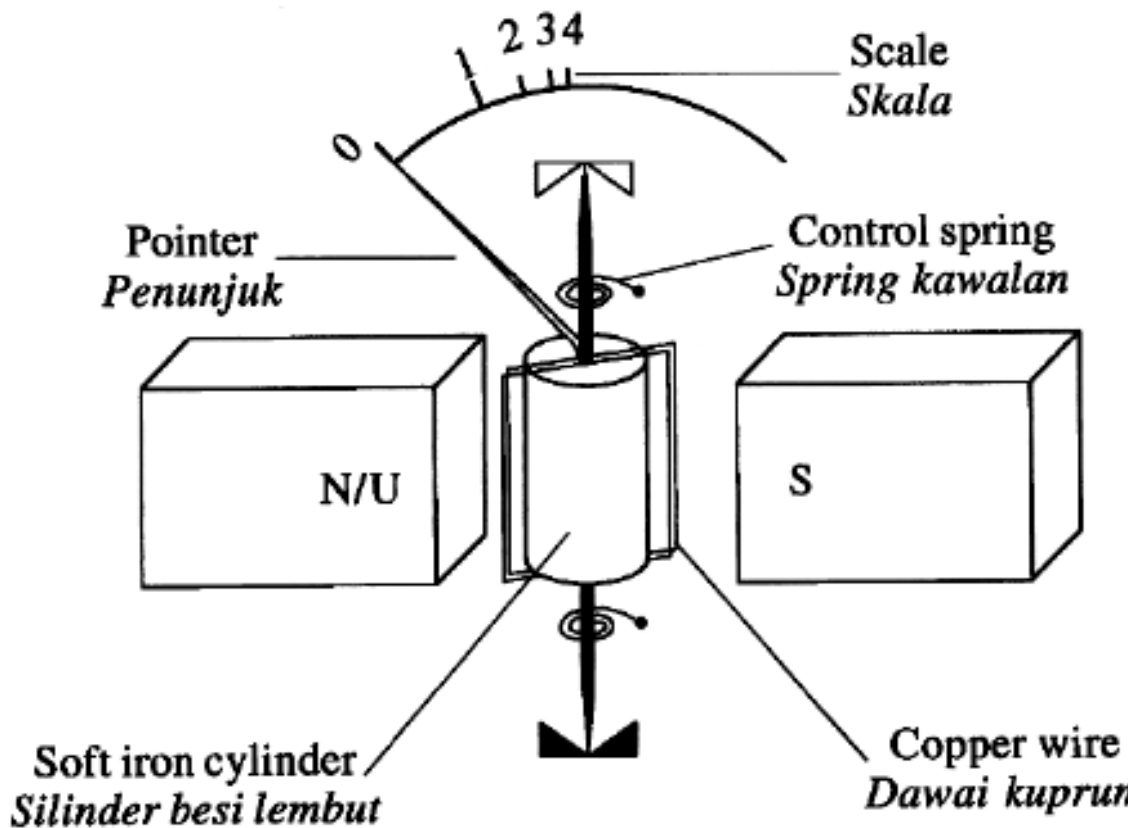
Beri satu sebab mengapa magnet itu sepatutnya mesti mempunyai bentuk seperti yang dicadangkan di 7(b0(i)).



Concentration of magnetic field / produce stronger magnetic field / Menumpukan medan magnet / medan magnet lebih ku



- (b) Diagram 7.3 shows a moving-coil ammeter.
Rajah 7.3 menunjukkan sebuah ammeter gelung bergerak.



- (iii) Parallax error occurs when taking a reading using an ammeter. Suggest one additional component to overcome this problem. Explain your answer.
Ralat paralaks berlaku apabila bacaan diambil menggunakan suatu ammeter. Cadang satu komponen tambahan untuk mengatasi masalah ini. Jelaskan jawapan anda.

Component **Plane mirror**
 komponen **cermin satah**
 Explanation:
 Penjelasan

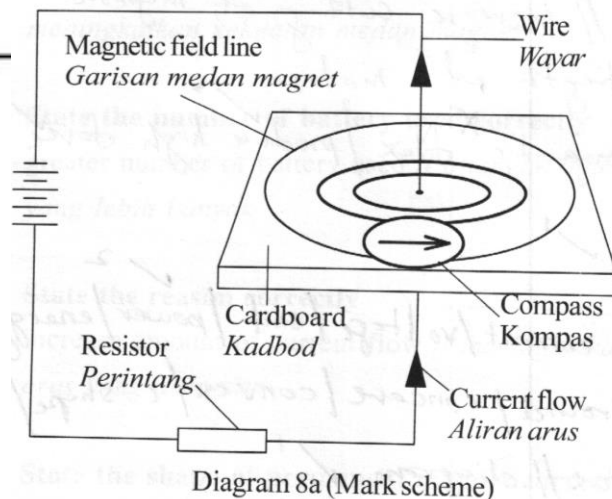
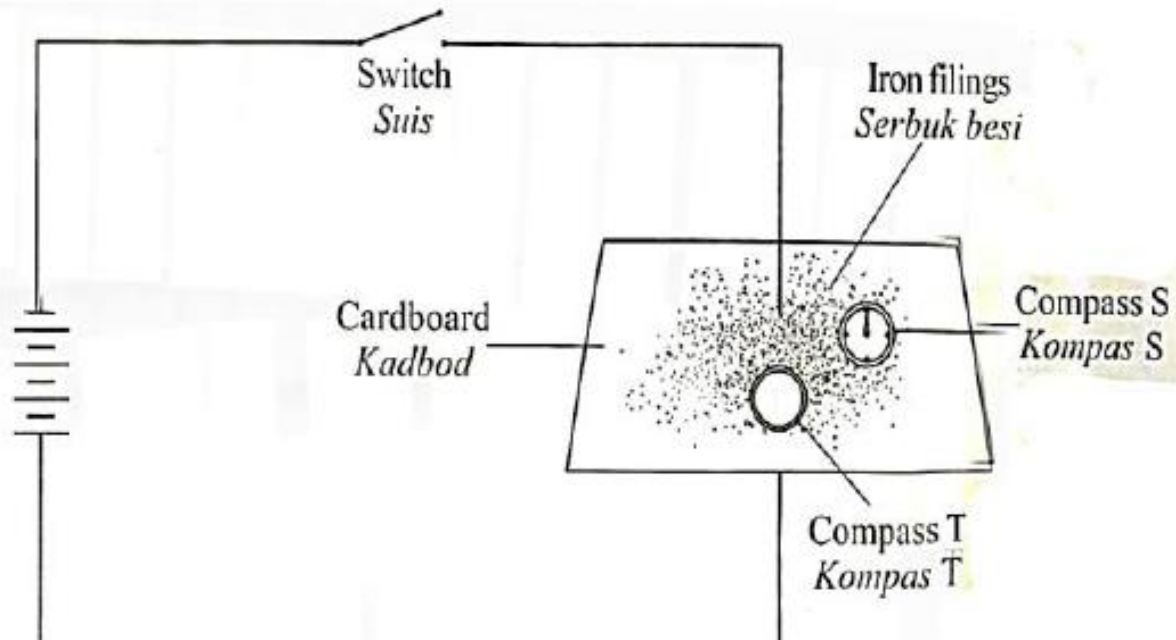
Pointer and image of the pointer must be overlapped to avoid parallax error / penunjuk dan imej penunjuk bertindih untuk elakkan ralat paralaks



Questions 8

Diagram 8.1 shows the compass needle direction of compass S with the switch is off.

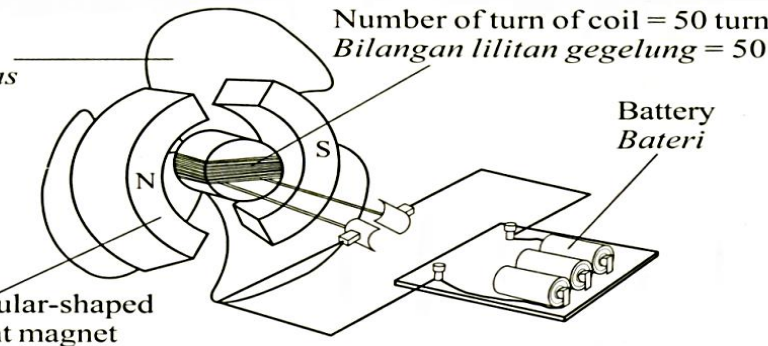
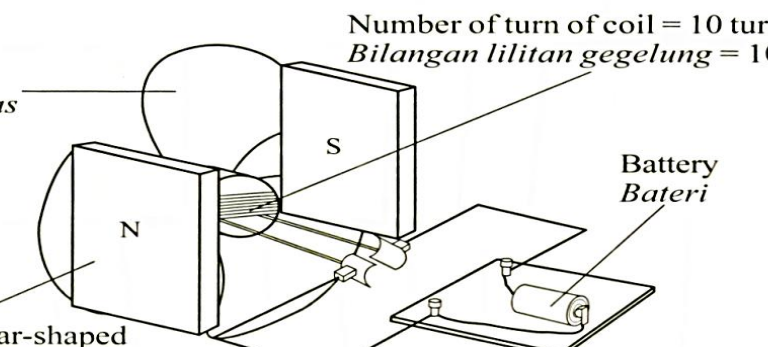
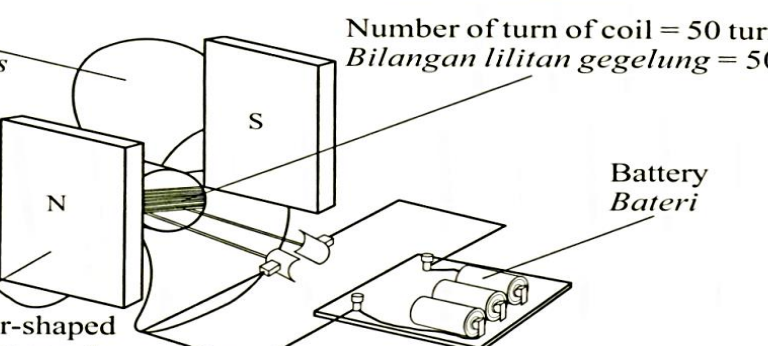
Rajah 8.1 menunjukkan arah jarum kompas S dengan suis dimatikan.



- (a) When the switch in Diagram 8.1 is on,
Apabila suis dalam Rajah 8.1 dihidupkan,
- (i) Indicate with an arrow the direction of current in the circuit.
Tunjukkan dengan menggunakan anak panah arah arus dalam litar. [1 mark]
- (ii) Draw the magnetic field pattern on the cardboard.
Lukis corak medan magnet di atas kadboard tersebut. [2 marks]
- (iii) Indicate with an arrow the direction of compass needle of the compass T.
Tunjukkan dengan menggunakan anak panah arah jarum kompas T. [1 mark]
- (b) Name the rule used to determine the direction of magnetic field in Diagram 8.1.
Namakan petua yang digunakan untuk menentukan arah medan magnet dalam Rajah 8.1.

Right hand grip rule /
Petua gengaman tangan kanan



<p>Electric motor X <i>Motor elektrik X</i></p>	
<p>Electric motor Y <i>Motor elektrik Y</i></p>	
<p>Electric motor Z <i>Motor elektrik Z</i></p>	

(c) Diagram 8.2 shows three electric motors design X, Y and Z used to built a small portable fan.
Rajah 8.2 menunjukkan tiga reka bentuk motor elektrik X, Y dan Z yang digunakan untuk membina sebuah kipas mudah alih yang kecil.

Based on Diagram 8.2, state the suitable characteristics of an electric motor to be used to rotate the fan blade with greater speed.

Berdasarkan Rajah 8.2, nyatakan ciri-ciri bagi sebuah motor elektrik yang boleh memusingkan bilah kipas dengan lebih laju. Beri sebab untuk kesesuaian ciri-ciri itu:

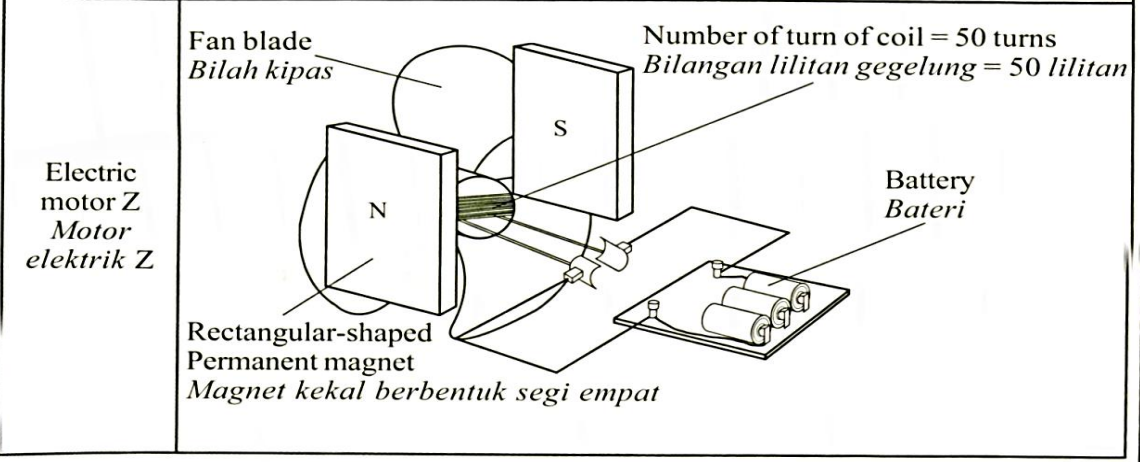
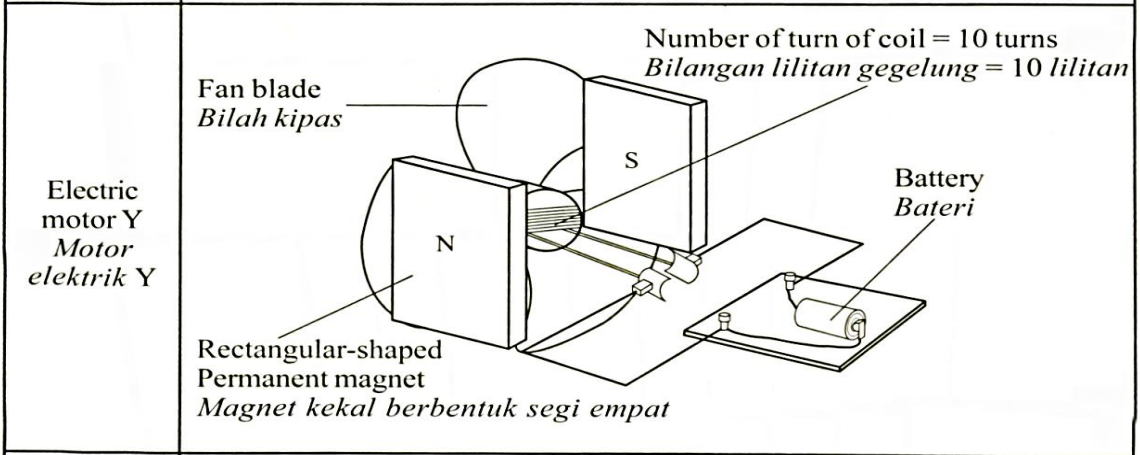
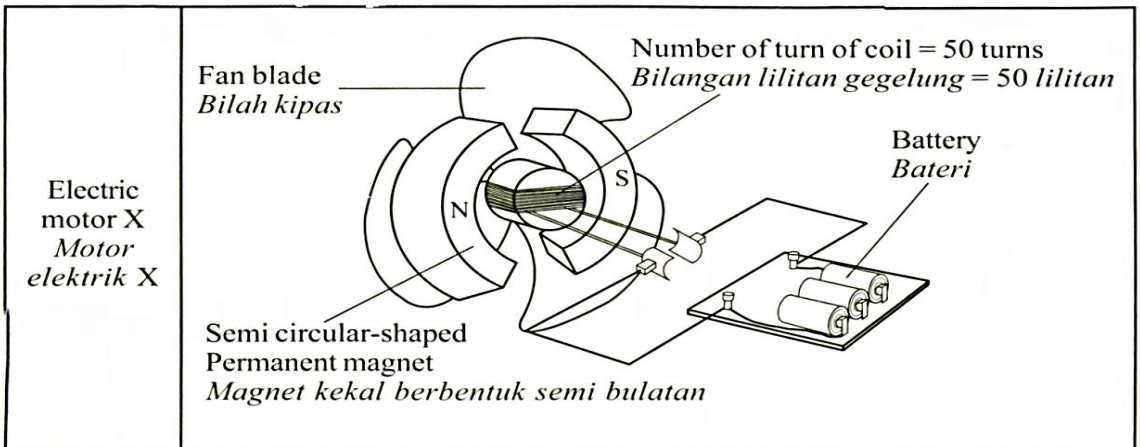
- (i) Number of turn of coil
Bilangan lilitan gegelung

Greater / besar

Reason / Sebab

Increase the force / strength of magnetic field / daya bertambah / kekuatan medan magnet bertambah





(ii) Number of battery used
Bilangan bateri yang digunakan

Greater / banyak

Reason / Sebab

Increase current/ arus besar

[2 marks]

(iii) Shape of permanent magnet
Bentuk magnet kekal

Semi circular shape / semi bulatan

Reason / Sebab

Increase strength of magnetic field / radial magnetic field / tambah kekuatan medan magnet / medan magnet jejarian

[2 marks]

(iv) Determine the most suitable design of an electric motor that can be used to rotate the fan blade with greater speed.

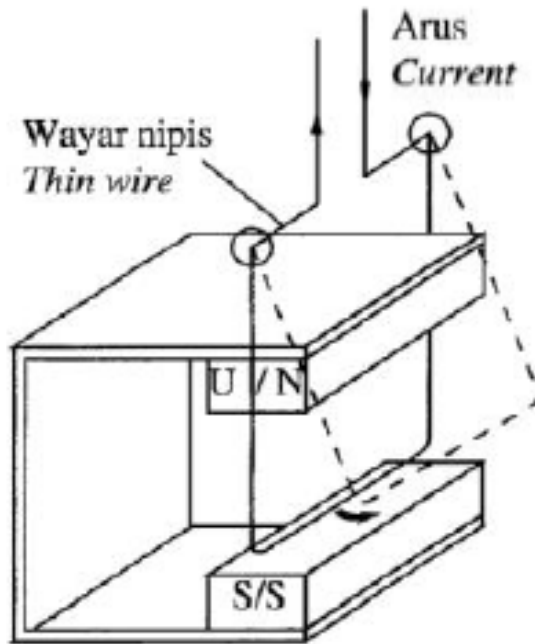
Tentukan reka bentuk motor elektrik yang paling sesuai, yang boleh digunakan untuk memusingkan bilah kipas dengan lebih laju.

Motor X

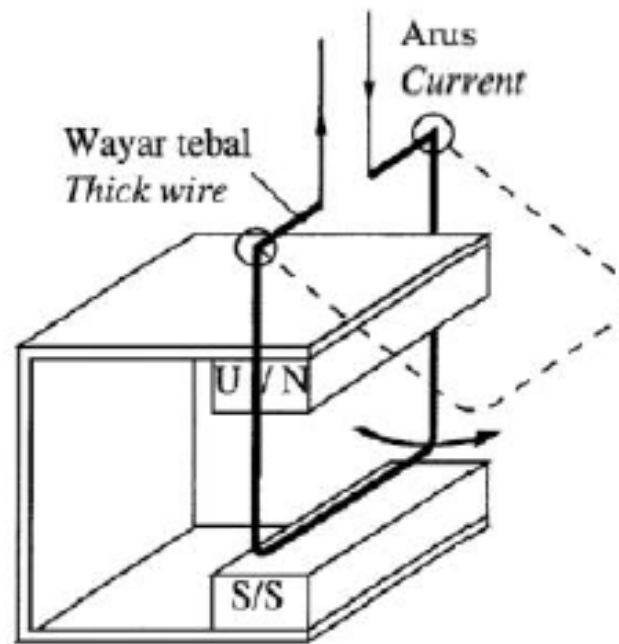
Soalan 6

Rajah 6.1(a) dan Rajah 6.1(b) menunjukkan dawai kuprum dalam medan magnet berayun apabila arus mengalir melaluinya.

Diagram 6.1(a) and Diagram 6.1(b) show the copper wire in the magnetic field swings when the current flow through it.



Rajah 6.1(a)
Diagram 6.1(a)



Rajah 6.1(b)
Diagram 6.1(b)

- (a) Namakan hukum yang digunakan untuk menentukan arah ayunan dawai kuprum itu.
Name the rule that is used to determine the direction of the copper wire swing.

Hukum Tangan Kiri Fleming
Fleming left hand rule [1 markah]



(b) Perhatikan Rajah 6.1(a) dan Rajah 6.1(b). Bandingkan
Observe Diagram 6.1(a) and Diagram 6.1(b). Compare

- (i) ketebalan dawai kuprum
the thickness of the copper wire

6.1(b) > 6.1 (a)

[1 markah / 1 mark]

- (ii) saiz sudut ayunan dawai kuprum
the size of swing angle of the copper wire

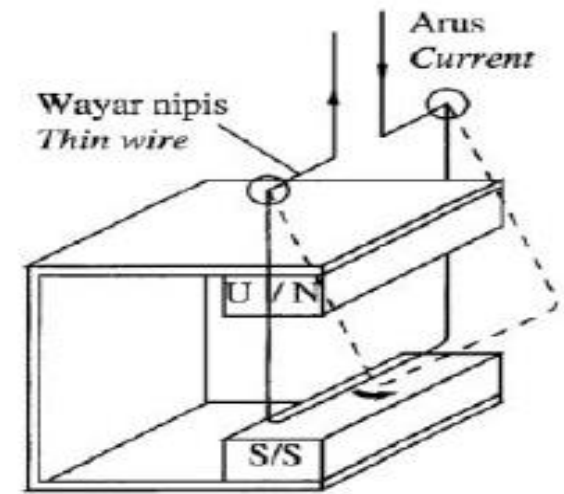
6.1(b) > 6.1 (a)

[1 markah / 1 mark]

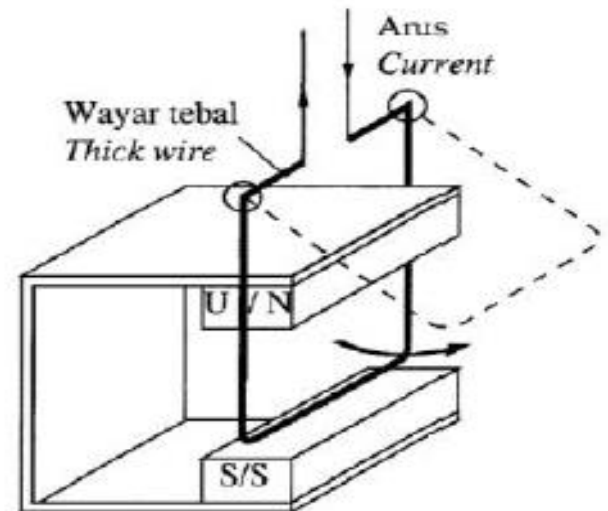
- (iii) daya yang bertindak ke atas dawai kuprum
the force that acted on the copper wire

6.1(b) > 6.1 (a)

[1 markah / 1 mark]



Rajah 6.1(a)
Diagram 6.1(a)



Rajah 6.1(b)
Diagram 6.1(b)



(c) Berdasarkan jawapan di 6(b), nyatakan hubungan antara daya yang bertindak ke atas dawai kuprum dengan
Based on the answer in 6(b), state the relationship between the force acted on the copper wire and

(i) ketebalan wayar kuprum
the thickness of copper wire

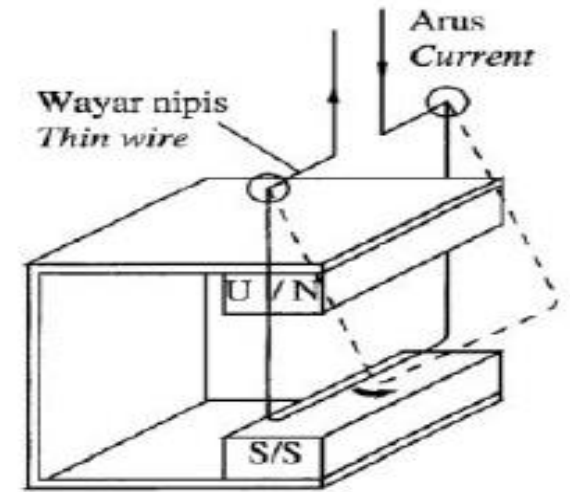
Berkadar terus / directly proportional
.....

[1 markah / 1 mark]

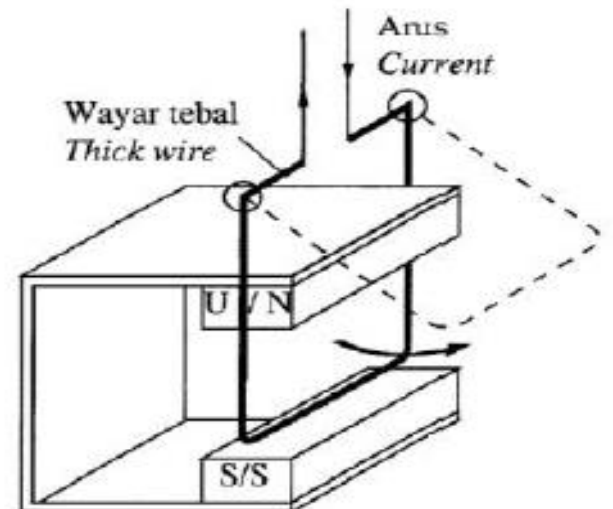
(ii) saiz sudut ayunan dawai kuprum
size of swing angle of copper wire

Berkadar terus / directly proportional
.....

[1 markah / 1 mark]



Rajah 6.1(a)
Diagram 6.1(a)

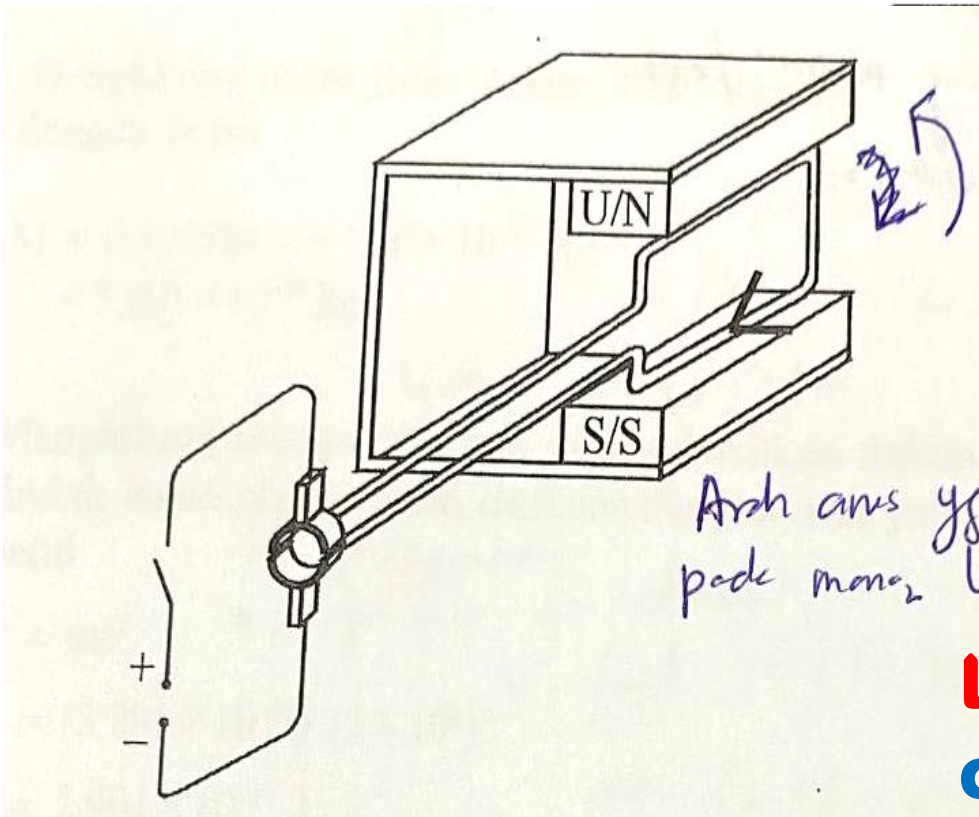


Rajah 6.1(b)
Diagram 6.1(b)



- (e) Dawai kuprum dalam Rajah 6.1(b) kemudiannya digantikan dengan satu gegelung seperti ditunjukkan dalam Rajah 6.2. Apabila suis dihidupkan, gegelung tersebut berputar pada satu arah.

The copper wire in Diagram 6.1(b) is then replaced with a coil as shown in Diagram 6.2. When the switch is on, the coil rotate in one direction.



- (i) Padar Rajah 6.2, tandakan arah aliran arus elektrik dalam gegelung itu.
In Diagram 6.2, mark the direction of electric current in the coil.

.....
[1 markah / 1 mark]

- (ii) Nyatakan arah putaran gegelung tersebut.
State the direction of rotation of the coil.

Lawan arah jam // Anti clockwise //
counter clockwise
.....
[1 markah / 1 mark]

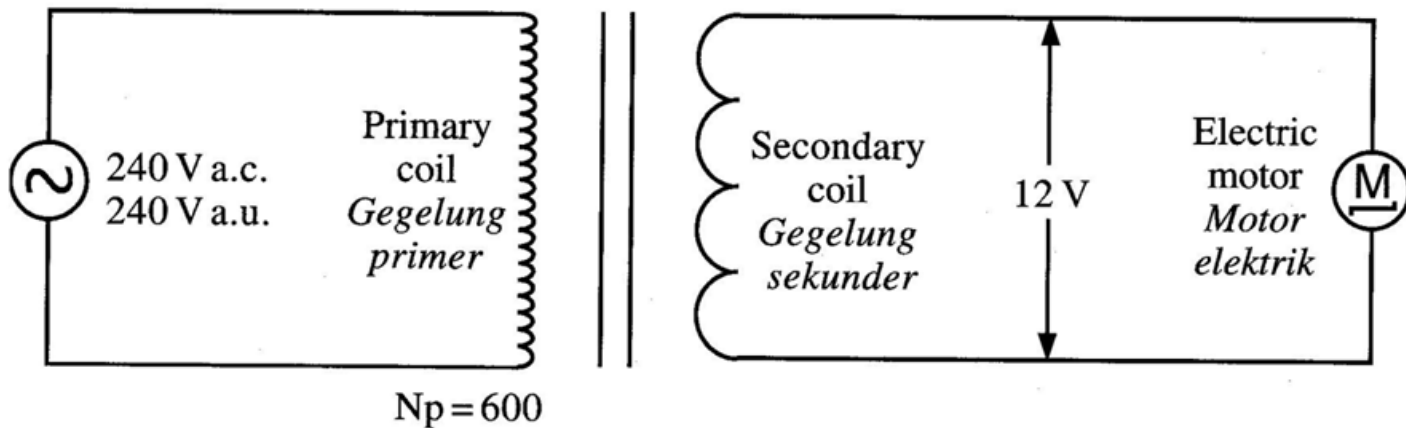
Rej: arah berlainan / arah terbalik



Question 2

Diagram 2.1 shows a transformer which is connected to a 12V, 24 W a.c. electric motor.

Rajah 2.1 menunjukkan sebuah transformer yang disambung kepada motor elektrik 12 V, 24 W a.u.



(a) State the type of transformer used.

Nyatakan jenis transformer yang digunakan.

Step down transformer
Transformer injak turun [1 mark]

(b) (i) Calculate the number of turns of the secondary coil.

Hitung bilangan lilitan gegelung sekunde itu. [1 mark]

$$\begin{aligned} V_p/N_p &= V_s/N_s \\ 240/600 &= 12/N_s \\ N_s &= 30 \end{aligned}$$

(ii) Calculate the current flow in the secondary coil.

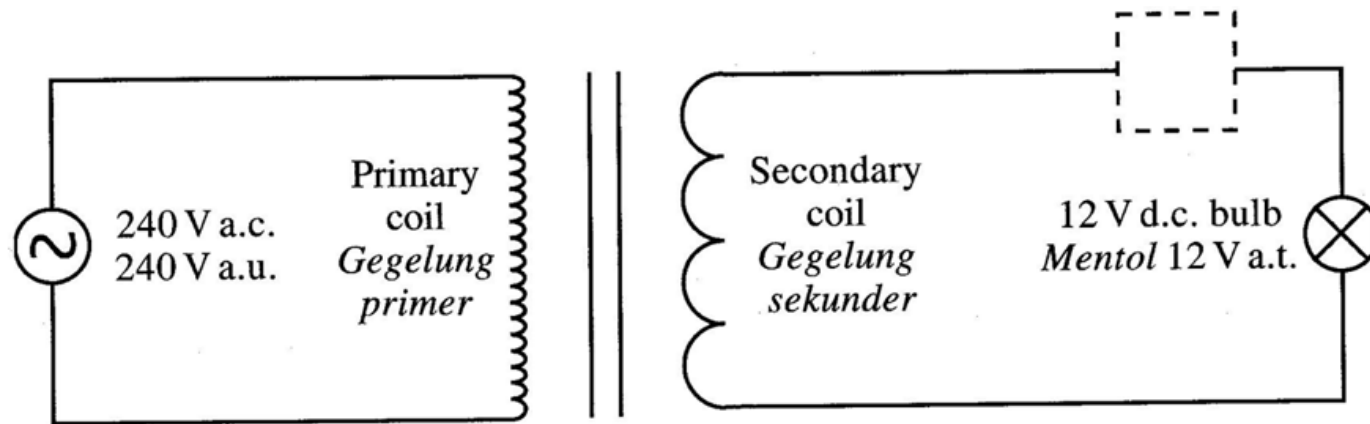
Hitung arus yang mengalir dalam gegelung sekunder itu. [2 marks]

$$\begin{aligned} P &= VI \\ I &= 24/12 = 2 \text{ A} \end{aligned}$$



(c) Diagram 2.2 shows the same transformer being connected to an electrical component in box X to light up a d.c. bulb.

Rajah 2.2 menunjukkan transformer yang sama disambungkan kepada sebuah komponen elektrik dalam kotak X untuk menyalakan sebuah mentol a.t.



Name the electrical component in box X.

Namakan komponen elektrik dalam kotak X.

Diode

[1 mark]



4. Rajah 4 menunjukkan satu litar transformer multi tap.

Diagram 4 shows a circuit of multi tap transformer.

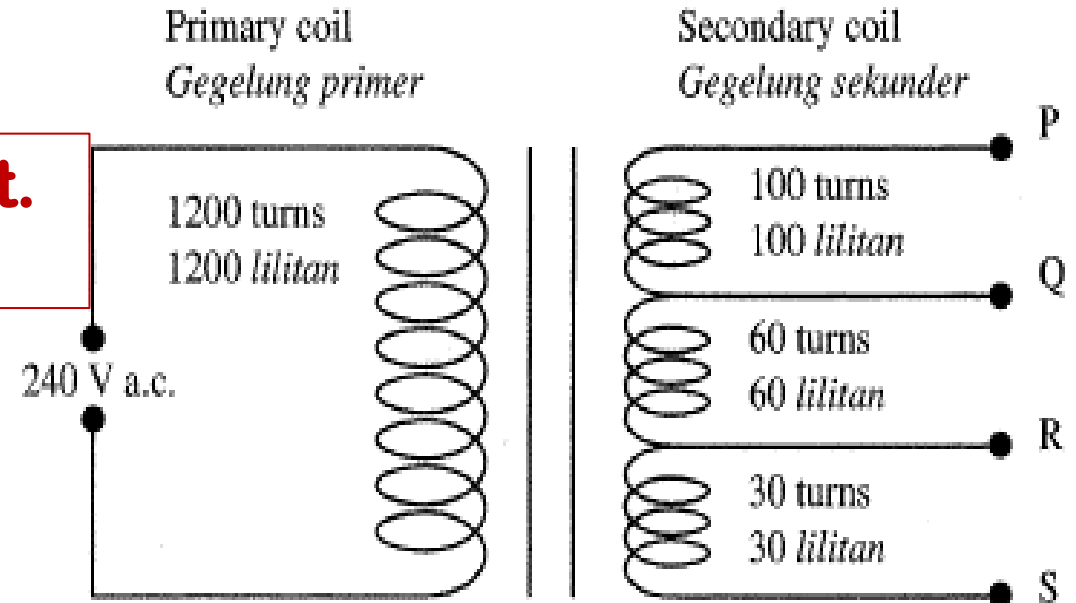
(a) Nyatakan fungsi sebuah transformer.

State the function of a transformer. [1 m]

Menambah atau mengurangkan voltan output.
Increase or decrease output voltage.

(b) Terangkan bagaimana voltan output dihasilkan pada gegelung sekunder itu.

Explain how output voltage is produced at the secondary coil. [3 m]



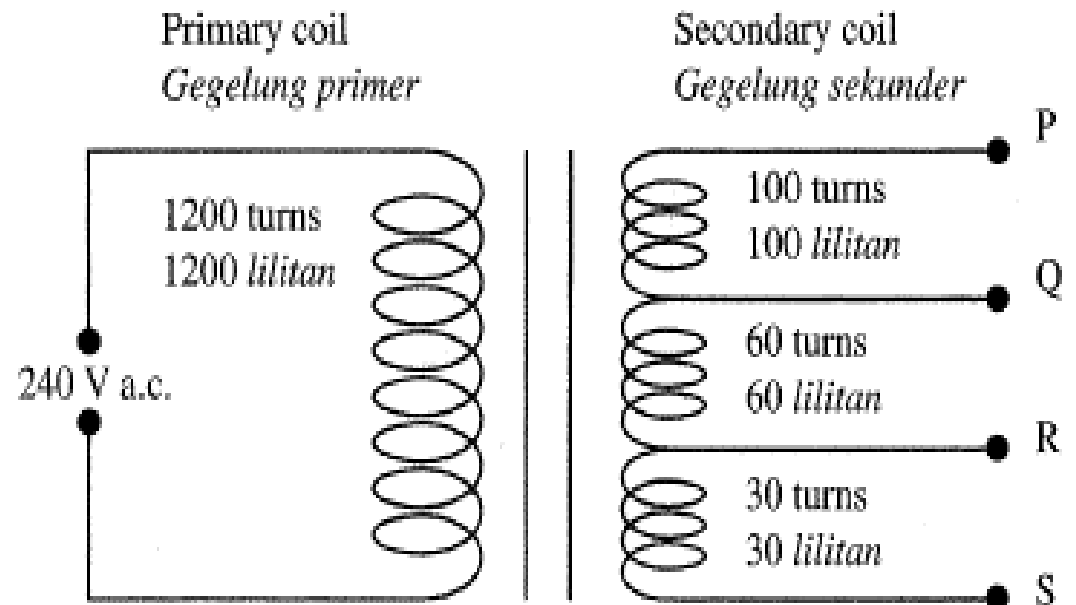
- **Bila suis dihidupkan medan magnet terbentuk pada gegelung primer.**
When the switch is on, magnetic field will be form at the primary coil.
- **Pada gegelung sekunder, medan magnet dipotong / diubah**
At secondary circuit the magnetic field line will be cut / changed
- **menghasilkan arus aruhan / dge aruhan.**
producing induced current.



(c) Bilangan lilitan gegelung primer ialah 1 200 lilitan dan voltan input ialah 240 V.
The number of turns at the primary coil is 1200 turns and the input voltage is 240 V.

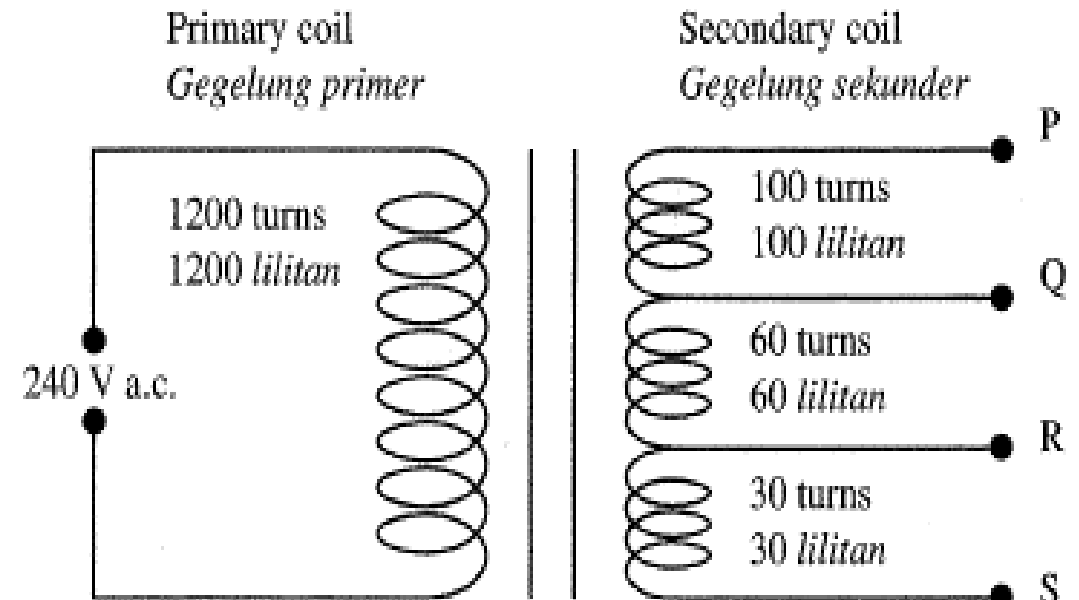
(i) Hitung voltan output di QR.
Calculate the output voltage at QR.

$$V = \frac{240}{1200} \times 60 \quad [2 \text{ m}]$$
$$= 12 \text{ V}$$



(ii) Tentukan pada terminal manakah, sebihi mentol 6 V, 10 W disambung supaya mentol itu akan menyala dengan kecerahan normal. Beri satu sebab untuk jawapan anda.

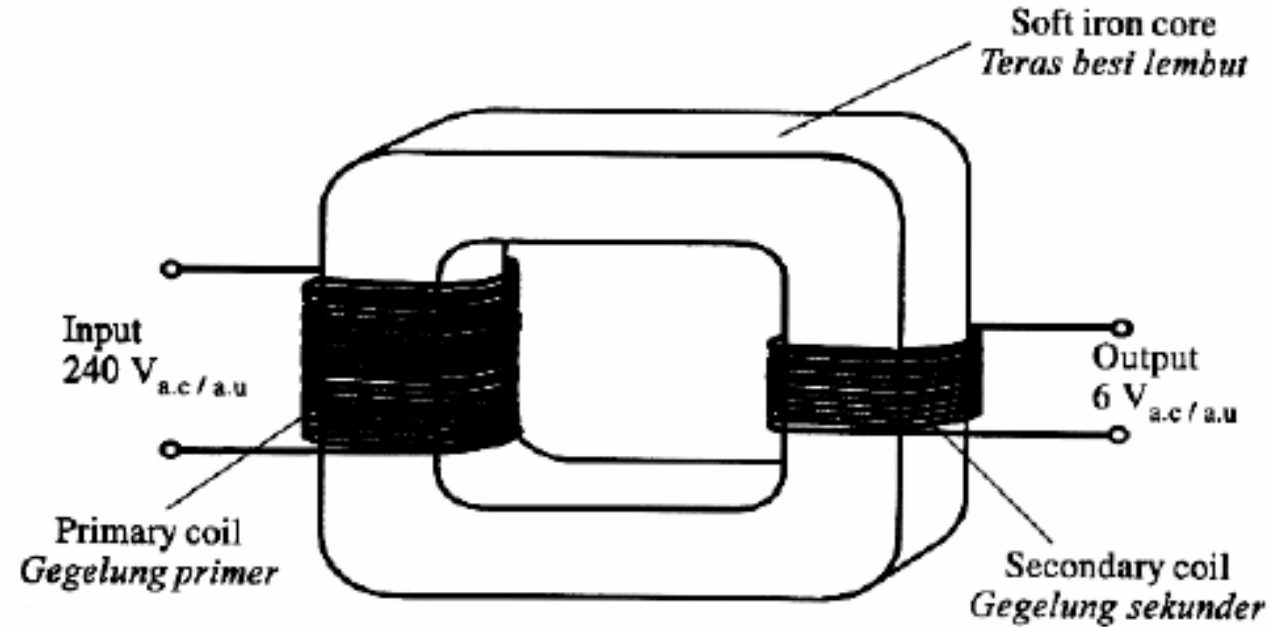
Determine at which terminal, a bulb 6 V, 10 W should be connected so that it will light up with normal brightness. Give one reasons for your answer.



- **RS // (terminal 30 lilitan**
- **$\frac{240}{6} = \frac{40}{1} = \frac{1200}{30}$**
- **voltage at RS is 6 V // Voltan pada RS adalah 6 V.**



7. Diagram 7 shows a simple transformer.
Rajah 7 menunjukkan sebuah transformer ringkas.



- (a)(i) Name the type of the transformer. [1 mark]
Namakan jenis transformer itu.

Step-down / injak turun

- (ii) State why soft iron is used as the transformer core. [1 mark]
Nyatakan mengapa besi lembut digunakan sebagai tera transformer.

Easy to magnetized and demagnetized
mudah dimagnet dan dimagnetkan



- (a) The number of turns on the primary coil in Diagram 7 is 1000. Calculate the number of turns on the secondary coil.

Bilangan lilitan pada gegelung primer pada Rajah 7 ialah 1 000. Hitung bilangan lilitan pada gegelung sekunder.

[2 marks]

$$N_s = \frac{1000 \times 6}{240} \\ = 25$$

- (b) The transformer in Diagram 7 is used to switch on an electrical appliance. The current in the primary coil is 0.1 A and the efficiency is 75%.

Transformer dalam Rajah 7 digunakan untuk menghidupkan sebuah alat elektrik. Arus yang mengalir dalam gegelung primer ialah 0.1 A dan kecekapannya ialah 75%.

- (i) Calculate the output power of the transformer.

[2 marks]

Hitung kuasa output transformer itu.

$$\frac{V_s I_s}{V_p I_p} \times 100\% = 75\%$$

$$\frac{\text{output power}}{240 \times 0.1} = \frac{75}{100} = 0.75$$

$$\text{output power} = 18 \text{ W}$$



(ii) An electrical appliance which needs 20 W of power is connected to the transformer output. Suggest a modification to the transformer that enables the appliance to function correctly. [1 mark]

Satu alat elektrik yang memerlukan kuasa 20 W disambung pada output transformer itu. Cadangkan satu pengubahsuaian pada transformer itu supaya alat itu boleh berfungsi dengan betul.

laminated iron core / low resistance coil
teras besi lembut berlamina / wayar berintang rendah

(ii) An electrical component is connected to the output of the transformer so that the television functions. [2 marks]

Satu komponen elektrik disambugn kepada output transformer itu supaya televisyen itu berfungsi. Namakan komponen elektrik itu dan nyatakan bagaimana sambungan itu dilakukan?

(c) A student connects a television which uses direct current to the output of the transformer in Diagram 7. When the television is switched on, it does not function.

Seorang murid menyambungkan sebuah televisyen yang menggunakan bekalan arus terus kepada output transformer pada Rajah 7. Apabila suis televisyen dihidupkan, didapati televisyen itu tidak berfungsi.

(i) Why the television does not function? [1 mark]

Mengapakah televisyen itu berfungsi?

Transformer supplies ac / TV cannot work on ac / transformer bekalan au / Tv tidak berfungsi dengan au

- 1- Diode // rectifier / diod**
- 2- Series / siri**



6. A charger adapter is a device which has a step-down transformer as one of the component. Diagram 6.1 shows a charger of a laptop and the specifications of its step-down transformer. Diagram 6.2 shows a charger of an electric toy car and the specifications of its step-down transformer.

Adapter pengecas adalah satu peranti yang mempunyai transformer injak turun sebagai salah satu komponennya. Rajah 6.1 menunjukkan satu pengecas untuk komputer riba dan spesifikasi bagi transformer injak turunnya. Rajah 6.2 menunjukkan satu pengecas untuk sebuah kereta mainan elektrik dan spesifikasi bagi transformer injak turunnya.



Number of turns of primary coil, N_p <i>Bilangan lilitan gegelung primer, N_p</i>	2400
Number of turns of secondary coil, N_s <i>Bilangan lilitan gegelung sekunder, N_s</i>	190
Ratio of $\frac{N_p}{N_s}$ <i>Nisbah $\frac{N_p}{N_s}$</i>	12.6
Input voltage, V_p <i>Voltan input, V_p</i>	240 V
Output voltage, V_s <i>Voltan output, V_s</i>	19 V

Diagram 6.1 / Rajah 6.1



Number of turns of primary coil, N_p <i>Bilangan lilitan gegelung primer, N_p</i>	2400
Number of turns of secondary coil, N_s <i>Bilangan lilitan gegelung sekunder, N_s</i>	60
Ratio of $\frac{N_p}{N_s}$ <i>Nisbah $\frac{N_p}{N_s}$</i>	40
Input voltage, V_p <i>Voltan input, V_p</i>	240 V
Output voltage, V_s <i>Voltan output, V_s</i>	6 V

Diagram 6.2 / Rajah 6.2



- (a) What is the meaning of step-down transformer?
Apakah yang dimaksudkan dengan transformer injak turun?

Output voltage produced is smaller / secondary voltage is smaller
// Voltan output terhasil lebih kecil./ voltan sekunder lebih kecil

[1 mark]

- (b) Explain how the output voltage is produced by the transformer.
Huraikan bagaimana voltan output dihasilkan oleh transformer.

M1: Changing magnetic flux in secondary coil // Perubahan fluks magnet dalam gegelung sekunder / cut magnetic field secondary / potong medan magnet sekunder

M2: Produced induced electromotive force (e.m.f) //
Menghasilkan daya gerak elektrik (d.g.e) teraruh



(c) Observe Diagram 6.1 and Diagram 6.2, compare:

Perhatikan Rajah 6.1 dan Rajah 6.2, bandingkan:

(i) the input voltage
Voltan input

Same / sama

[1 mark]

(ii) the output voltage
Voltan output

6.1 > 6.2

[1 mark]

(iii) the number of turns of the secondary coil.
Bilangan lilitan gegelung sekunder.

6.1 > 6.2

[1 mark]



Number of turns of primary coil, N_p <i>Bilangan lilitan gegelung primer, N_p</i>	2400
Number of turns of secondary coil, N_s <i>Bilangan lilitan gegelung sekunder, N_s</i>	190
Ratio of $\frac{N_p}{N_s}$ <i>Nisbah $\frac{N_p}{N_s}$</i>	12.6
Input voltage, V_p <i>Voltan input, V_p</i>	240 V
Output voltage, V_s <i>Voltan output, V_s</i>	19 V

Diagram 6.1 / *Rajah 6.1*



Number of turns of primary coil, N_p <i>Bilangan lilitan gegelung primer, N_p</i>	2400
Number of turns of secondary coil, N_s <i>Bilangan lilitan gegelung sekunder, N_s</i>	60
Ratio of $\frac{N_p}{N_s}$ <i>Nisbah $\frac{N_p}{N_s}$</i>	40
Input voltage, V_p <i>Voltan input, V_p</i>	240 V
Output voltage, V_s <i>Voltan output, V_s</i>	6 V

Diagram 6.2 / *Rajah 6.2*



(iv) the ratio of the number of primary coil to the number of secondary coil, $\frac{N_P}{N_S}$.
Nisbah bilangan lilitan primer kepada bilangan lilitan sekunder, $\frac{N_P}{N_S}$.

6.1 < 6.2

[1 mark]

(d) Based on your answer in 6(c), state the relationship between $\frac{N_P}{N_S}$ and the output voltage.

Berdasarkan kepada jawapan anda dalam 6(c), nyatakan hubungan antara $\frac{N_P}{N_S}$ dengan voltan output.

Inversely proportional / berkadar songsang

[1 mark]



Number of turns of primary coil, N_p <i>Bilangan lilitan gegelung primer, N_p</i>	2400
Number of turns of secondary coil, N_s <i>Bilangan lilitan gegelung sekunder, N_s</i>	190
Ratio of $\frac{N_p}{N_s}$ <i>Nisbah $\frac{N_p}{N_s}$</i>	12.6
Input voltage, V_p <i>Voltan input, V_p</i>	240 V
Output voltage, V_s <i>Voltan output, V_s</i>	19 V

Diagram 6.1 / Rajah 6.1



Number of turns of primary coil, N_p <i>Bilangan lilitan gegelung primer, N_p</i>	2400
Number of turns of secondary coil, N_s <i>Bilangan lilitan gegelung sekunder, N_s</i>	60
Ratio of $\frac{N_p}{N_s}$ <i>Nisbah $\frac{N_p}{N_s}$</i>	40
Input voltage, V_p <i>Voltan input, V_p</i>	240 V
Output voltage, V_s <i>Voltan output, V_s</i>	6 V

Diagram 6.2 / Rajah 6.2



Soalan 7 SPM 2014

- (a) Diagram 7.1 shows electric transmission cables that transmit electrical energy from one place to another.

Rajah 7.1 menunjukkan kabel penghantaran elektrik yang menghantar tenaga elektrik dari satu tempat ke tempat yang lain.



The electric current transmitted through the cable of resistance 10Ω is 10 A .

Arus elektrik yang mengalir melalui kabel yang berintangannya 10Ω itu ialah 10 A .

- (i) What is the meaning of electric current?

Apakah yang dimaksudkan dengan arus elektrik?

Charge flow per unit time

Kadar pengaliran cas

[1 mark]

- ii) Calculate the power loss in the cable.

Hitung kehilangan kuasa dalam kabel itu.

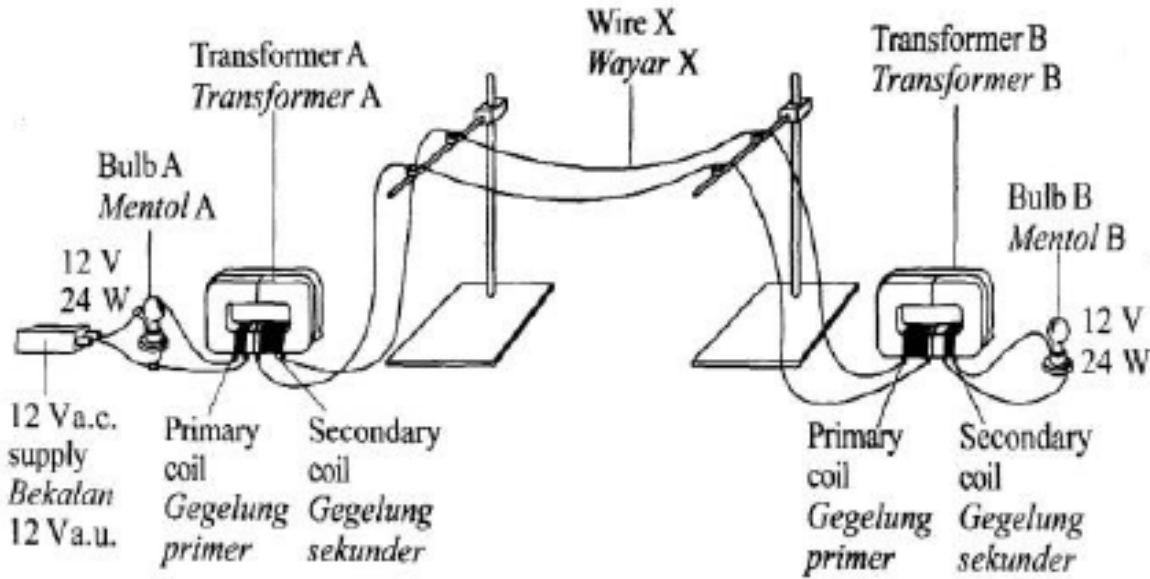
[2 marks]

$$\begin{aligned} P &= I^2 R = 10 \times 10 \times 10 \\ &= 1\,000 \text{ W} \end{aligned}$$



(b) Diagram 7.2 shows a model of electric power transmission.

Rajah 7.2 menunjukkan satu model penghantaran kuasa elektrik.



The brightness of the bulb B is lower than bulb A due to the power loss in the wire X.

Suggest modifications that can be made to the model to increase the brightness of bulb B based on the following aspects:

Kecerahan mentol B adalah lebih rendah daripada mentol A disebabkan kehilangan kuasa di dalam wayar X. Cadangkan pengubahsuaian yang boleh dibuat kepada model itu untuk menambah kecerahan mentol B berdasarkan aspek-aspek berikut:

(i) Diameter of wire X

Diameter wayar X

Thick wire / dawai tebal

Reason / Sebab

Low resistance

Kurang rintangan

[2 marks]

(ii) Number of turns of secondary coil of transformer A

Bilangan lilitan gegelung sekunder bagi transformer A

Many number of turns

Bilangan lilitan banyak

Reason / Sebab

Higher voltage

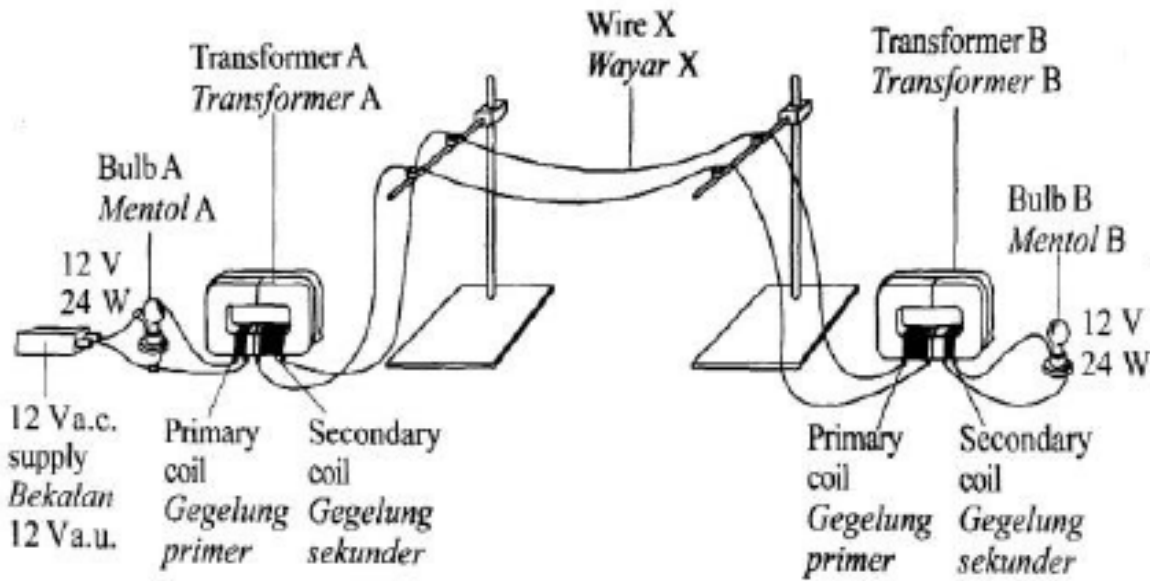
Beza keupayaan tinggi

[2 marks]



(b) Diagram 7.2 shows a model of electric power transmission.

Rajah 7.2 menunjukkan satu model penghantaran kuasa elektrik.



The brightness of the bulb B is lower than bulb A due to the power loss in the wire X.

Suggest modifications that can be made to the model to increase the brightness of bulb B based on the following aspects:

Kecerahan mentol B adalah lebih rendah daripada mentol A disebabkan kehilangan kuasa di dalam wayar X. Cadangkan pengubahsuaian yang boleh dibuat kepada model itu untuk menambah kecerahan mentol B berdasarkan aspek-aspek berikut:

(iii) Name of material of wire X

Nama bahan bagi wayar X

**Copper / aluminium /
kuprum / aluminium**

Reason / Sebab

Low resistance

Kurang rintangan

[2 marks]

Give one reason why a.c power supply is used in the model.

Beri satu sebab mengapa bekalan kuasa a.u. digunakan dalam model itu.

Ac voltage can be stepped up

Voltage au boleh diturunkan [1 mark]



Question 8

Diagram 8 shows how electricity is transmitted from power station to a school using transmission cables and transformers.

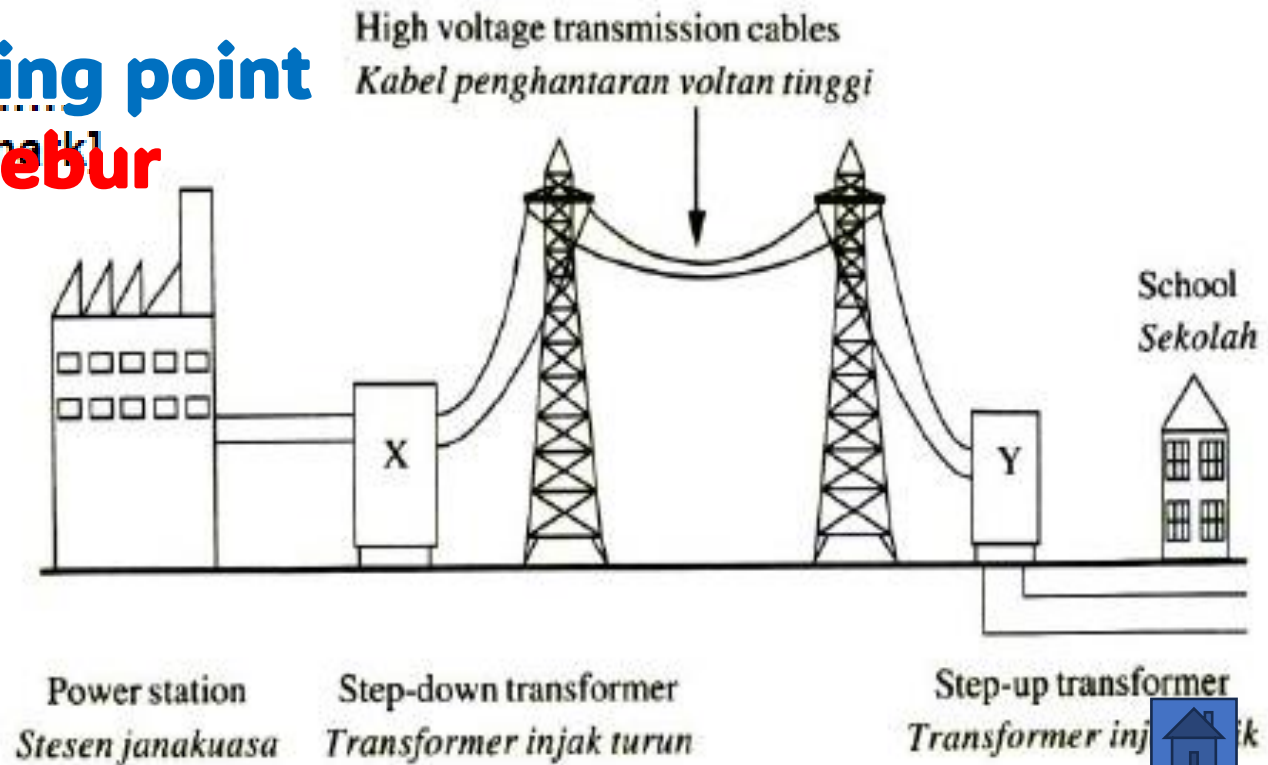
Rajah 8 menunjukkan bagaimana elektrik dihantar dari stesen janakuasa ke sekolah menggunakan kabel penghantaran dan transformer.

(a) State one characteristic of the material that is used to make the transmission cables.

Nyatakan satu ciri bahan yang digunakan untuk membuat kabel penghantaran.

Low resistance / thick / high melting point

Rintangan rendah / tebal / takat lebur tinggi



(b) The output power and the output voltage at the transmission cables are 10 MW and 132 kV respectively. The total resistance of the transmission cable is 600 Ω .

Kuasa output dan voltan output pada kabel penghantaran masing-masing ialah 10 MW dan 132 kV. Jumlah rintangan kabel penghantaran ialah 600 Ω .

$$M1: \frac{10 \times 10^6}{132 \times 10^3} // \frac{10}{32}$$

$$M2: 75.76$$

Calculate / Hitung,

(i) The current flow through the cable
Arus yang mengalir melalui kabel.

[2 marks]

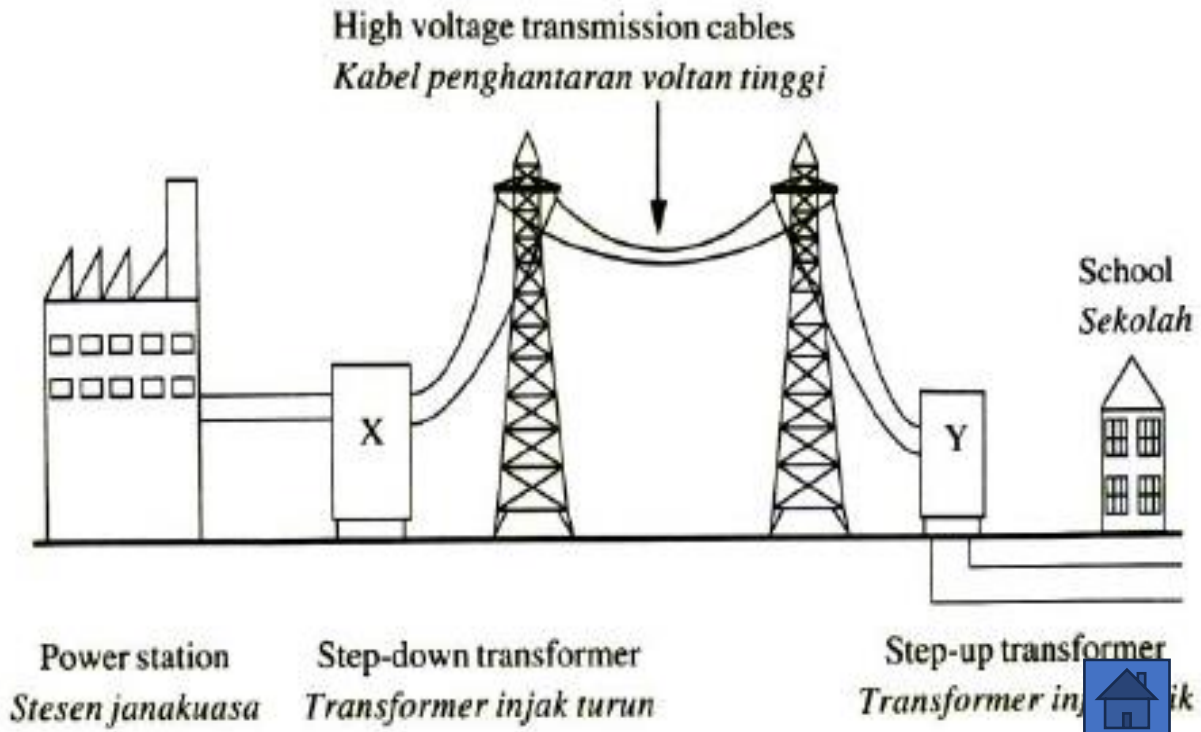
(ii) The power loss in the cable.
Kehilangan kuasa dalam kable itu.

$$M1: P = I^2R = (75.76)^2 \times 600$$

$$// (75.75)^2 \times 600$$

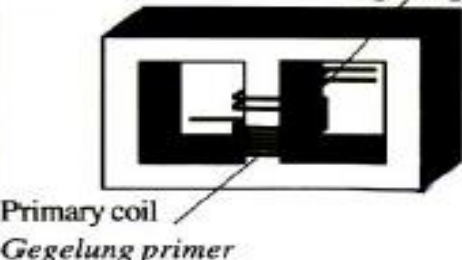
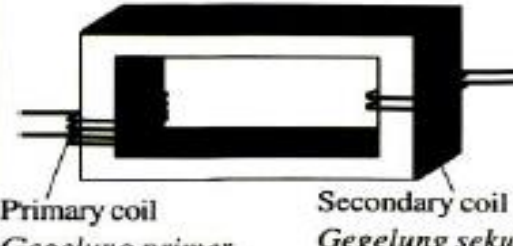
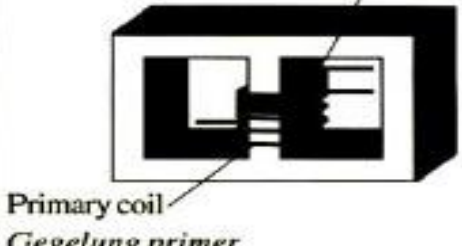
$$M2: = 3.44 \times 10^6 \text{ W}$$

[2 marks]



(c) In the school laboratory, a step-down transformer is used to light up a 12 V bulb. P, Q and R are three different step-down transformers that can be used to step down the voltage from 240 V to 12 V. Table 2 shows the characteristics of those transformers.

Dalam makmal sekolah, sebuah transformer injak turun digunakan untuk menyalakan mentol 12 V. P, Q dan R adalah tiga transformer injak turun yang berlainan yang boleh digunakan untuk menurunkan voltan dari 240 V kepada 12 V. Jadual 2 menunjukkan ciri-ciri bagi transformer tersebut.

Transformer <i>Transformer</i>	Material of the core <i>Bahan untuk teras</i>	Shape of the core <i>Bentuk teras</i>	$N_p : N_s$
P	Iron <i>Besi</i>	Shape X <i>Bentuk X</i> 	1 : 20
Q	Soft iron <i>Besi lembut</i>	Shape Y <i>Bentuk Y</i> 	16 : 1
R	Soft iron <i>Besi lembut</i>	Shape X <i>Bentuk X</i> 	20 : 1



Based on Table 2, state the suitable characteristics of the transformer which can light up the bulb with normal brightness and the least energy loss. Give reason for the suitability of the characteristics.

Berdasarkan Jadual 2, nyatakan kesesuaian ciri-ciri transformer yang digunakan untuk menyalakan mentol dengan kecerahan normal dan kehilangan tenaga yang paling kecil. Beri sebab untuk kesesuaian ciri-ciri tersebut.

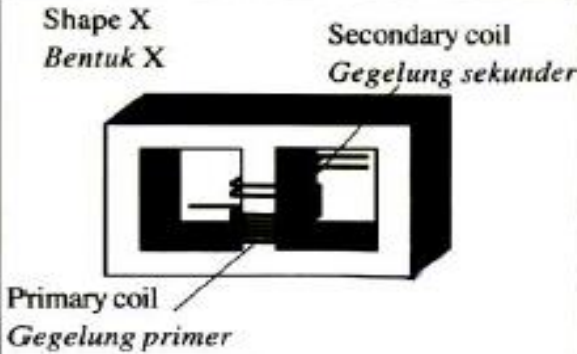
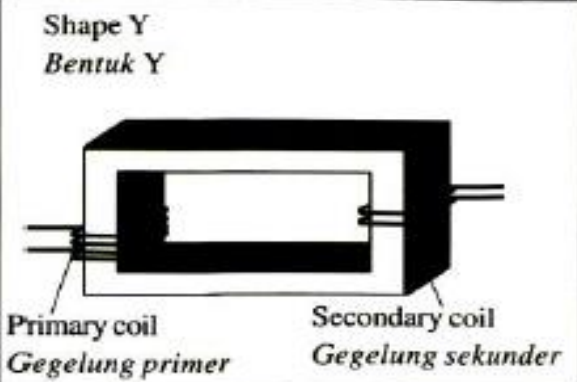
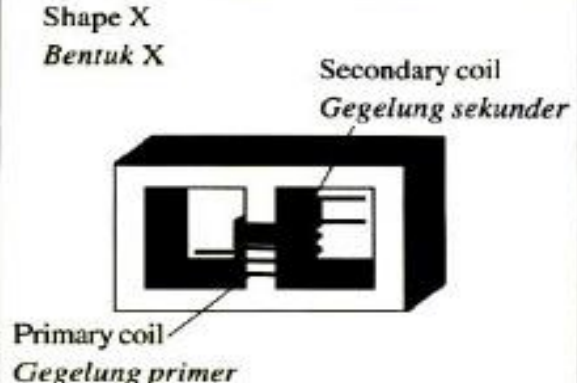
(i) Material of the core / Bahan untuk teras

Soft iron / besi lembut

Reason / Sebab:

Easy to magnetised and demagnetised / mudah dimagnet dan dinyahmagnetkan

[2 marks]

Transformer	Material of the core Bahan untuk teras	Shape of the core Bentuk teras	$N_p : N_s$
P	Iron Besi	Shape X Bentuk X 	1 : 20
Q	Soft iron Besi lembut	Shape Y Bentuk Y 	16 : 1
R	Soft iron Besi lembut	Shape X Bentuk X 	20 : 1



[2 marks]

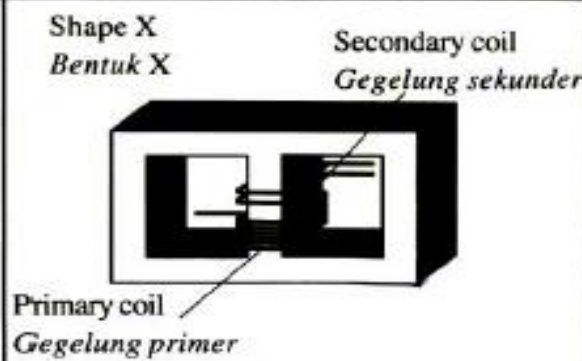
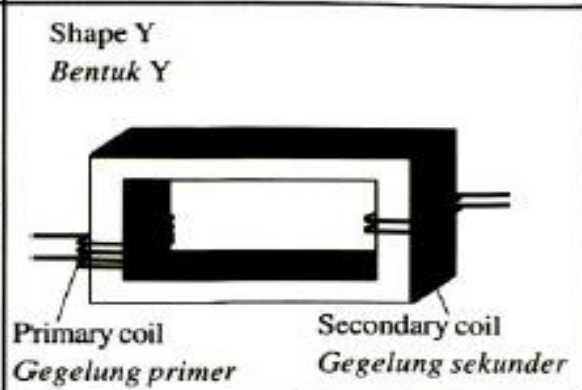
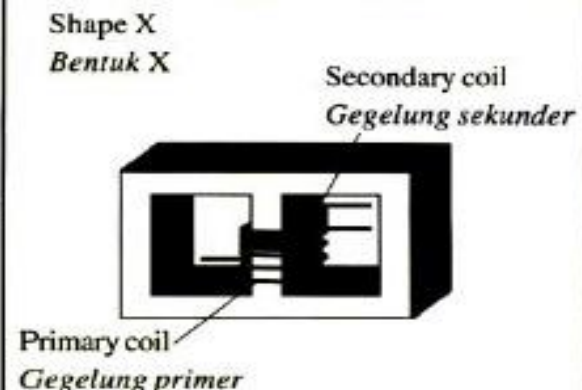
(ii) Shape of the core / *Bentuk teras*

Shape X / bentuk X

Reason / *Sebab*:

**The secondary coil and primary coil can be wound on top of each other / reduce leakage of magnetic flux /
Gegelung sekunder dililit rapat dengan gegelung primer // Gegelung sekunder dan gegelung primer dililitkan di atas satu sama lain /
mengurangkan kebocoran fluks magnet**

[2 marks]

Transformer	Material of the core <i>Bahan untuk teras</i>	Shape of the core <i>Bentuk teras</i>	$N_p : N_s$
P	Iron <i>Besi</i>	Shape X <i>Bentuk X</i> 	1 : 20
Q	Soft iron <i>Besi lembut</i>	Shape Y <i>Bentuk Y</i> 	16 : 1
R	Soft iron <i>Besi lembut</i>	Shape X <i>Bentuk X</i> 	20 : 1



(iii) $N_p : N_s$

20:1

Reason / Sebab:

Output voltage is 12 V / decrease output voltage

// voltan output 12 V /

[2 marks]

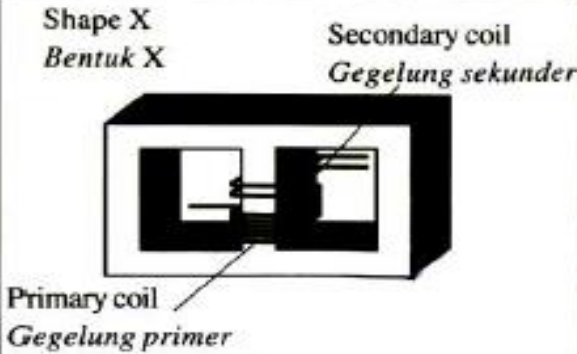
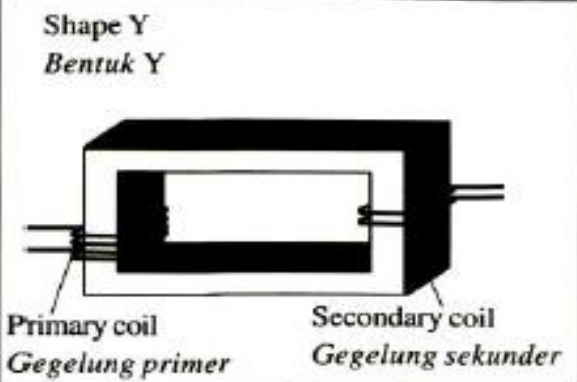
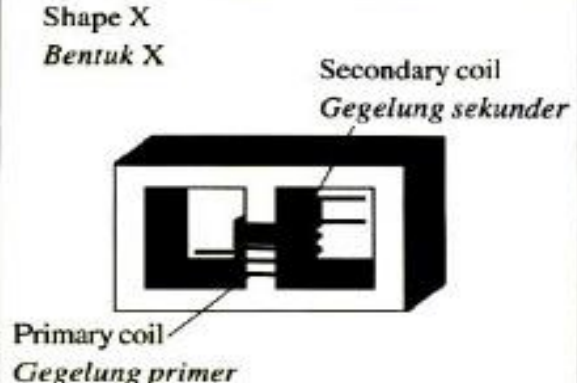
menurunkan voltan output /

(iv) Based on the answer in 8(c)(i), 8(c)(ii) and 8(c)(iii), choose the most suitable transformer.

Berdasarkan jawapan di 8(c)(i), 8(c)(ii) dan 8(c)(iii), pilih transformer yang paling sesuai.

R

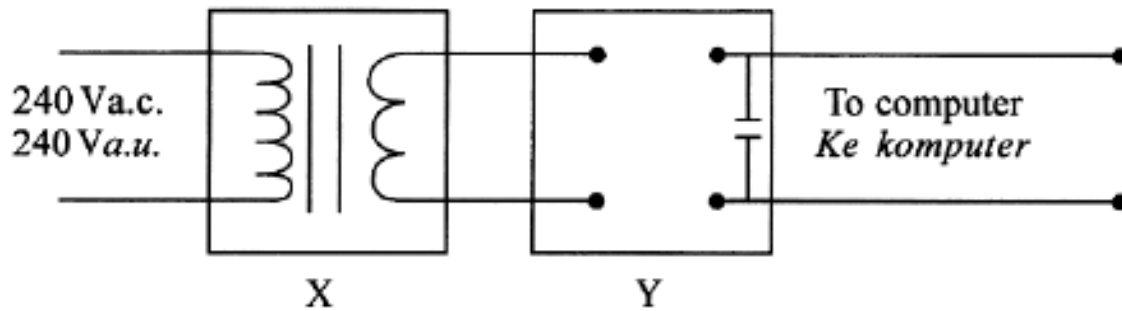
[1 mark]

Transformer	Material of the core Bahan untuk teras	Shape of the core Bentuk teras	$N_p : N_s$
P	Iron Besi	Shape X Bentuk X  Primary coil Gegelung primer Secondary coil Gegelung sekunder	1 : 20
Q	Soft iron Besi lembut	Shape Y Bentuk Y  Primary coil Gegelung primer Secondary coil Gegelung sekunder	16 : 1
R	Soft iron Besi lembut	Shape X Bentuk X  Primary coil Gegelung primer Secondary coil Gegelung sekunder	20 : 1



4. Diagram 4.1 shows a computer battery charger connected to a 240 V a.c. power supply. The battery charger contains box X and box Y.

Rajah 4.1 menunjukkan sebuah pengecas bateri computer yang disambungkan kepada bekalan kuasa 240 V a.u. Pengecas bateri itu mengandungi kotak X dan kotak Y.



- (a) The function of the component in box X is to lower the voltage from 240 V a.c to 20 V a.c.

Fungsi komponen di dalam kotak X adalah untuk menurunkan voltan daripada 240 V a.u kepada 20 V a.u.

- (i) Name the component in box X.
Namakan komponen di dalam kotak X.

Step down transformer /

transformer injak turun [1 mark]

- (ii) Explain why a.c and not d.c is supplied in Diagram 4.1.

Terangkan mengapa a.u dan bukan a.t yang dibekalkan dalam Rajah 4.1 [1 mark]

To change the direction and magnitude of the magnetic field
menukarkan arah dan magnitude medan magnet

- (iii) State the physics concept which explains how the component in box X works.

Nyatakan konsep fizik yang menerangkan bagaimana komponen di dalam kotak X berfungsi.

Electromagnetic induction / aruhan elektromagnet



- (b) The efficiency of the component in box X is 80%. Calculate the input current when the output power is 65 W. [2 marks]

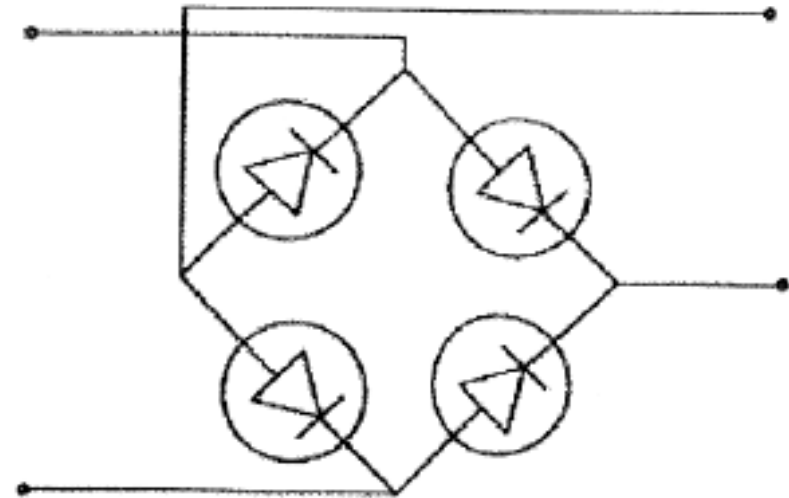
Kecekapan komponen di dalam kotak X ialah 80%. Hitung arus input apabila kuasa output ialah 65W.

$$\frac{65}{240 \times I_p} \times 100\% = 80\%$$

$$I_p = 0.34 \text{ A}$$

- (c) Box Y contains four identical electronic components to change a.c. to d.c. On Diagram 4.2, draw the electronic components in the circles provided.

Kotak Y mengandungi empat komponen elektronik yang serupa untuk menukar a.u. kepada a.t. Pada Rajah 4.2, lukis komponen elektronik tersebut di dalam bulatan yang disediakan.



Bahagian B

[20 markah]

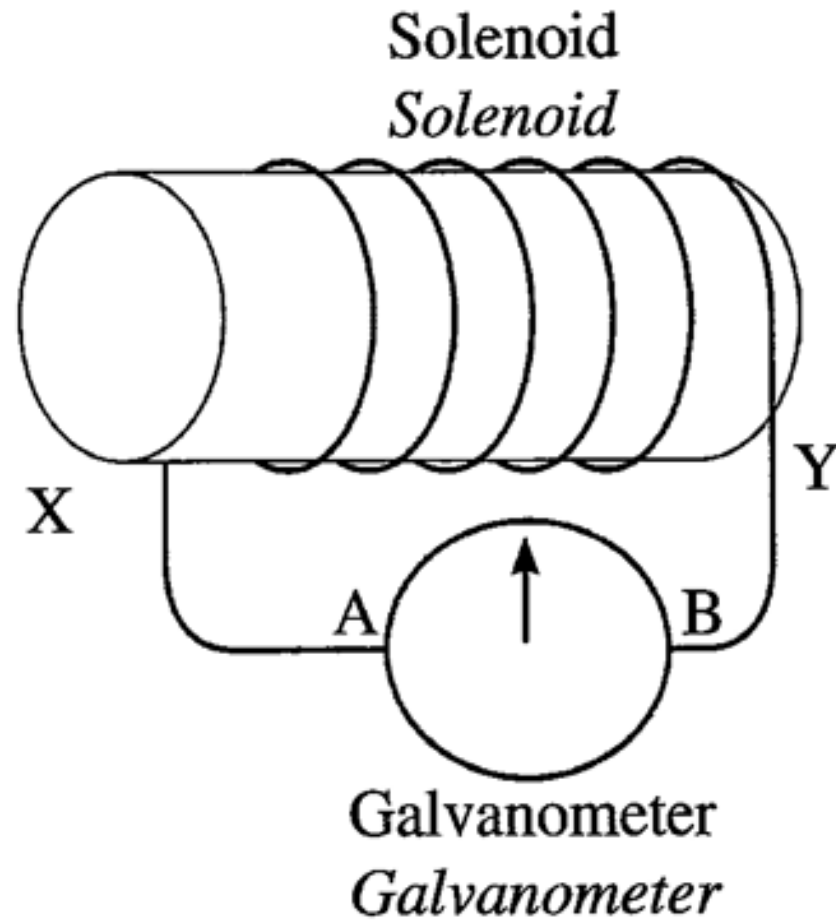
*Bahagian ini mengandungi **dua** soalan. Jawab **satu** soalan.*

- 9 Rajah 9.1 menunjukkan sebatang magnet bar digerakkan mendekati satu solenoid. Pesongan galvanometer dapat diterangkan berdasarkan konsep aruhan elektromagnet.

Diagram 9.1 shows a bar magnet is moved closer to a solenoid. The deflection of galvanometer can be explained based on the concept of electromagnet induction.



Magnet ditolak mendekati solenoid
Magnet is pushed closer to a solenoid



Rajah 9.1
Diagram 9.1



(a) Apakah maksud aruhan elektromagnet?

What is meant by electromagnetic induction?

(a)

[1 markah]

- ✓ **Penghasilan d.g.e aruhan / arus aruhan merentasi suatu konduktor apabila terdapat gerakan relatif antara konduktor dan medan magnet.**
- ✓ **Production of an induced e.m.f / induced current across conductor when there is relative motion between the conductor and a magnetic field.**
- ✓ **Hasil d.g.e / arus aruhan apabila ada pemotongan / perubahan fluks / medan / garis medan magnet**
- ✓ **Produce induce current due to change of magnetic flux / cutting magnetic flux.**

[1 mark]



(b) Berdasarkan Rajah 9.1,

Based on Diagram 9.1,

(i) Nyatakan kekutuban di X dan Y

State the polarity at X and Y

[2 markah]

[2 marks]

(ii) Tentukan arah arus yang mengalir melalui galvanometer dan nyatakan pesongan galvanometer.

Determine the direction of current that flows through galvanometer and state the deflection of the galvanometer.

[2 markah]

[2 marks]

(iii) Terangkan jawapan anda untuk 9(b)(ii).

Explain your answer for 9(b)(ii).

[1 markah]

[1 mark]



(b)(i) Menyatakan kekutuban dengan betul

M1: X – Utara / North / U / N

Reject: n yang kecil

M2: Y – Selatan / south / S

(b)(ii) Menentukan arah aliran arus dalam litar

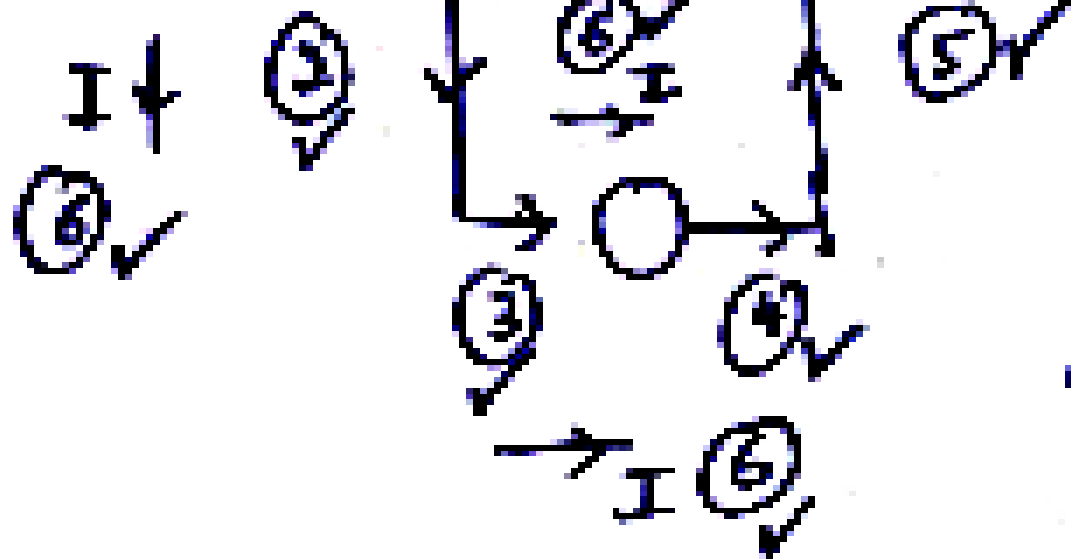
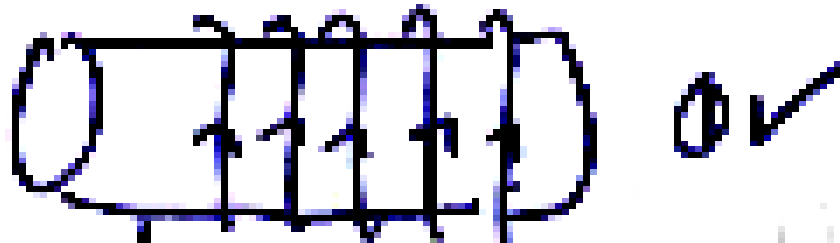
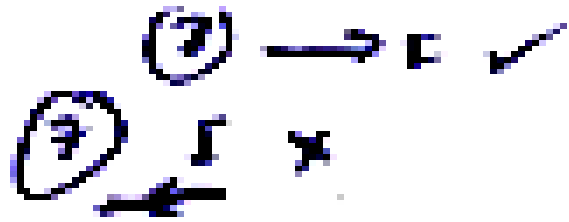
M1: Arah arus dari A ke B

✓ **Direction of current from A to B**

✓ **Arus A ke B / arus ke kanan**

✓ **Current A to B**

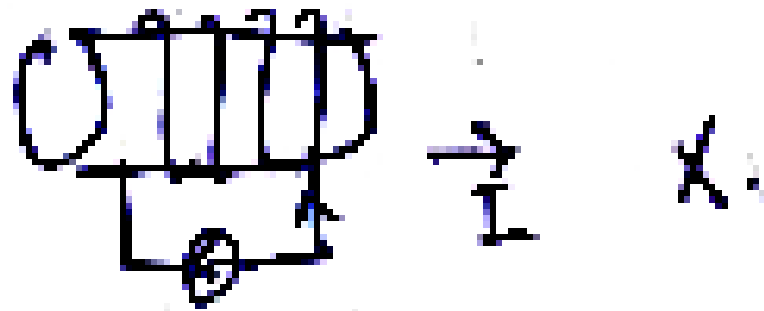




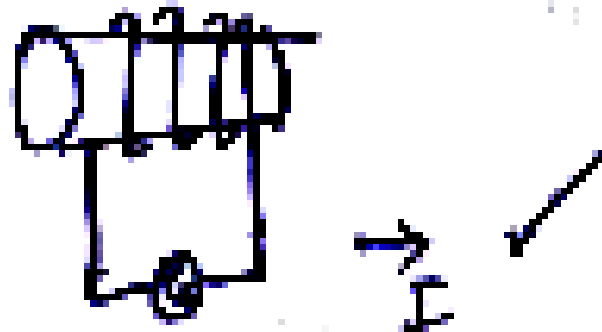
Remark :
 Di luar konduktor mark
 label I .



Contoh 1



Contoh 2

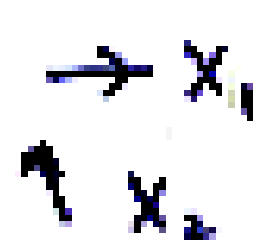


Di ruang gambar

Contoh 3



Contoh 4



ada label I
tanda bentuk bulat
galvanometer



(iii) Terangkan jawapan anda untuk 9(b)(ii).

Explain your answer for 9(b)(ii).

[1 markah]

- ✓ **Menghasilkan kesan menentang**
- ✓ **Produce oppose effect**
- ✓ **Menentang Utara / North / N / U**
- ✓ **Oppose magnet**
- ✓ **Ada d.g.e / has e.m.f**
- ✓ **Ada arus / has current**
- ✓ **Pemotongan / perubahan fluks magnet**
- ✓ **Perubahan medan magnet / cutting / change of magnetic field**
- ✓ **Gerakan relatif antara konduktor dan medan magnet**
- ✓ **Relative motion between conductor and magnetic field**



- (c) Berdasarkan konsep aruhan elektromagnet, terangkan bagaimana arus aruhan boleh terhasil dalam solenoid.

Based on the concept of electromagnetic induction, explain how an induced current can be produced in a solenoid.

[4 markah]

[4 marks]



M1: Apabila magnet mendekati gegelung, medan magnet terpotong

✓ **When the magnet closer to coil, magnetic field is being cut**

M2: Medan magnet terpotong / Perubahan fluks @ medan magnet

✓ **Cutting of magnetic field / Changing in magnetic flux / field**

M3: dge hasil / Emf produce / D.g.e teraruh / Emf is induced.

M4: mematuhi Hukum Lenz / Obey's Lenz law

M5: Arah arus aruhan sentiasa menentang perubahan fluks (yang menghasilkannya

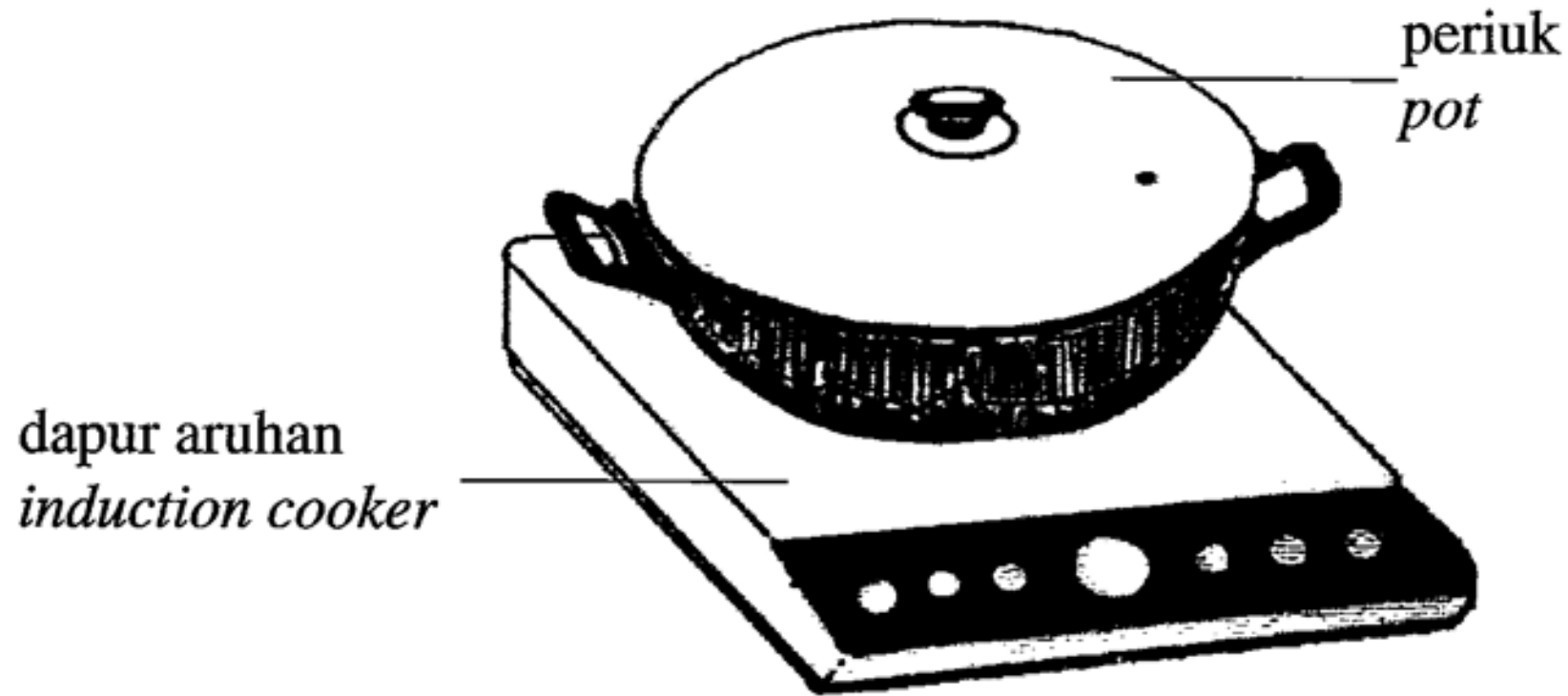
✓ **Idea penerangan Hukum Lenz.**

✓ **Induced current always in a direction oppose change flux produces it.**



(d) Rajah 9.2 menunjukkan sebuah periuk dan dapur aruhan.

Diagram 9.2 shows a pot and an induction cooker.



Rajah 9.2
Diagram 9.2



Anda dikehendaki menyiasat ciri-ciri bagi sebuah dapur aruhan seperti yang ditunjukkan dalam Jadual 2.

You are required to investigate the characteristics of an induction cooker as shown in Table 2.

Terangkan kesesuaian setiap ciri dapur aruhan. Tentukan dapur aruhan yang paling berkesan untuk digunakan bagi memasak makanan dengan lebih cekap dan menjimatkan.

Explain the suitability of each characteristic of induction cooker. Determine the most effective induction cooker to be used to cook food more effectively and economically.

[10 markah]

[10 marks]



Dapur aruhan <i>Induction cooker</i>	Jenis bekalan kuasa <i>Type of power supply</i>	Bahan untuk permukaan dapur <i>Material for the surface of cooker</i>	Bahan untuk dasar periuk <i>Material for the base of the pot</i>	Jenis gegelung elektromagnet <i>Type of electromagnetic coil</i>
J	arus terus <i>direct current</i>	keluli <i>steel</i>	besi <i>iron</i>	kuprum <i>copper</i>
K	arus terus <i>direct current</i>	seramik <i>ceramic</i>	tanah liat <i>clay</i>	nikrom <i>nichrome</i>
L	arus ulang alik <i>alternating current</i>	seramik <i>ceramic</i>	besi <i>iron</i>	kuprum <i>copper</i>
M	arus ulang alik <i>alternating current</i>	keluli <i>steel</i>	tanah liat <i>clay</i>	nikrom <i>nichrome</i>



M1: Arus ulangalik
Alternating current
Reject: a.u / a.c

M2: Medan magnet berubah
Changes magnetic field / cut magnetic flux /
potong fluks magnet

M3: (permukaan
dapur) seramik //
ceramic (surface
cooker)

M4: Tidak panas // **not hot / suhu tidak**
meningkat / muatan haba tentu tinggi /
lambat panas / kenaikan suhu rendah /
poor heat conductor / (heat) insulator /
penebat



M5: (dasar periuk) besi // iron

**M6: ada @ hasil @ wujud arus
pusar / hasil aruhan EM / hasil
d.g.e / hasil arus aruhan / hasil
voltan @ beza keupayaan / form
eddy current / produce e.m.f**

**M7: (gegelung) kuprum //
copper**

**M8: Rintangan rendah /
kerintangan rendah / banyak arus /
medan magnet kkuat / low
resistance / low resistivity / more
current / stronger magnetic field.**

M9: L

**M10: menyata semua ciri, semua sebab atau
kombinasi ciri dan sebab**



Question 12

(a) Most of our electrical energy comes from hydroelectric power station and thermal power stations. These power stations are connected by cables to transmit electricity to users in industries, offices, schools and houses. This system is called the national grid network.

Sebahagian besar tenaga elektrik yang digunakan datang daripada stesen janakuasa elektrik hidro dan stesen janakuasa termal. Stesen janakuasa itu disambung antara satu sama lain menggunakan kabel untuk menyalurkan tenaga elektrik kepada industri, pejabat, sekolah dan rumah kediaman. Sistem ini dikenali sebagai rangkaian grid nasional.

(i) State the transformation of energy in a hydroelectric power system.

Nyatakan pemindahan bentuk tenaga yang berlaku di stesen janakuasa elektrik hidro.

[1 mark]

Tenaga keupayaan → tenaga kinetik → tenaga elektrik
Potential energy → kinetic energy → electrical energy.



(ii) Explain briefly the importance of the national grid network system in distributing electrical energy to the users.

Terangkan secara ringkas, kepentingan sistem rangkaian grid nasional dalam penghantaran tenaga elektrik kepada pengguna.

[4 marks]

Pastikan bekalan elektrik berterusan dan mencukupi
Maintain continuously and enough electrical supply

Beban bekalan kuasa elektrik diambil alih oleh stesen yang lain jika rosak / Can revert to another network if the existing network is faulty

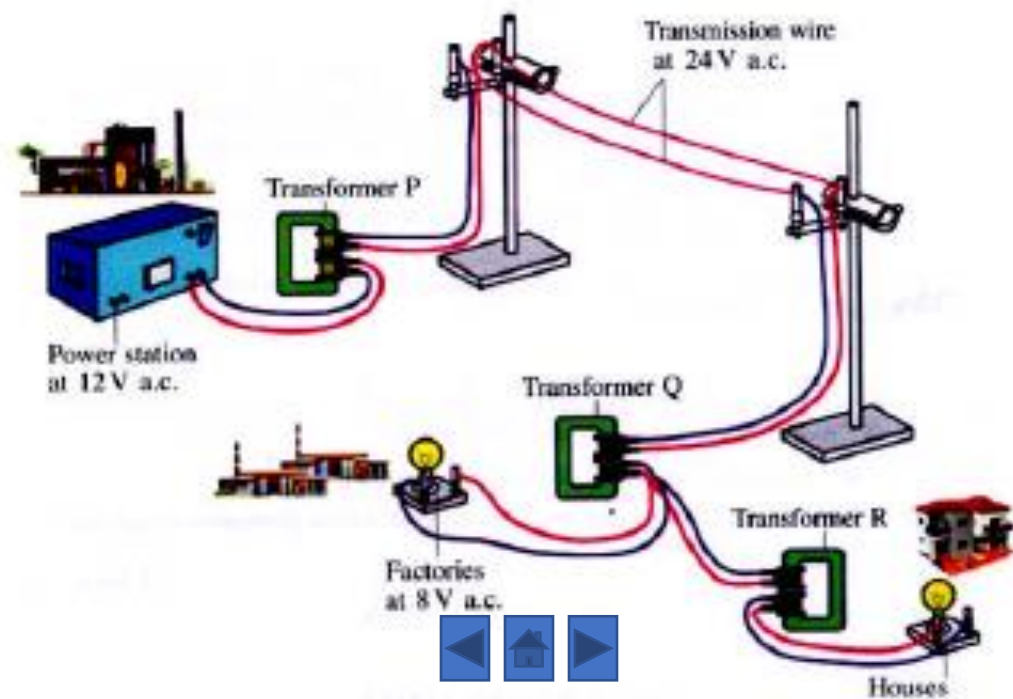
Kos keseluruhan penghasilan elektrik boleh dikurangkan
The overall cost of production of electricity can be reduced.

Kuasa boleh dikawal dan diagihkan ikut permintaan
Power can be controlled and distributed according to the demand



(b) Diagram 12.1 shows how a model of an electric transmission system can be set up in a laboratory. The model consists of a power station that generates 12 V of alternating current (a.c) that transmits the electrical energy to the users using transmission wires and transformers P, Q and R.

Rajah 12.1 menunjukkan satu model penghantaran elektrik yang boleh disusun dalam makmal. Model itu mengandungi stesn kuasa yang menjana 12 V arus ulang alik yang menghantar tenaga elektrik ke pengguna menggunakan dawai penghantaran dan transformer P, Q dan R.



You are required to set up a model as in the Diagram 12.1, using the information in the following table.

Anda dikehendakki untuk menyusun satu model seperti dalam Rajah 12.1 menggunakan maklumat berikut.

Using the information in the Diagram and Table above determine:

Menggunakan rajah dan jadual di atas tentukan:

(i) the type of core you will use in all the transformers and justify your choice.

jenis teras yang akan digunakan dalam semua transformer dan beri justifikasi pilihan anda.

(ii) the material you will use for the transmission wire and justify your choice.

bahan yang digunakan untuk membuat kabel penghantaran dan beri justifikasi pilihan anda.

(iii) the number of turns in the primary coil and the secondary coil of transformers P, Q and R and show your working.

bilangan lilitan dalam gegelung primer dan gegelung sekunder untuk transformer P, Q dan R dan tunjukkan jalan kerja.

[10 marks]



Bilangan lilitan gegelung	Jenis teras transformer	Bahan untuk kabel penghantar
1200	Solid cuprum core	konstantan
1000		<i>Constantan</i>
500	<i>Teras kuprum padat</i>	
400		Kuprum
160		<i>Copper</i>
120	Laminated cuprum core	Aluminium
	<i>Teras kuprum berlapis</i>	
	Solid soft iron core	Nichrome
	<i>teras besi lembut padat</i>	
	Laminated Soft iron core	
	<i>Teras besi lembut berlapis</i>	

(b)

Transformer P (12 V → 24 V)

$$\frac{12}{24} = \frac{N_P}{N_S} = \frac{500}{1000}$$

Transformer Q (24 V → 8 V)

$$\frac{24}{8} = \frac{N_P}{N_S} = \frac{1200}{400}$$

Transformer R (24 V → 6 V)

$$\frac{24}{6} = \frac{N_P}{N_S} = \frac{500}{120}$$



Teras besi lembut berlamina
laminated soft iron core

Kurangkan arus pusar dalam teras besi lembut dan mudah dimagnet dan dinyahmagnetkan.
It can reduce eddy current and easy to magnetized and demagnetized

Wayar penghantar ialah kuprum
Copper as the transmission wire

Rintangan kecil dan ringan
Small resistance and lighter



- (c) If the resistance of the transmission wires between transformers P and Q in the model at Diagram above is $30\ \Omega$, calculate:

Jika rintangan dalam dawai penghantar antara transformer P dan Q dalam model ialah $30\ \Omega$, hitung:

- (i) the current that flows in the transmission wire.
Arus yang mengalir dalam dawai penghantar.

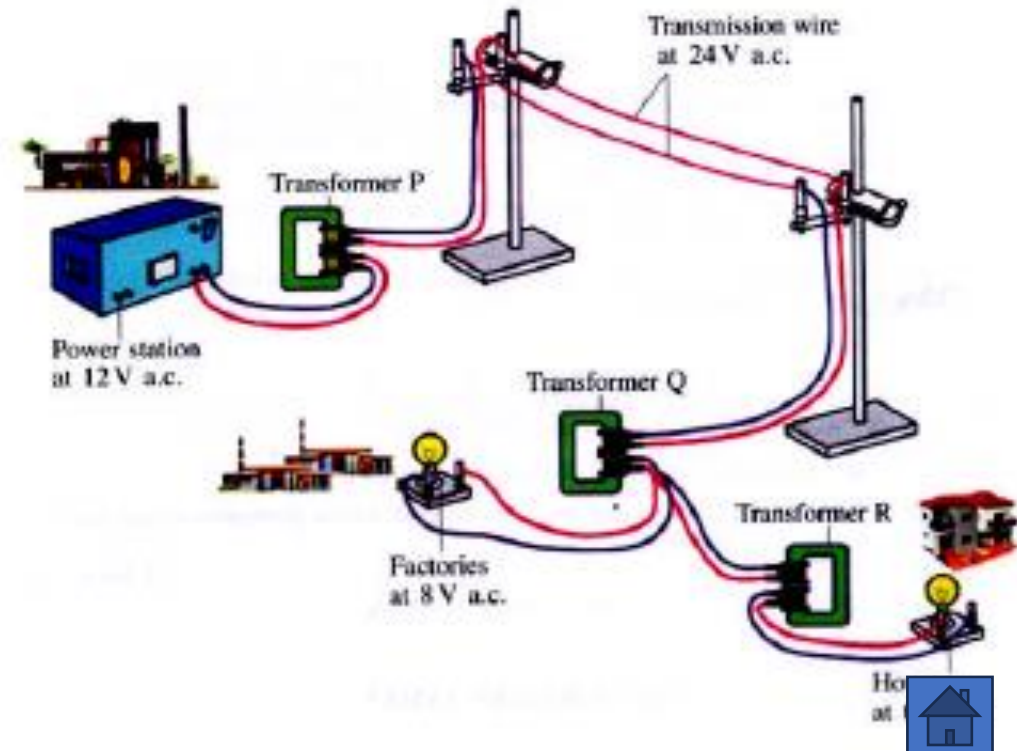
$$I = \frac{24}{30} = 0.8\ \text{A}$$

- (ii) The power loss due to the heating effect of the current in the transmission wire.

Kuasa yang hilang akibat kesan pemanasan arus elektrik dalam dawai.

[5 marks]

$$P = I^2 R = (0.8)^2 \times 30 = 19.2\ \text{W}$$



Question 12

Figure 12.1 shows circuits J, K, L, M and N each containing an ideal transformer. Diodes in the circuits are used for the purpose of rectification.

Rajah 12.1 menunjukkan litar J, K, L, M dan N masing-masing mempunyai transformer unggul. Diod dalam litar digunakan untuk tujuan rektifikasi.

Key :

N_p = Number of turns in primary coil

Bilangan lilitan gegelung primer

N_s = Number of turns in secondary coil

Bilangan lilitan gegelung sekunder

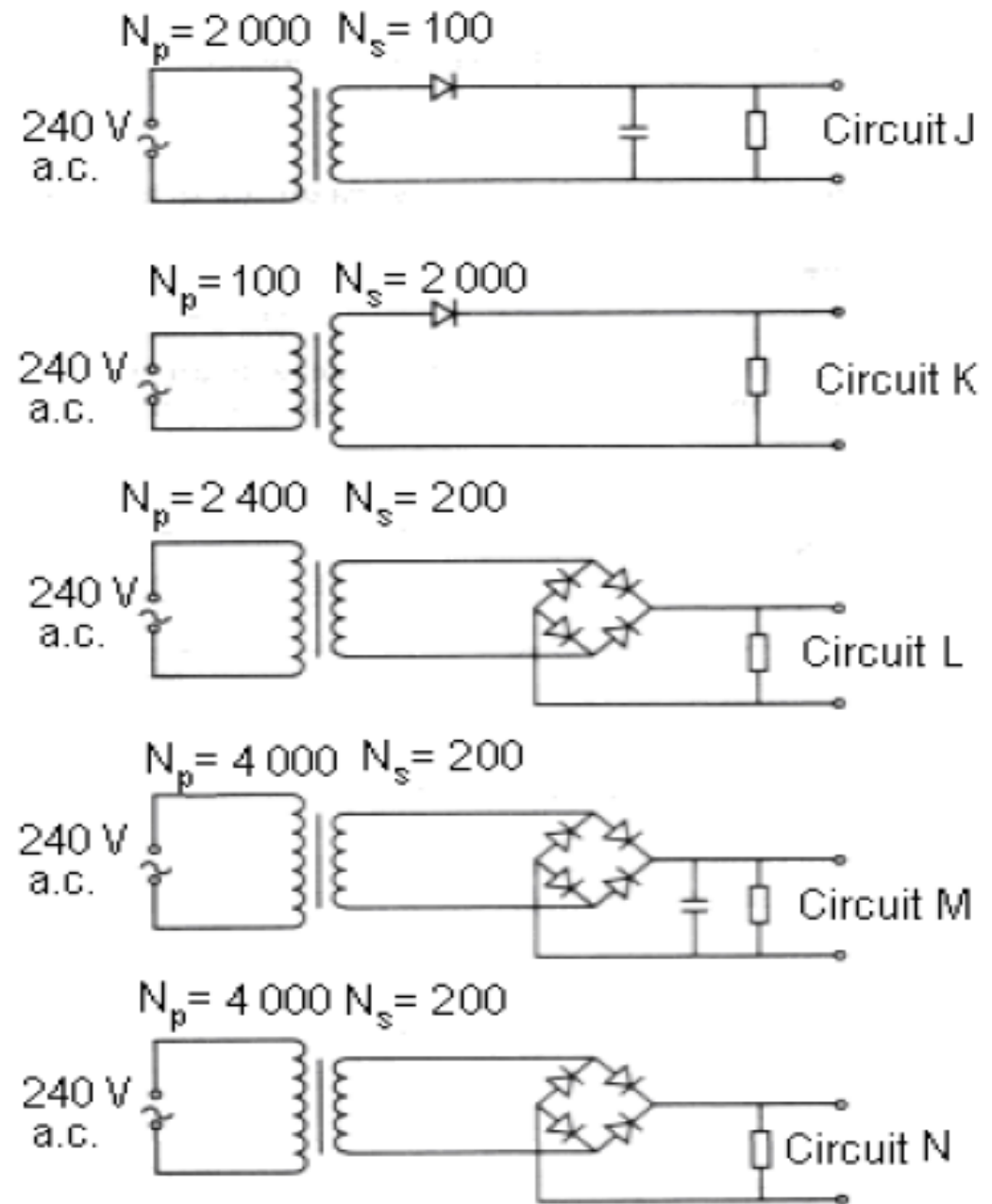
(i) What is meant by rectification?

Apakah yang dimaksudkan dengan rektifikasi?

[1 mark]

Proses menukarkan arus ulangalik kepada arus terus.

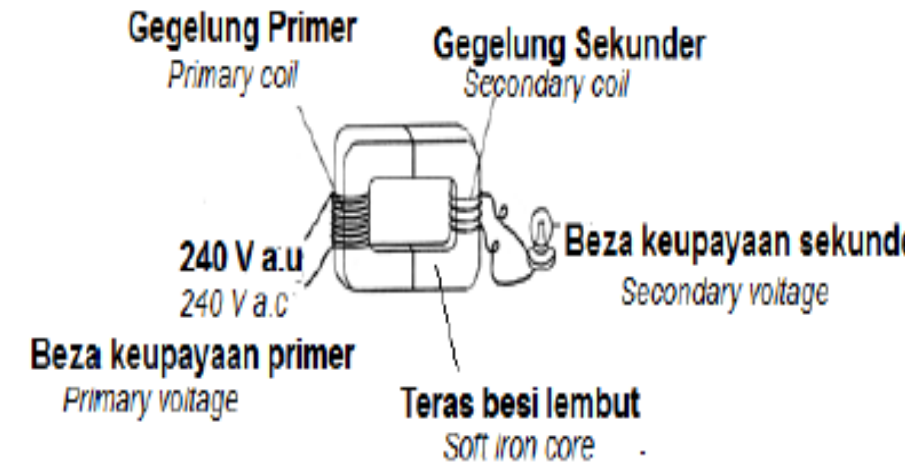
Process of converting alternating current to direct current



(ii) Explain the working principle of a transformer.

Terangkan prinsip kerja transformer.

- **Arus ulangalik mengalir melalui gegelung primer**
a.c current flows through the primary coil
- **Teras besi lembut dimagnetkan**
Soft iron core will be magnetized.
- **Teras besi lembut hubungkan antara gegelung primer dan gegelung sekunder**
Soft iron core is the linkage between the primary coil and secondary coil
- **arus a.u mempunyai arah dan magnitud berubah.**
Ac. Current has different direction and magnitude
- **Maka terdapat perubahan medan magnet.**
So there will be change in magnetic field
- **Arus aruhan mengalir melalui gegelung sekunder**
Induced current will produce through the secondary coil



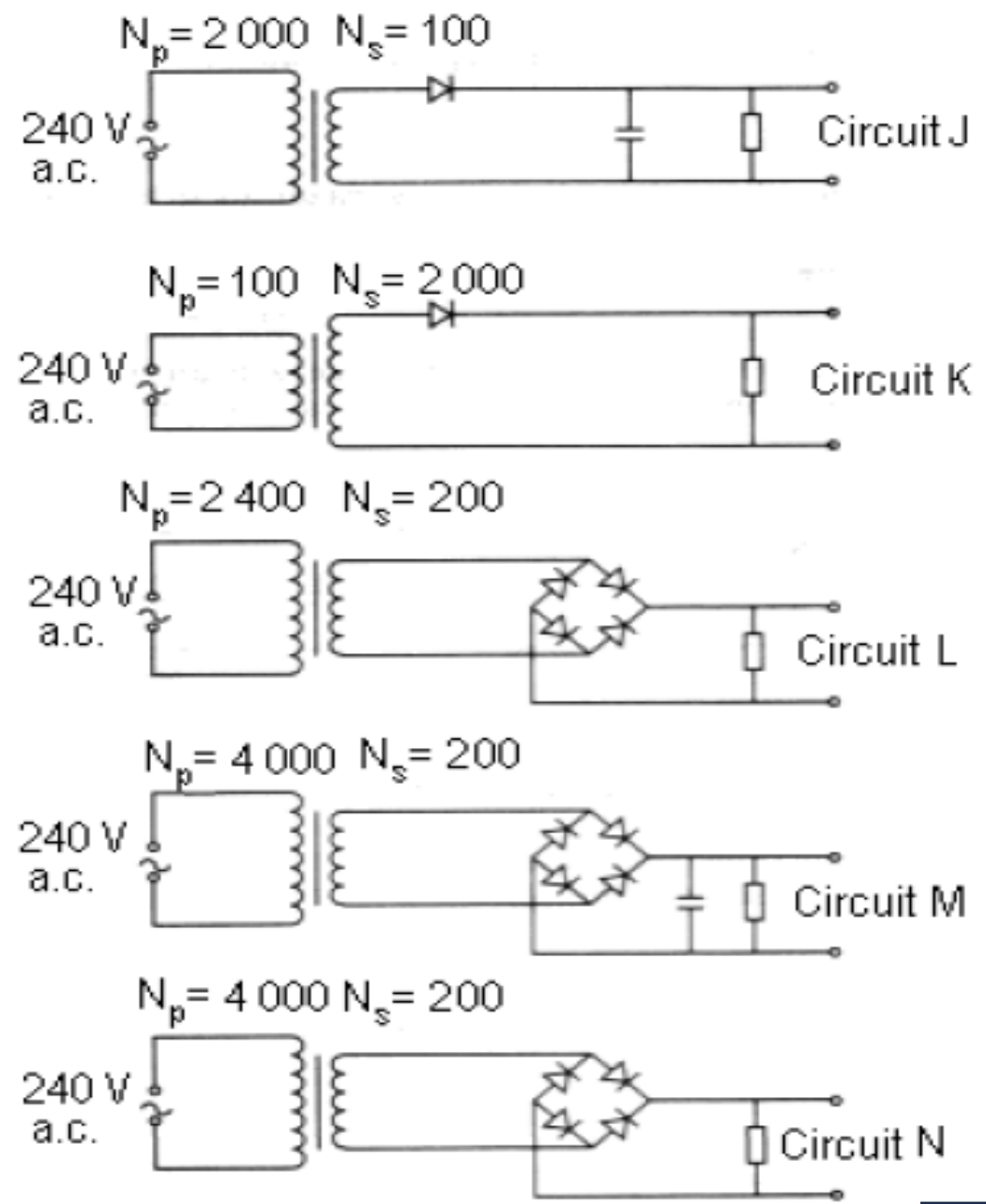
(iii) You are asked to make a 12 V battery charger . Study the circuits, J, K ,L, M and N in Figure (a) and consider the following aspects:

Anda ditugaskan untuk membina satu alat pengecas bateri 12 V. Kaji litar J,K,L,M dan N dalam Rajah 12.1 dan pertimbangkan aspek berikut:

- **type of transformer**
jenis transformer
- **ratio of the number of turns in primary coil to secondary coil**
nisbah bilangan lilitan gegelung primer kepada gegelung sekunder.
- **type of rectification**
jenis rektifikasi
- **characteristic of output current**
ciri arus output

Explain the suitability of the above aspects and hence, determine the most suitable circuit to make the battery charger.

Terangkan kesesuaian aspek-aspek itu dan seterusnya tentukan litar yang paling sesuai untuk membina pengecas bateri itu. Berikan sebab untuk pilihan anda.



[10 marks]



**1st : transformer injak turun
step down transformer**

**3rd : nisbah gegelung $N_p : N_s$
= 20:1// ratio of the coils $N_p : N_s = 20:1$**

**5th: guna susunan 4 diod
Use arrangement of 4 diodes**

**7th : guna kapasitor
use capacitor**

**9th : pilih M
choose M**

**2nd : boleh turunkan beza
keupayaan**

can reduce the voltage

**4th: menghasilkan voltan output 12 V
to produce output voltage of 12 V**

**6th : boleh hasilkan rektifikasi
penuh gelombang
can produce full wave
rectification**

**8th : boleh meratakan voltan at.
can smooth the dc voltage**



- (d) Figure 12.2 shows a circuit consisting of a transformer, an ammeter and two light bulbs. The ammeter reading is 0.5 A and both bulbs light up with normal brightness.

Rajah 12.2 menunjukkan sebuah litar yang terdiri daripada sebuah transformer, ammeter, dan dua buah mentol. Bacaan ammeter ialah 0.5 A dan kedua-dua mentol itu menyala dengan kecerahan normal.

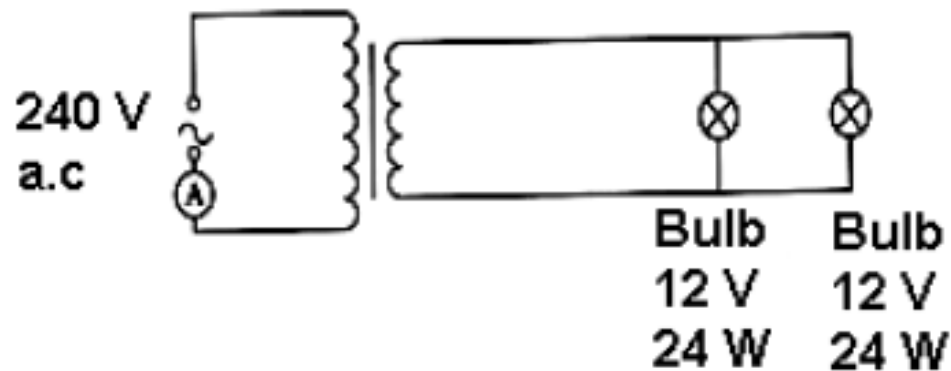


Figure 12.2

- (i) What is the output voltage of the transformer?
Berapakah voltan output transformer itu?
- (ii) Calculate the efficiency of the transformer.
Hitungkan kecekapan transformer itu.
- [5 marks]

Output voltage of transformer =
12 V

input power = $240 \times 0.5 = 120 \text{ W}$
Output power = $24 + 24 = 48 \text{ W}$

Efficiency = $\frac{48}{120} \times 100\% = 40\%$



Question 10

Diagram 10.1 and Diagram 10.2 show wire coils connected to the ammeters, switches and d.c. power supply.

Rajah 10.1 dan Rajah 10.2 menunjukkan gegelung dawai yang disambungkan kepada ammeter, suis dan bekalan kuasa a.t.

When the switch is on and iron filings of the same amount is spread on each of the cardboard surface, the pattern of the iron filings is formed as shown in the diagrams.

Apabila suis dihidupkan dan serbuk besi yang sama banyak ditaburkan pada setiap permukaan setiap kadbod, corak susunan serbuk besi terhasil adalah seperti yang ditunjukkan dalam kedua-dua rajah tersebut.

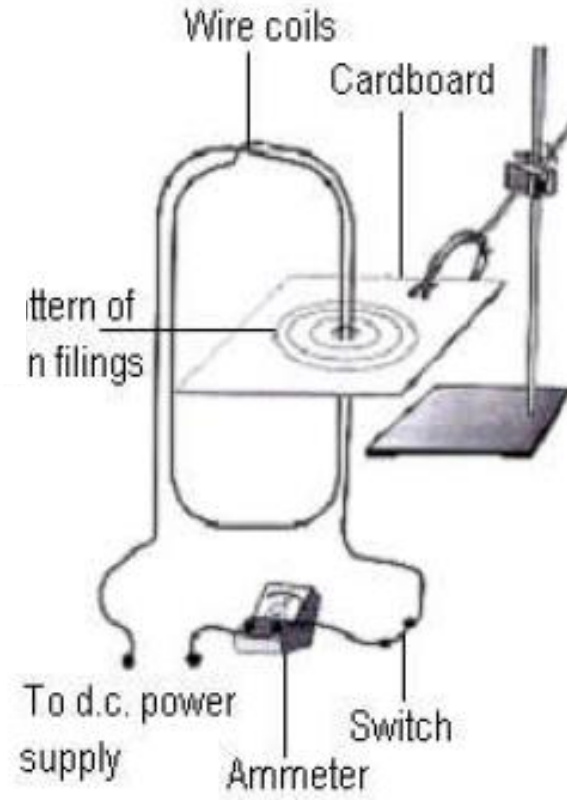


Diagram 10.1

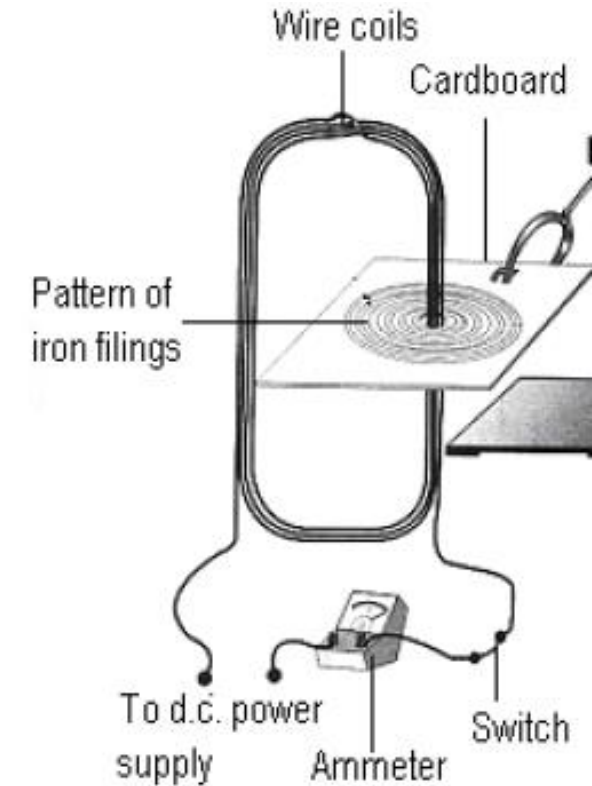


Diagram 10.2

(b) What is meant by magnetic field?

Apakah maksud medan magnet? [1 mark]

Magnetic field is region where there is a magnetic force
Kawasan di mana terdapat daya magnet



(c) Using Diagram(a) and Diagram(b), compare the number of turn of the coils, the pattern of the iron filings and the angle of deflection of the ammeter indicator.

Menggunakan Rajah 10.1 dan Rajah 10.2, bandingkan bilangan lilitan gegelung, corak susunan serbuk besi dan sudut pesongan penunjuk ammeter. [3 marks]

The number of turn of the coils: 10.2 > 10.1
bilangan lilitan gegelung: 10.2 > 10.1

The pattern of iron filings formed: 10.2 > 10.1
Corak susunan serbuk besi: 10.2 > 10.1

The angle of deflection of the ammeter: 10.2 > 10.1
Sudut pesongan penunjuk ammeter: 10.2 > 10.1

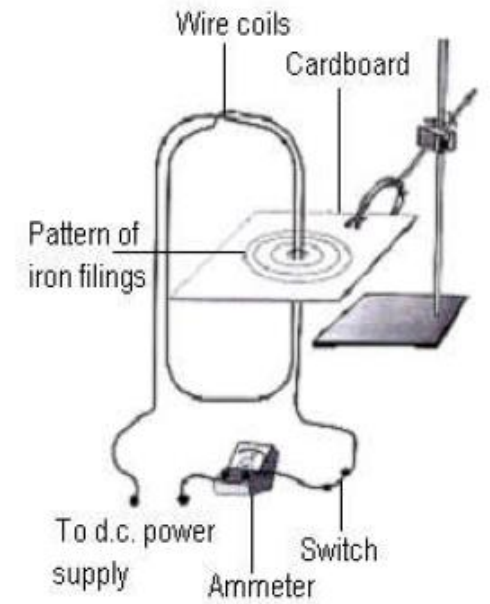


Diagram 10.1

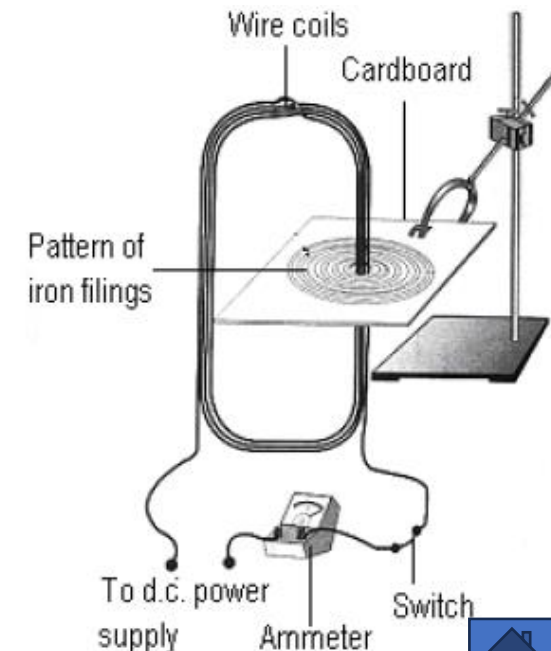


Diagram 10.2



(d) State the relationship between the strength of the magnetic field and

Nyatakan hubungan antara kekuatan medan magnet dengan

(i) the pattern of iron filings,
corak susunan serbuk besi

(ii) the number of turn of the coils.
Bilangan lilitan gegelung [2 marks]

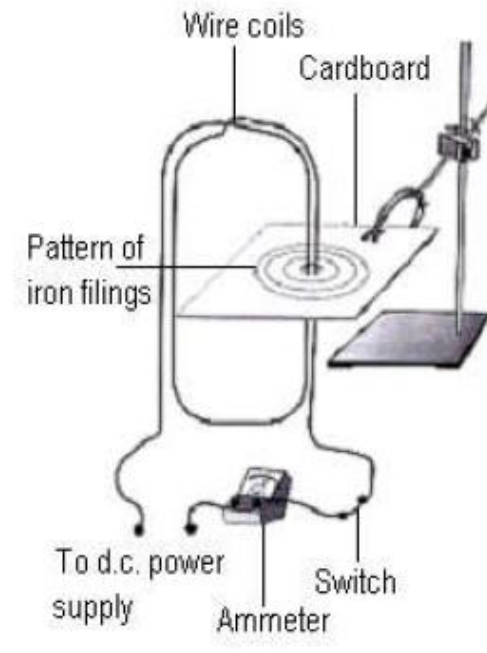


Diagram 10.1

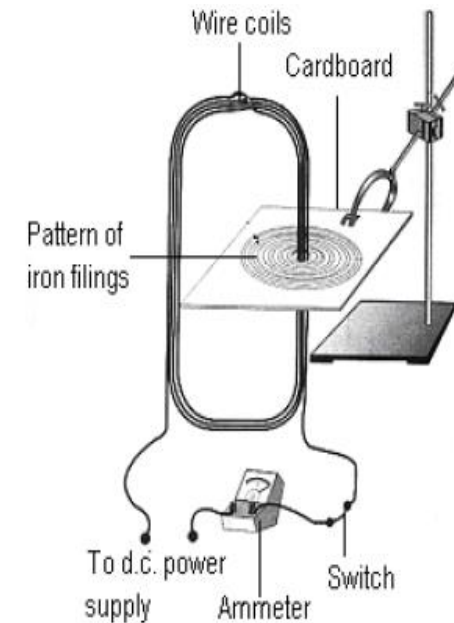


Diagram 10.2

The denser the pattern of iron filings, the stronger the strength of the magnetic field/ **semakin padat corak susunan serbuk besi, semakin kuat medan magnet**

The greater the number of turn of the coils, the stronger the strength of the magnetic field / **semakin besar bilangan lilitan gegelung, semakin kuat medan magnet**



(d) Diagram 10.3 shows two thin copper strips, PQ and RS, connected to a circuit.

Rajah 10.3 menunjukkan dua jalur kuprum nipis, PQ dan RS, yang disambungkan kepada satu litar.

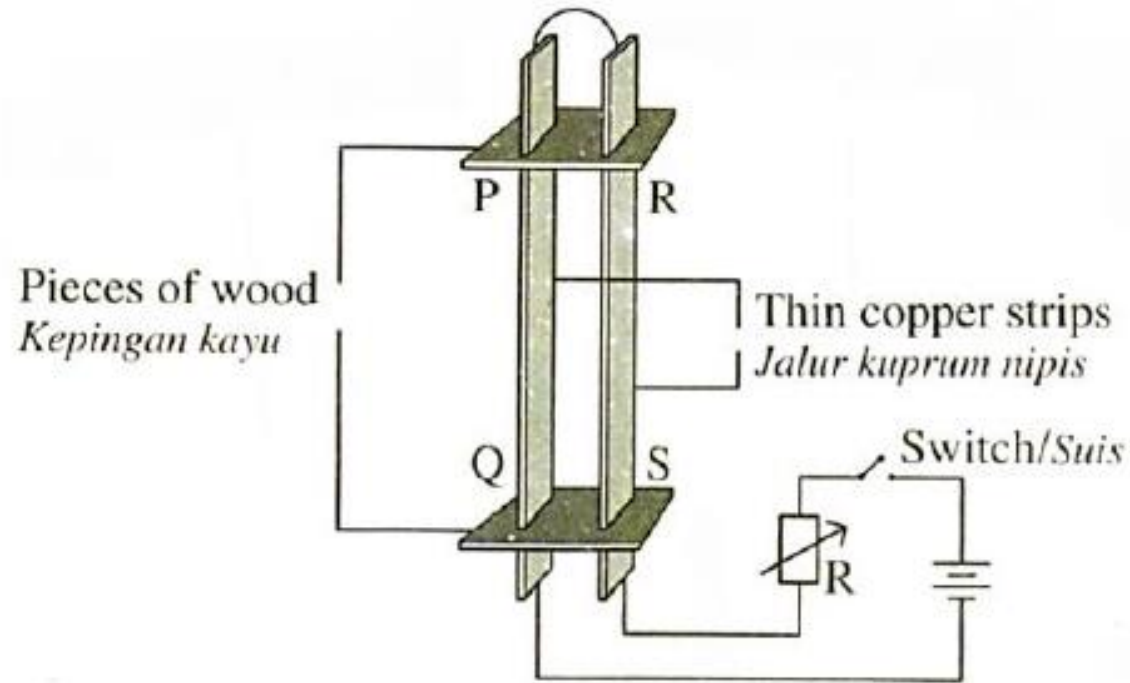


Diagram 10.3

Explain what happens to PQ and RS, when the switch is on.

Terangkan apa yang berlaku kepada PQ dan RS apabila suis dihidupkan.

[4 marks]



When the switch is on, the current flow from SR to PQ / in opposite direction / *apabila suis dihidupkan, arus mengalir dari SR ke PQ*

Produces magnetic field / *hasilkan medan magnet*

Magnetic field in the middle (between the two strips) has the same direction (downward)

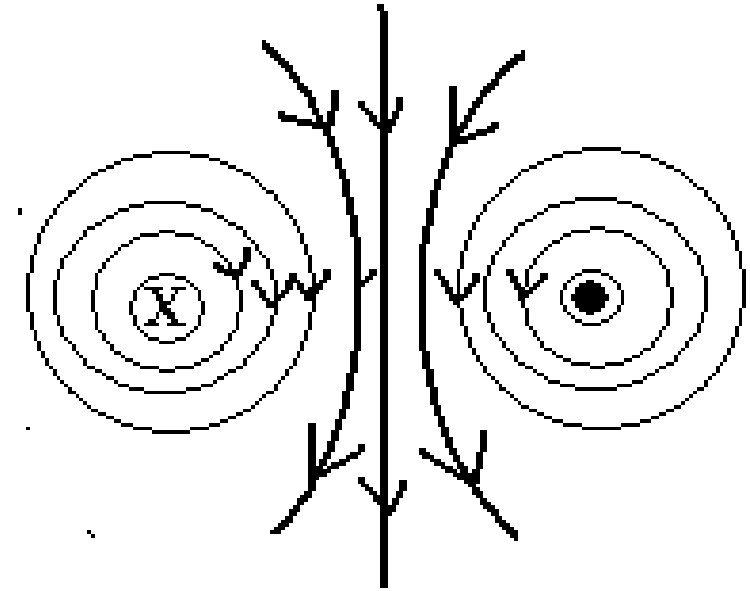
Medan magnet di tengah sama arah

Magnetic field in the middle is stronger

Medan magnet di tengah lebih kuat

The two copper strips will repel each other

Kedua-dua kepingan kuprum menolak antara satu sama lain



(e) Diagram 10.4 shows an electric motor which is supplied with 12 V a.c.

Rajah 10.4 menunjukkan sebuah motor elektrik menggunakan bekalan kuasa 12 V a.u.

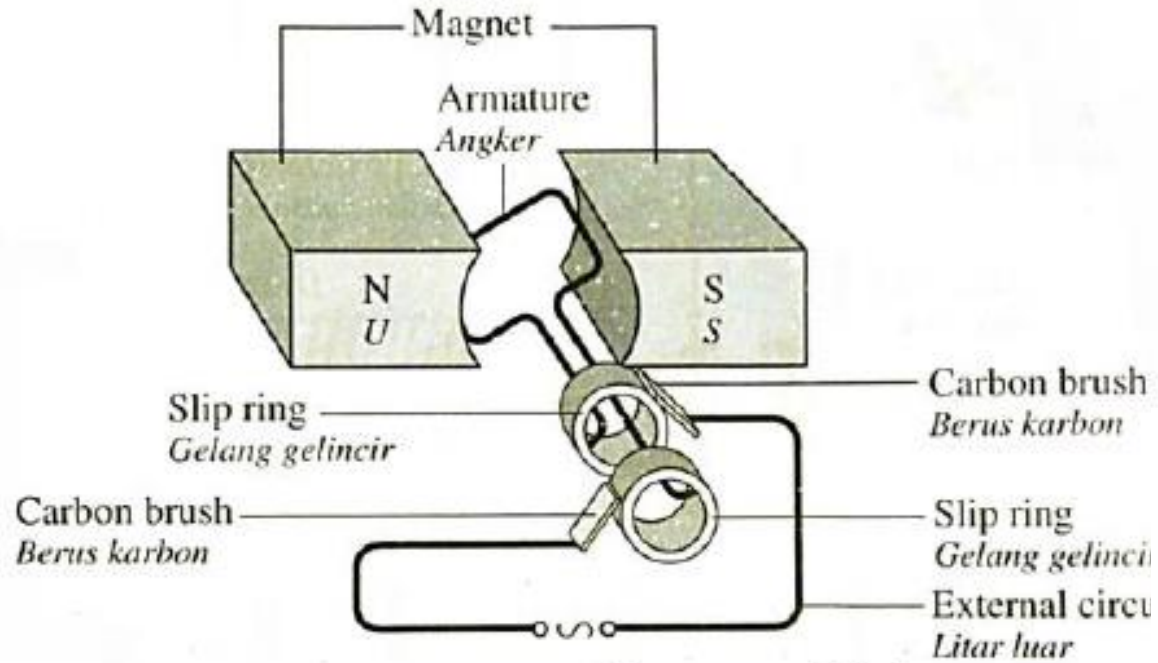
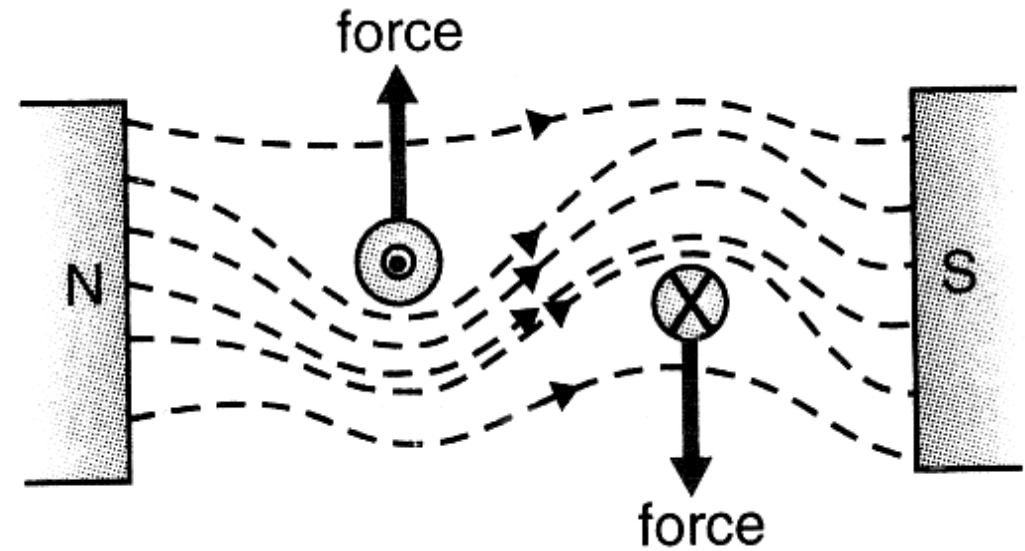
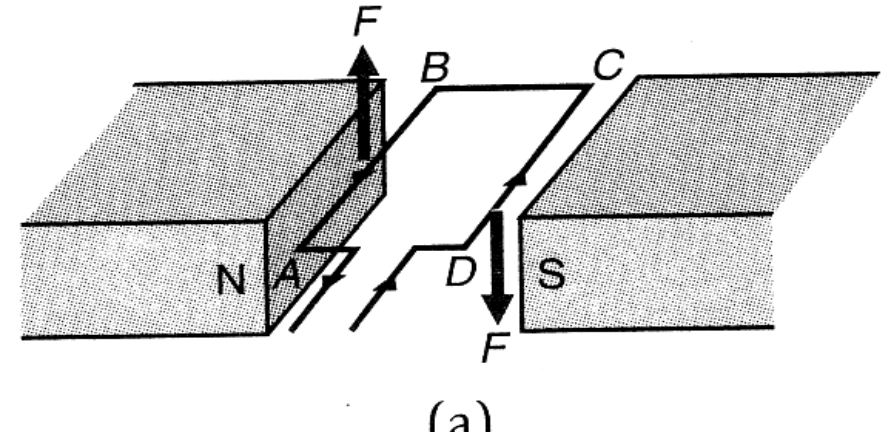


Diagram 10.4



(i) Explain how the motor is able to rotate.
Terangkan bagaimana motor tersebut boleh berputar.

[4 marks]



Current flows in the armature./ arus mengalir melalui armatur

Magnetic field produced by current carrying conductor will interact with the magnetic field from the permanent magnet.

Medan magnet dihasilkan oleh gegelung pembawa arus bergabung dengan medan magnet dari magnet kekal

Produces non-uniform magnetic field (catapult field)

Hasilkan medan magnet tidak seragam (medan lastik)

A pair of resultant forces which are equal but opposites direction are produced which will rotate the armature/turning force

Sepasang daya paduan yang sama tapi bertentangan arah dihasilkan yang putarkan armature / daya putaran



(ii) Using a 12V a.c. power supply, explain the modification that needs to be done on the motor and the external circuit to enable to be a d.c. electric motor and rotate.

Dengan menggunakan bekalan kuasa 12 V a.u, terangkan pengubahsuaian ke atas motor itu dan litar luar supaya motor itu dapat dijadikan motor elektrik a.t. dan berputar lebih laju.

[6 marks]



Modification

Reason

Replace slip rings with a commutator / **gantikan gelang gelincir dengan komutator**

Reverse the direction of current in the armature. The armature rotate in one direction only

Tukar arah arus dalam armature/ armature putar dalam satu arah sahaja

Increase the number of turn of coils/ use stronger magnet / **tambah bilangan lilitan gegelung / guna magnet kuat**

Increase force so rotate faster
Tambah daya supaya putar lebih laju

Use diode and capacitor // rectification circuit / **diod & kapasitor / litar rektifikasi**

To change a.c to d.c current
Tukar a.u ke a.t



Question 10: Section B

Diagram 10.1 and Diagram 10.2 show a bar magnet is dropped into two different coils from the same height.

Rajah 10.1 dan Rajah 10.2 menunjukkan satu magnet bar dijatuhkan ke dalam dua gegelung yang berbeza dari ketinggian yang sama.

- a) Name the physical quantity that is measured by galvanometer.
Namakan kuantiti fizik yang diukur oleh galvanometer.

[1 mark]

Current / arus elektrik

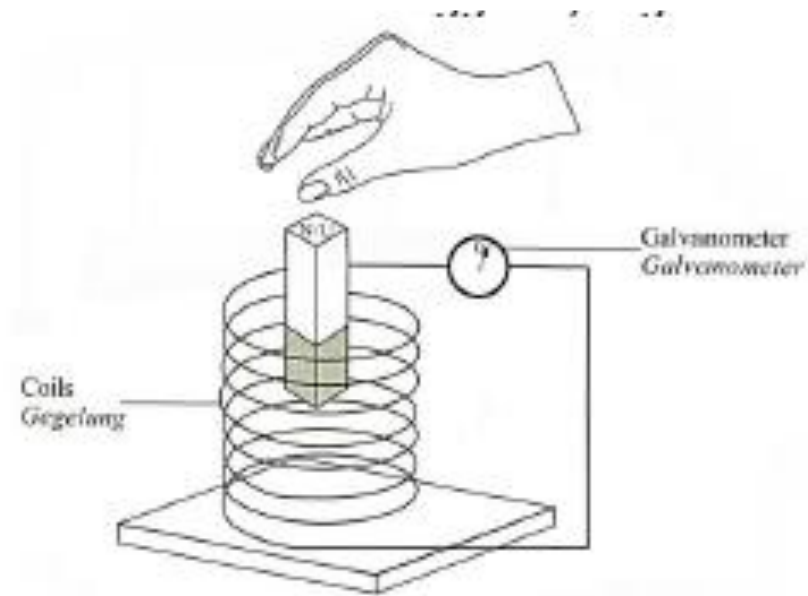


Diagram 10.1

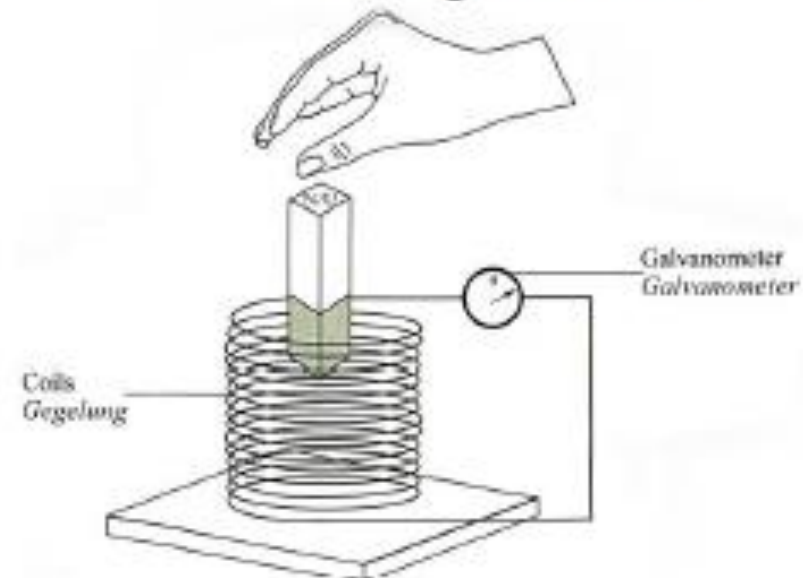


Diagram 10.2



b) Using Diagram 10.1 and Diagram 10.2,

Menggunakan Rajah 10.1 dan Rajah 10.2,

(i) compare the strength of magnetic field of the bar magnet, the number of turns of the coil, and the size of deflection of the galvanometer pointer.

bandingkan kekuatan medan magnet bagi magnet bar, bilangan lilitan gegelung dan saiz pesongan penunjuk galvanometer.

[3 marks]

- **The strength of magnetic field of the bar magnet are equal**
kekuatan medan magnet magnet bar sama
- **The number of turns of the coil: 10.2 > 10.1**
bilangan lilitan gegelung: 10.2 > 10.1
- **The deflection of galvanometer pointer: 10.2 > 10.1**
Pesongan penunjuk galvanometer: 10.2 > 10.1



- (ii) state the relationship between the number of turns of the coil with the size of deflection of the galvanometer pointer and the number of turns of the coil with the rate of change of magnetic flux to make a deduction regarding the relationship between the rate of change of magnetic flux and the magnitude of induced current.

Nyatakan hubungan antara bilangan lilitan gegelung dengan saiz pesongan penunjuk galvanometer dan bilangan lilitan gegelung dengan kadar perubahan fluks magnet untuk membuat deduksi tentang hubungan antara kadar perubahan fluks magnet dengan magnitud arus aruhan yang dihasilkan.

[3 marks]

The greater the number of turns of the coil, the greater the deflection of the galvanometer pointer. Semakin bertambah bilangan lilitan gegelung, semakin besar pesongan penunjuk galvanometer

The greater the number of turns of the coil, the greater the rate of change of magnetic flux. Semakin besar bilangan lilitan gegelung, semakin besar kadar perubahan fluks magnet

- **The rate of change of magnetic flux is directly proportional to the induced current/kadar perubahan fluks magnet berkadar terus dengan arus aruhan**



c) Diagram 10.3 shows a simple d.c. generator.

Rajah 10.3 menunjukkan satu penjana a.t. ringkas.

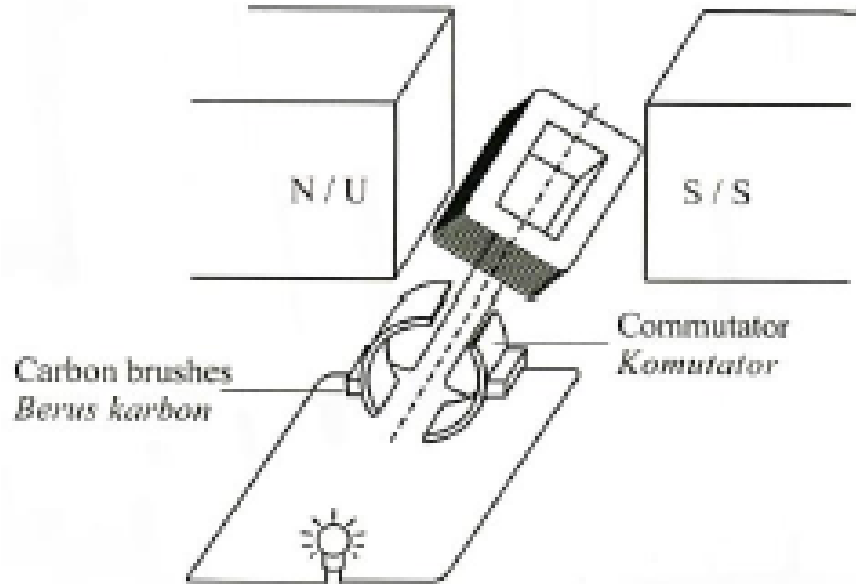


Diagram 10.3

Explain the working principle of the d.c. generator.

Terangkan prinsip kerja penjana a.t. tersebut.

[3 marks]

- **Rotate the coil**
putar gegelung
- **It will cut the magnetic flux.**
Gegelung potong fluks magnet
- **Produce induced current.**
Hasilkan arus aruhan



d) Diagram 10.4 shows a low efficiency transformer.

Rajah 10.4 menunjukkan sebuah transformer dengan kecekapan yang rendah.

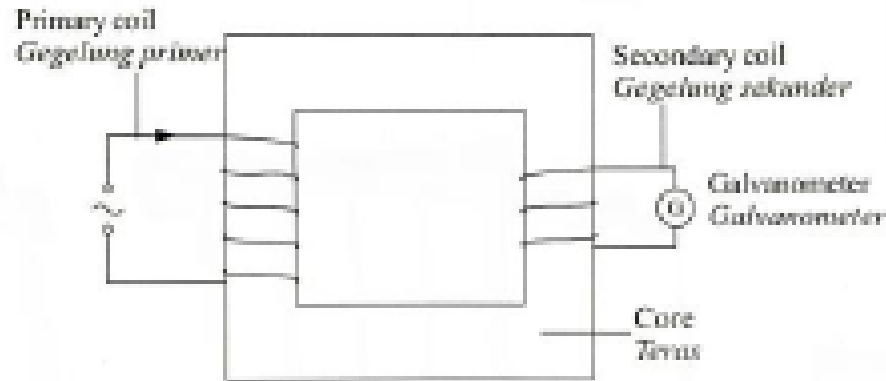


Diagram 10.4

You are required to modify the transformer in Diagram 10.4 so that the efficiency of the transformer is increased. State and explain the modifications based on the following aspects:

Anda dikehendaki untuk mengubahsuai transformer dalam Rajah 10.4 supaya kecekapan transformer itu meningkat. Nyatakan dan terangkan pengubahsuaian berdasarkan aspek-aspek berikut:

(i) the type of material used for the wire.

jenis bahan yang digunakan untuk dawai.

(ii) the diameter of wire.

Diameter dawai

(iii) the type of material of the core

jenis bahan yang digunakan untuk teras.

(iv) the characteristics of the core.

ciri-ciri teras

(v) the distance between primary coil and secondary coil.

jarak antara gegelang primer dan gegelang sekunder.

[10 marks]



- 1st :Copper wire / dawai kuprum**
- 2nd :Low resistance / rintangan rendah**
- 3rd :Thick diameter of wire / diameter dawai tebal**
- 4th :Low resistance / rintangan rendah**
- 5th :Use soft iron core / guna teras besi lembut**
- 6th :Easy to magnetized and demagnetized / mudah dimagnet dan dinyahmagnetkan**
- 7th :Use laminated core / guna teras berlamina**
- 8th :Reduce eddy current/ kurang arus pusar**
- 9th : wind secondary coil on the primary coil / lilit gegelung sekunder di atas gegelung primer**
- 10th : Reduce the leakage of magnetic flux
kurang kebocoran fluks magnet**

10. Question 10 Section B: SPM 2016

Diagram 10.1 shows a position of the magnets before being released into the identical coils. Diagram 10.2 shows the maximum deflection of the pointer of the galvanometer when the magnets enter the coils. The deflection of the pointer is due to the flow of induced current in the coil.

Rajah 10.1 menunjukkan kedudukan magnet sebelum dilepaskan ke gegelung yang serupa. Rajah 10.2 menunjukkan pesongan maksimum bagi penunjuk galvanometer bila magnet memasuki gegelung. Pesongan penunjuk galvanometer adalah disebabkan oleh pengaliran arus aruhan dalam gegelung.

(a) What is the meaning of induced current?

Apakah yang dimaksudkan dengan arus aruhan?

[1 mark]

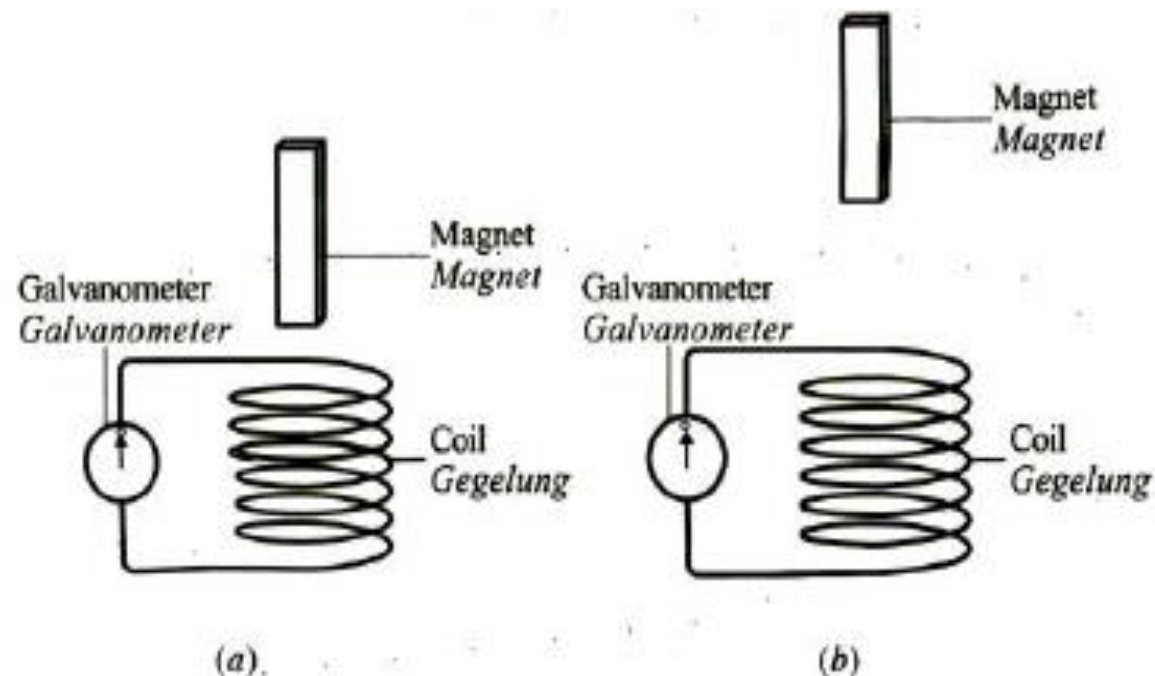


Diagram 10.1
Rajah 10.1

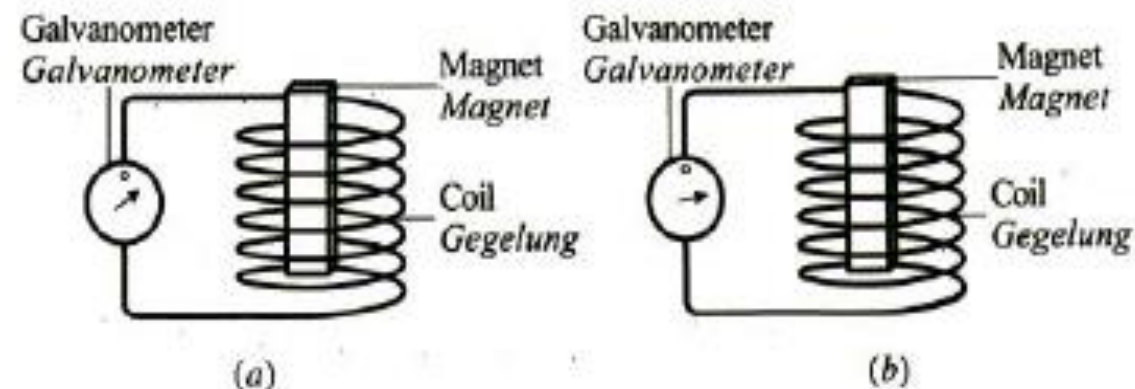


Diagram 10.2
Rajah 10.2



(b) Observe Diagram 10.1 and Diagram 10.2. Compare the height of the magnet released and the size of the deflection of the galvanometer.

Perhatikan Rajali 10.1 dan Rajah 10.2. Bandingkan tinggi magnet yang dilepaskan dan saiz pesongan jarum galvanometer.
[2 marks]

(c) State the relationship between

Nyatakan hubungan antara

(i) the height of the magnet released and the velocity of the magnet when it enters the coil.

tinggi magnet dilepaskan dengan halaju magnet bila memasuki gegelung.

(ii) the height of the magnet released and the size of the deflection of the galvanometer.

tinggi magnet dilepaskan dengan saiz pesongan jarum galvanometer.

(iii) the velocity of the magnet and the magnitude of induced current when it enters the coil.

halaju magnet dengan magnitud arus aruhan bila ia memasuki gegelung.

[3 markah]

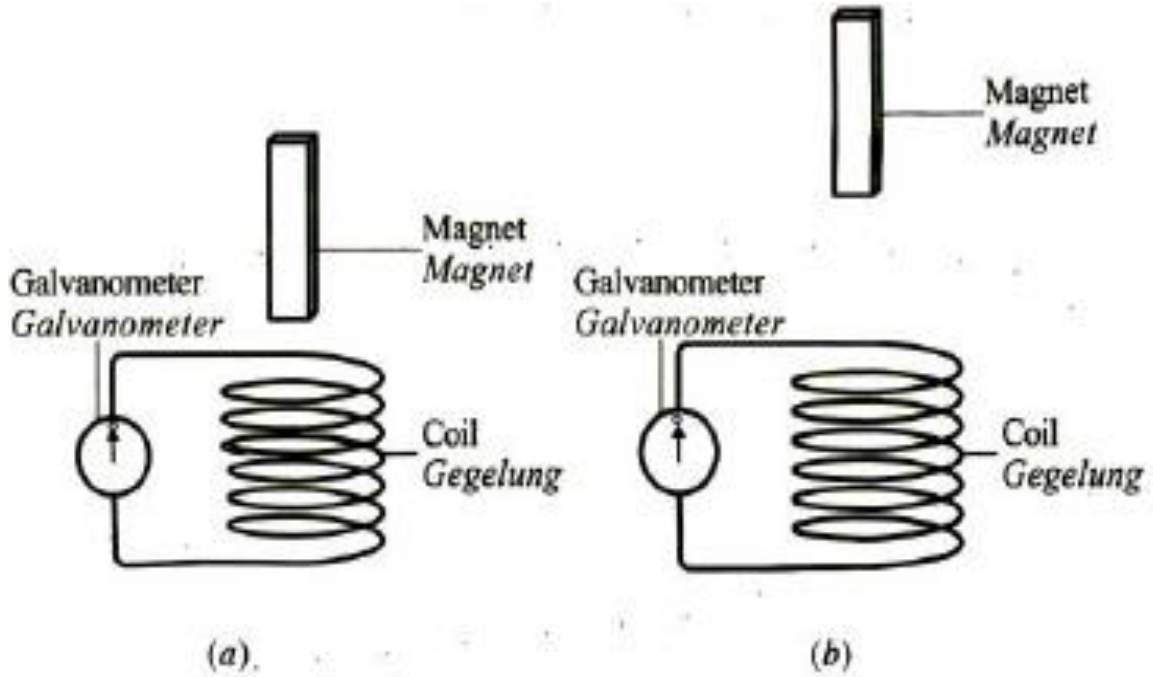


Diagram 10.1
Rajah 10.1

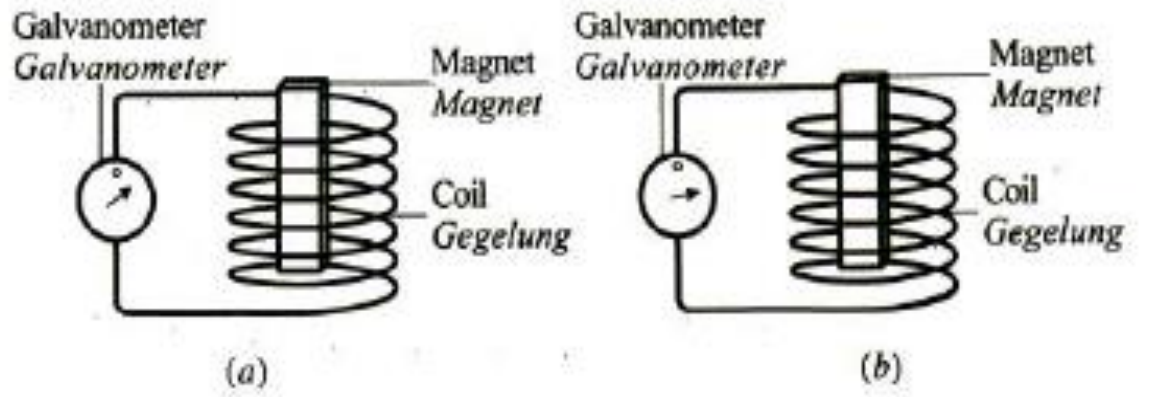


Diagram 10.2
Rajah 10.2



- **Height of magnet 10.1(b) is higher / ketinggian magnet 10.1(b) lebih tinggi**
- **Deflection of the galvanometer 10.2(b) is greater / pesongan jarum galvanometer 10.2(b) lebih besar**
- **The higher the magnet the greater the velocity / semakin tinggi magnet semakin laju magnet**
- **The higher the magnet the greater the deflection of the galvanometer/ semakin tinggi magnet semakin besar pesongan jarum galvanometer**
- **The faster the magnet, the greater the induced current/ semakin laju magnet, semakin besar arus aruhan**

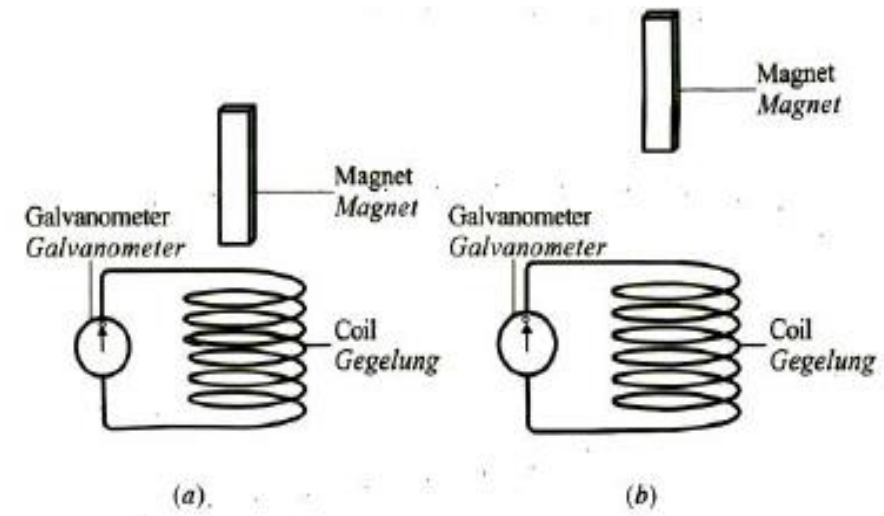


Diagram 10.1
Rajah 10.1

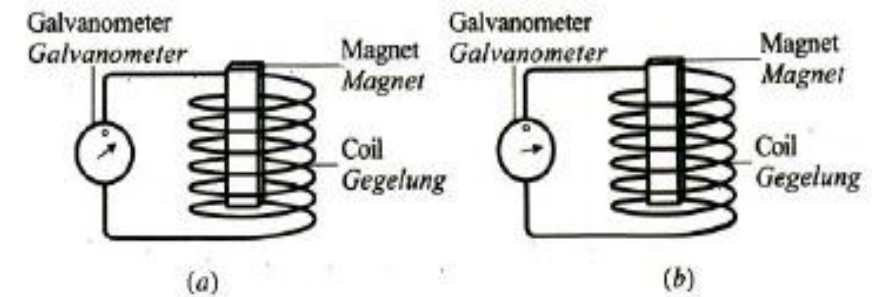
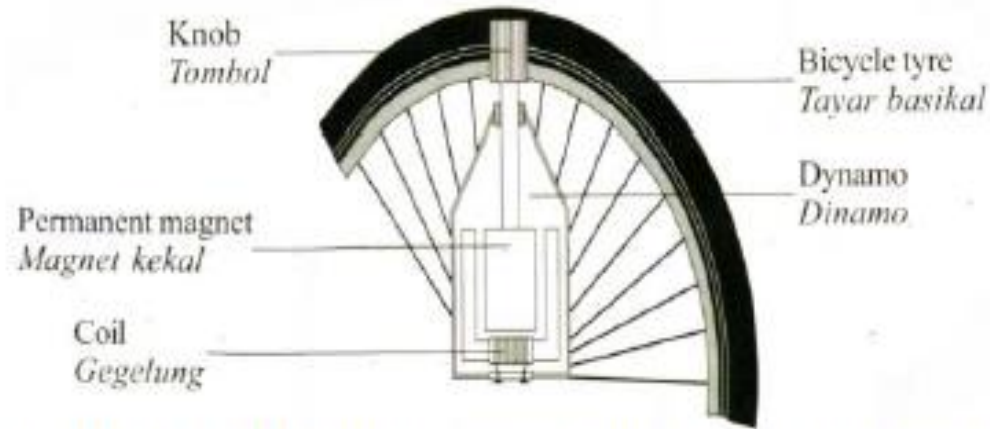


Diagram 10.2
Rajah 10.2



(d) Diagram 10.3 shows the structure of a bicycle dynamo.

Rajah 10.3 menunjukkan struktur sebuah dinamo basikal.



Explain how the dynamo works to produce current to light up the headlamp of the bicycle.

Terangkan bagaimana dinamo bekerja bcigi menghasilkan arus untuk menyalakan lampu depan basikal.

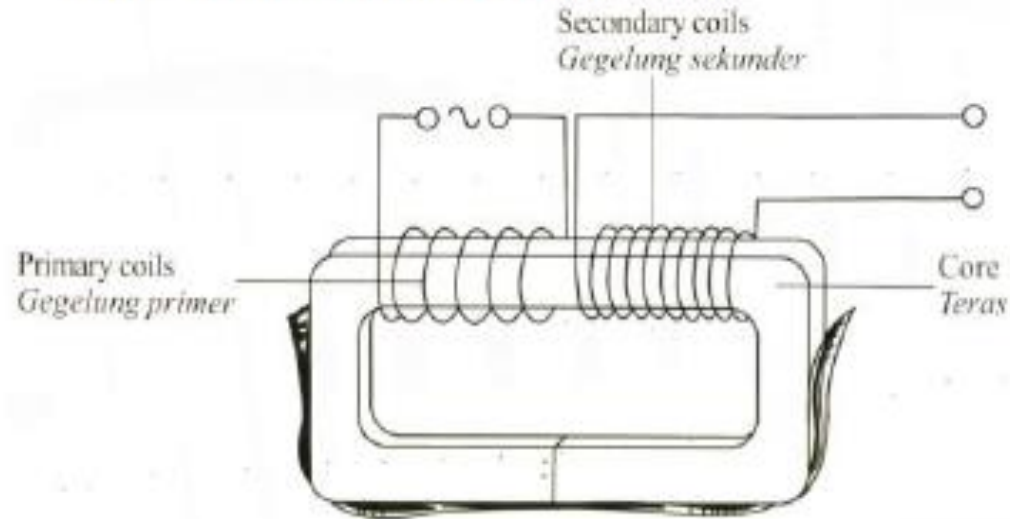
[4 marks]

- **The wheels turn the knob**
roda memutarakan tombol
- **The magnet rotates in the soft iron**
core magnet berputar di dalam
teras besi lembut
- **The magnetic field is cut**
medan magnet /fluks magnet
dipotong
- **Induced current is produced**
arus aruhan dihasilkan



(e) Diagram 10.4 shows a model of a step-up transformer. The transformer is not efficient.

Rajah 10.4 menunjukkan sebuah model transformer injak naik. Transformer itu tidak cekap.



You are required to modify the step-up transformer in Diagram 10.4 to a step-down transformer. Explain modifications that need to be done to change it into a more efficient transformer. In your explanation, emphasize the aspects of:

Anda dikehendaki untuk mengubahsuai transformer injak naik seperti dalam Rajah 10.4 kepada transformer injak turun. Terangkan pengubahsuaian yang perlu dilakukan untuk mengubahnya menjadi transformer yang lebih cekap. Dalam penerangan anda, berikan penekanan kepada aspek-aspek berikut:

- (i) **Number of turns of primary coil and secondary coil.**
Bilangan lilitan gegelung primer dan gegelung sekunder.
- (ii) **Type of wire of coil used.**
Jenis dawai gegelung yang digunakan.
- (iii) **Material and structure of core used.**
Bahan dan struktur teras yang digunakan.
- (iv) **Way of winding primary and secondary coils.**
Cara lilitan gegelung primer dan gegelung sekunder.

[10 marks]



Characteristics	reason
Number of turns of primary coil > secondary coil// bilangan lilitan gegelung primer > $N_p > N_s$	Decrease output voltage// mengurangkan voltan output
Thick wire/ good conductor/ low resistance// dawai tebal/ rintangan rendah/konduktor yang	Reduce/low resistance/ reduce energy lost to heat// rintangan rendah/ reduce heat loss
Use soft iron core// teras besi lembut	Easy to magnetized & demagnetized// senang dimagnet & dinyahmagnetkan
Laminated core / teras berlamina / teras berlapis	Reduce Eddy current mengurangkan arus pular
Wind secondary coil ontop on primary coil/ secondary coil overlap on primary coil// lilit gegelung sekunder ke atas gegelung primer	Reduce leakage of flux magnet// kurang kebocoran fluks magnet



Question 10, Section B

Diagram 10.1 and Diagram 10.2 show a wire and coil that are connected to a zero centred galvanometer. Both wire and coil are moved downwards between two magnet magnets with opposite polarity.

Rajah 10.1 dan Rajah 10.2 menunjukkan seutas dawai dan gegelung yang disambungkan kepada sebuah galvanometer berpusat sifar. Kedua-dua dawai dan gegelung itu digerakkan ke bawah di antara dua magnet magnadur yang bertentangan kutub.

(a) What is the meaning of induced current?

Apakah yang dimaksudkan dengan arus aruhan?

[1 mark]

- **A current due to the change in the magnetic field / Penghasilan arus dalam suatu konduktor apabila berlaku perubahan fluks magnet**

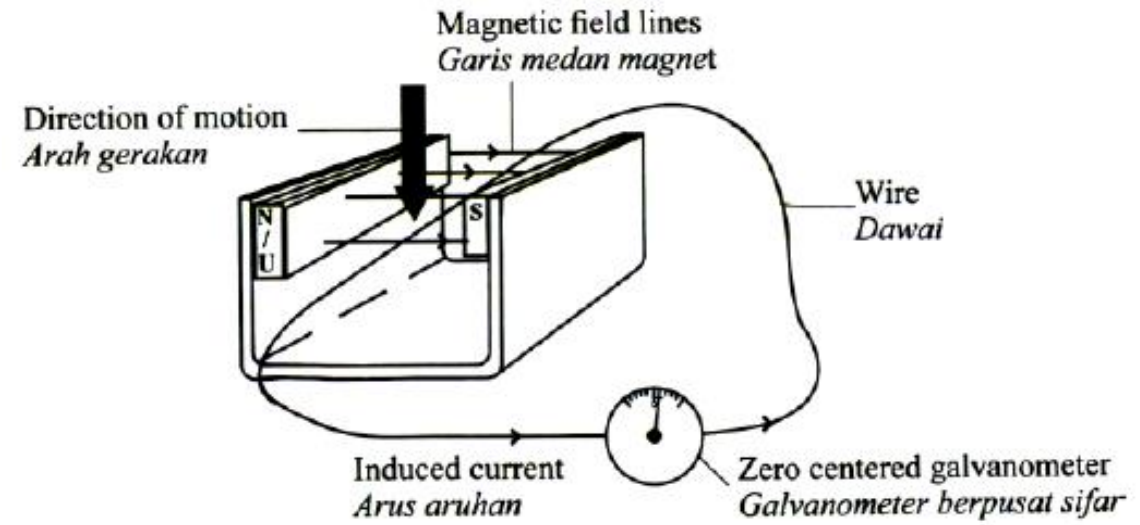


Diagram 10.1 / Rajah 10.1

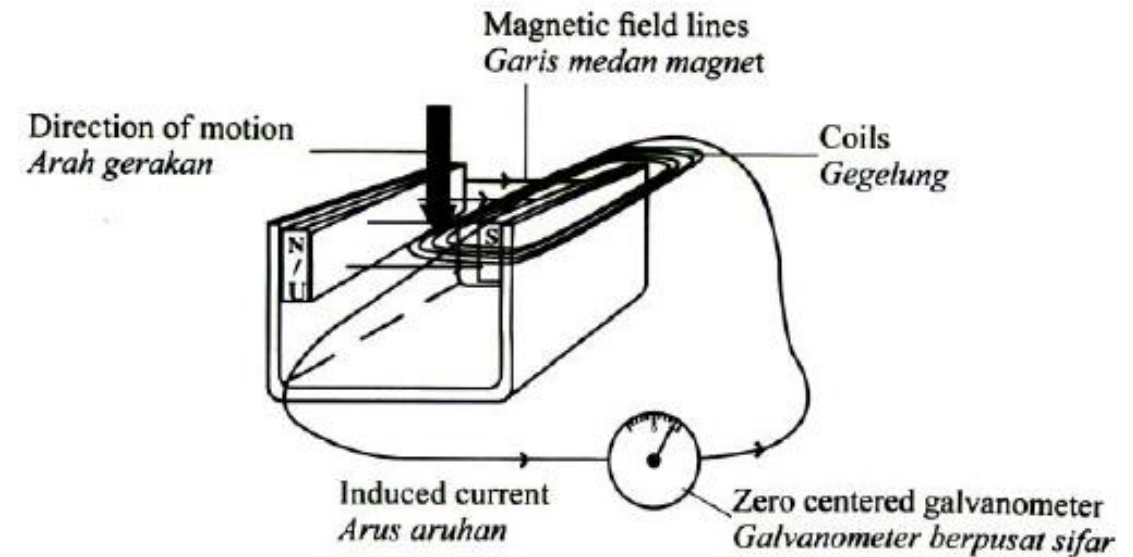


Diagram 10.2 / Rajah 10.2



(b) Based on Diagram 10.1 and Diagram 10.2,

Berdasarkan Rajah 10.1 dan Rajah 10.2,

(i) Compare and contrast the direction of motion, the number of turns of wire and coil, and the magnitude of deflection of the galvanometer pointer.

Banding dan bezakan arah gerakan, bilangan lilitan wayar dan gegelung serta magnitude pesongan penunjuk galvanometer.

- **same direction / / sama arah / both downward / kedua-dua ke bawah**
- **Number of turns 10.2 > 10.1**
bilangan lilitan 10.2 > 10.1
- **Deflection of galvanometer: 10.2 > 10.1**
pesongan penunjuk galvanometer: 10.2 > 10.1

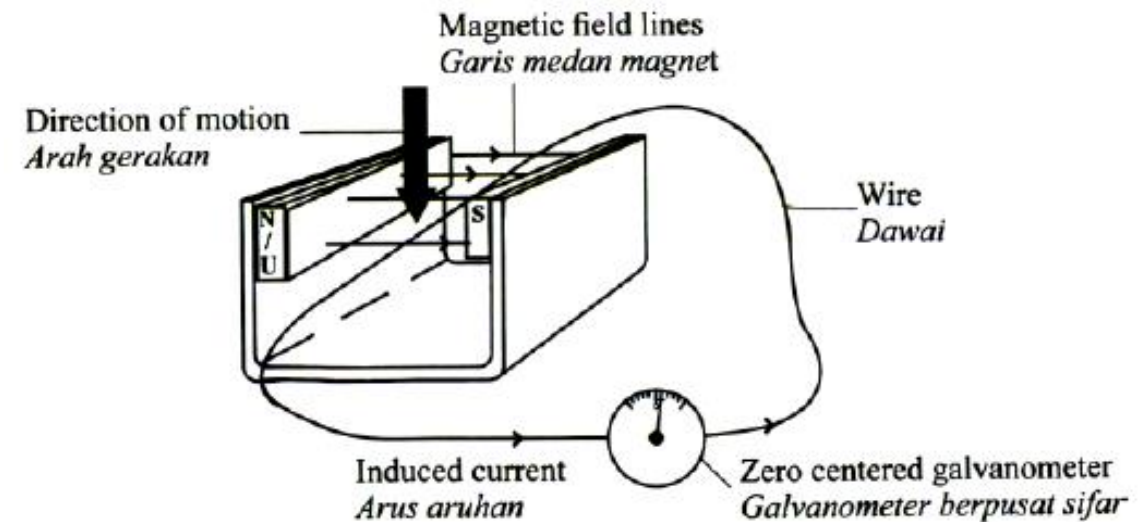


Diagram 10.1 / Rajah 10.1

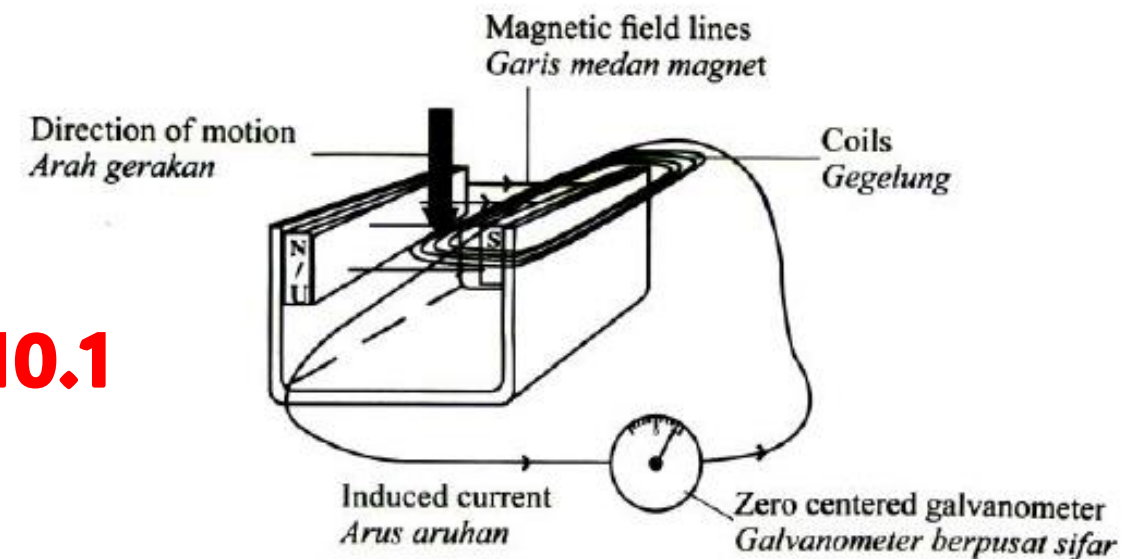


Diagram 10.2 / Rajah 10.2



(ii) Relate the magnitude of deflection of the galvanometer pointer with the number of turns to make a deduction regarding the relationship between the current induced and the number of turns of wire.

Name the physics concept involved.

Hubungkan magnitude pesongan penunjuk galvanometer dengan bilangan lilitan untuk membuat satu kesimpulan berkaitan hubungan antara arus yang diaruhkan dengan bilangan lilitan dawai. Namakan konsep fizik yang terlibat.

[6 marks]

- **Deflection of the pointer is directly proportional with the number of turns // pesongan penunjuk galvanometer berkadar terus dengan bilangan lilitan**
- **Induced current is directly proportional to the number of turns of wire // arus aruhan berkadar terus dengan bilangan lilitan dawai**
- **Faraday's law / Hukum Faraday**

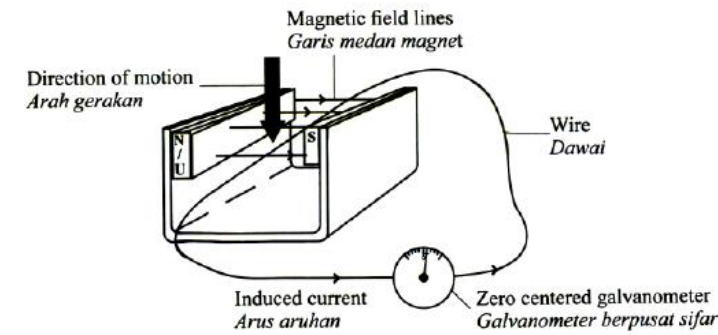


Diagram 10.1 / Rajah 10.1

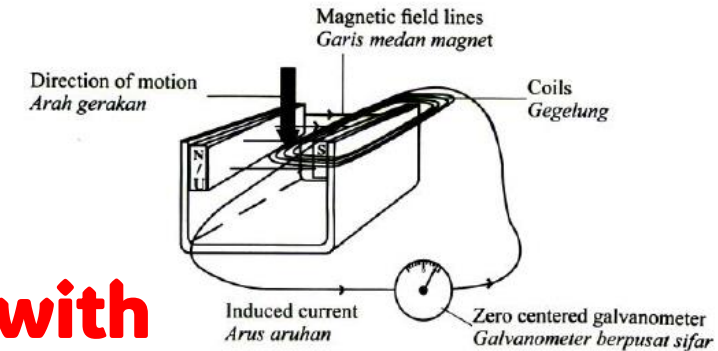
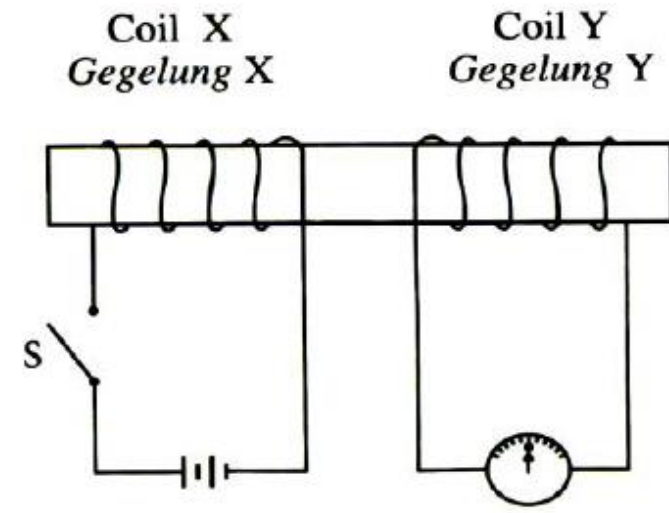


Diagram 10.2 / Rajah 10.2



- (c) Diagram 10.3 shows coil X and Y wound round a soft iron core. When switch S is turned on, the galvanometer pointer deflects to the right momentarily and returns to zero. Explain why the pointer deflects momentarily and returns to zero. *Rajah 10.3 menunjukkan gegelung X dan gegelung Y dililit pada satu teras besi lembut. Apabila suis S dihidupkan, penunjuk galvanometer terpesong ke arah kanan seketika dan kembali ke sifar. Terangkan sebab penunjuk terpesong seketika dan kembali ke sifar.*

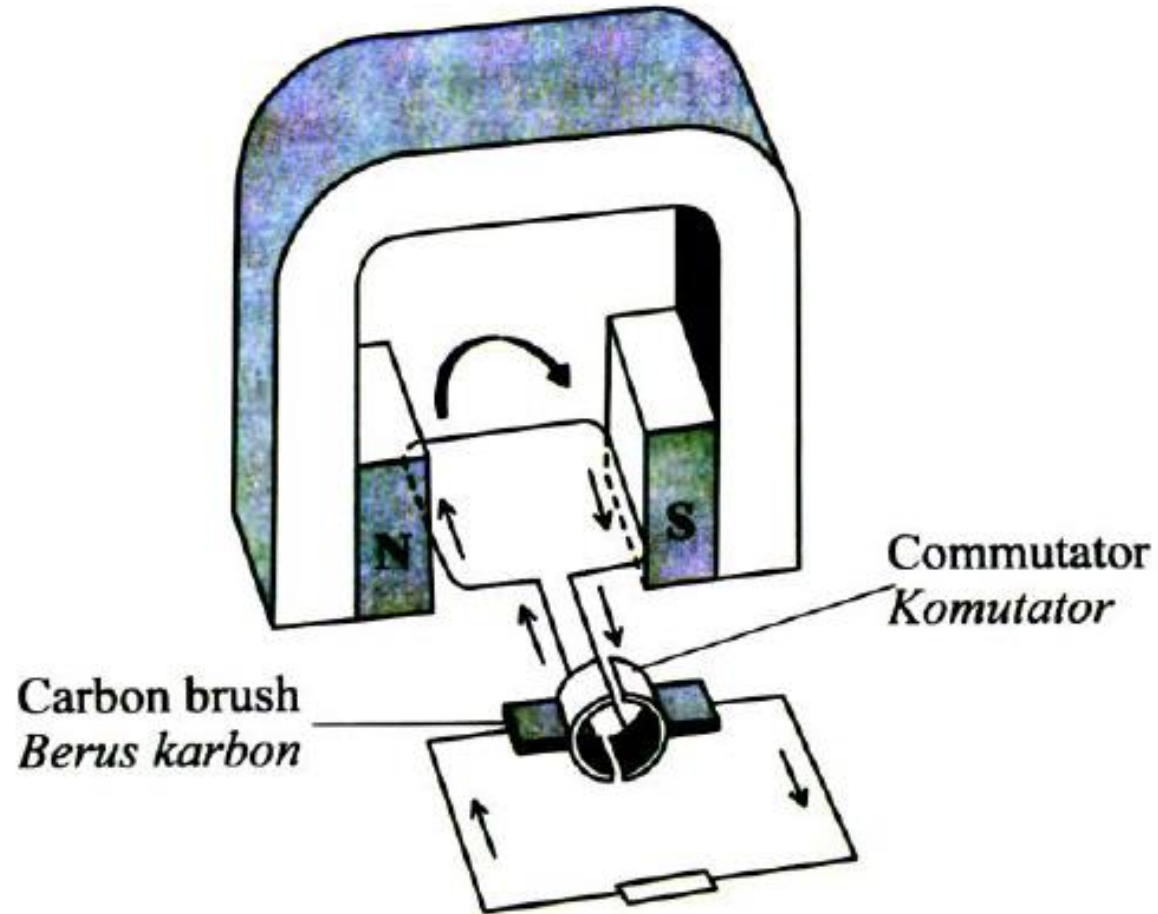


[3 marks]

- **current flow produces electromagnet / pengaliran arus menghasilkan elektromagnet**
- **Changes of magnetic flux / cut magnetic flux**
Mengubah fluks magnet / potong fluks magnet
- **Changes of magnetic flux / cut magnetic flux**
Mengubah fluks magnet / potong fluks magnet



- (d) Diagram 10.4 shows the structure of a direct current generator.
Rajah 10.4 menunjukkan struktur sebuah penjana arus terus.



The generator produces a small direct current. Suggest modifications that can be made to the structure of the generator in Diagram 10.4, so that it can produce a high alternating current (a.c). State and explain the modifications based on the characteristics of the magnet and wire, and the type of ring.

Penjana itu menghasilkan arus terus yang kecil. Cadangkan pengubahsuaian yang boleh dibuat kepada struktur penjana pada Rajah 10.4, supaya boleh menghasilkan arus ulangalaih (a.u) yang tinggi. Nyatakan dan terangkan pengubahsuaian itu berdasarkan ciri magnet dan dawai serta jenis gelang.

[10 marks]



M1: more magnet / strong magnet / powerful magnet // magnet kuat / Kuasa magnet lebih / tambah magnet

M2: more flux / magnetic field // lebih fluks / medan magnet lebih / strong Magnetic field / flux / flux kuat / medan magnet kuat

M3: curve magnet / magnet lengkung / concave magnet / magnet cekung.

M4: Radial magnetic field / concentrate magnetic field / flux / rate of cutting the flux is uniform // medan magnet jejarian / menumpu medan magnet / fluks / kadar pemotongan fluks / medan magnet seragam.

M5: Thick wire / big diameter wire / wayar tebal / diameter wayar besar

M6: Low resistance / rintangan rendah



M6: Low resistance / rintangan rendah

M7: more turns wire // lilitan wayar banyak

M8: cut more flux // pemotongan fluks / medan magnet lebih

**M9: copper wire / wayar kuprum / wayar aluminium /
low resistivity of wire / kerintangan wayar rendah**

M10: low resistance / rintangan rendah

M11: slip ring // gelang gelincir / cincin gelincir

M12: arah arus berubah // direction of current change.

