BAB 3

Elektrik
Electricity

3.1 Arus dan Beza Keupayaan
Current and Potential Difference

1. kawasan, cas, elektrik
region, charge, electric

2. (a) ✓
(b) ✓
(c) ✓

3.

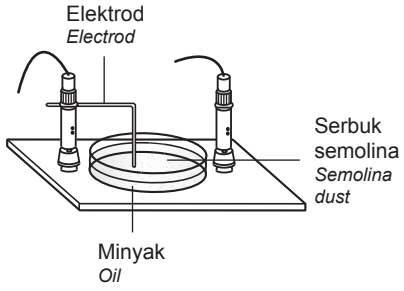
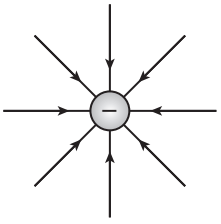
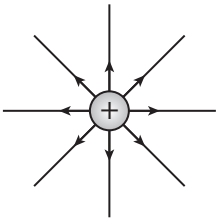
Pernyataan *Statement*	**Benar / Palsu** *True / False*
(a) Garis medan elektrik bermula dari cas positif dan berakhir di cas negatif. *Electric fileld lines start on positive charges and end on negative charges.*	Benar *True*
(b) Dalam suatu medan, elektrik cas-cas yang sama saling menolak manakala cas-cas yang berlainan saling menarik. *In an electric field,like charges repel each other while unlike charges attract each other.*	Benar *True*
(c) Garis medan elektrik bersilang dan memintas antara satu sama lain. *The electric field lines cross over or intercept each other.*	Palsu *False*
(d) Garis medan elektrik di sekeliling suatu zarah cas positif sentiasa menghala ke dalam manakala medan elektrik di sekeliling suatu cas negatif menghala ke luar. *The electric field lines around a positive charge always point inward while the electric field lines around a negative charge always point outward.*	Palsu *False*

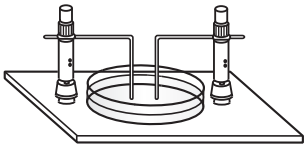
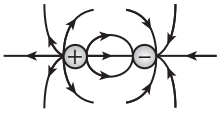
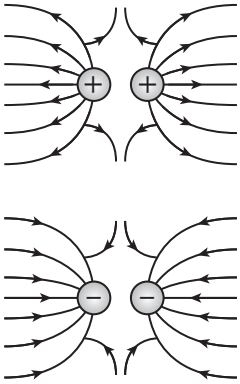
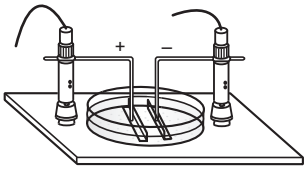
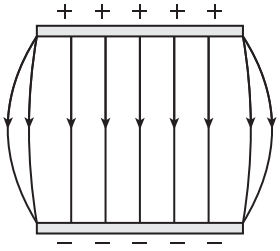
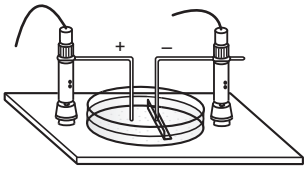
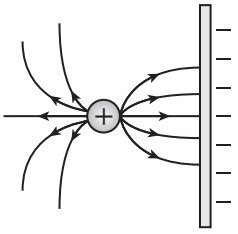
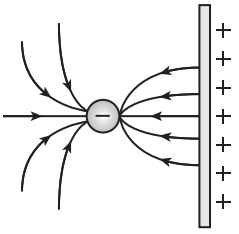
4.

Ruang A *Column A*	**Ruang B** *Column B*
(a) Medan elektrik adalah *Electric field is*	daya yang bertindak ke atas seunit cas positif yang terletak pada suatu titik di dalam medan elektrik. *the force acting on a unit of positive charge located at a point in the electric field.*
(b) Arus, *I* ialah *Current, I is*	kadar pengaliran cas, *Q* dalam satu konduktor. *the rate of flow of charge, Q in a conductor.*
(c) Kekuatan medan elektrik ialah *The strength of an electric field is*	$E = \frac{V}{d}$
(d) Formula medan elektrik ialah *The formula of electric field is*	kerja sebanyak 1 J dilakukan untuk menggerakkan 1 C cas dari satu titik ke titik yang lain. *if the work done to move 1 C of charge from one point to another is 1 J.*
(e) Beza keupayaan, *V* ialah *The potential difference, V is*	kawasan yang mana suatu cas mengalami daya elektrik. *a region in which an electric charge experiences electric force.*

5. (b) ditaburkan / *sprinkled*
(c) corak / *pattern*

6.

Susunan elektrod *Electrode arrangement*	**Garis medan bagi cas positif dan negatif** *Field lines for positive and negative charges*	
Elektrod tunggal *Single electrode* 		

Dua elektrod *Two electrodes* 		
Sepasang plat yang selari *A pair of parallel plate* 		
Satu elektord dan satu plat *An electrode and a plate* 		

7. (a) sama / *same*
(b) daya, unit / *force, unit*
(c) daya, cas, N C^{-1} / N C^{-1}
(d) *V* m^{-1} / *V* m^{-1}

8. Arahan / *Instruction*

3. (a) (i) positif, negatif
positive, negative
(ii) positif, tolakan
positively, repulsive
(iii) negatif
negative
(iv) negatif, positif
negative, positive
(v) berterusan, dimatikan
continued, turned off

(b) (i) ditambah
increased
(ii) dikurangkan
reduced

(c) (i) terion
ionize
(ii) positif, negatif
Positive, negative
(iii) positif, negatif, negatif, positif
positive, negative, negative, positive
(iv) terpisah, negatif
split, negative
(v) positif, berat, negatif
positive, heavier, negative

9. (a) kadar, cas / *rate, charge*
(b) *It*, jumlah cas elektrik, masa
It, total electric charges, time
(c) ampere (A), 1 coulomb cas per saat
ampere (A), 1 coulomb of charge per second

$1\ C\ s^{-1}$

10. (a) $Q = It$
$= 0.2\ A \times 1 \times 60\ s$
$= 12\ C$
(b) $I = \frac{Q}{t} = \frac{30\,000}{50 \times 60} = 10\ C\ s^{-1}$ / A
(c) $Q = ne$
$1 = n \times 1.6 \times 10^{-19}$
$n = 6.25 \times 10^{18}$
(d) $Q = It = 20 \times 10^{-3} \times 2 \times 60$
$= 2.4\ C$
$n = \frac{Q}{e} = \frac{2.4}{1.6 \times 10^{-19}} = 1.5 \times 10^{19}$

11. (a) kerja, coulomb cas / *work, coulomb of charge*
Volt (V) atau $J\ C^{-1}$ / *Volt (V) or $J\ C^{-1}$*
(b) Beza keupayaan, 1 Volt, 1 coulomb, 1 joule
potential difference, 1 Volt, 1 coulomb, 1 joule

12. (a) $V = \frac{W}{Q} = \frac{1.5 \times 10^{12}}{50} = 3.0 \times 10^{10}\ V$

(b) Cas mengalir melalui lampu dalam 10 s
Charge that flows through the lamp in 10 s
$Q = It = 2 \times 10 = 20\ C$
Tenaga elektrik berubah kepada haba,
Electrical energy changed to heat,
$W = VQ = 240 \times 20$
$= 4800\ J$
(c) Cas mengalir melalui lampu dalam 1 minit = 60 s
Charge that flows through the lamp in 1 minute = 60 s
$Q = It = 0.2 \times 60\ s = 12\ C$
$V = \frac{W}{Q} = \frac{24}{12} = 2V$
(d) $V = \frac{W}{Q} = \frac{240}{20} = 12\ V$

3.2 Rintangan
Resistance

1. konduktor / *conductor*
(b) beza keupayaan, arus
potential difference, current
(c) Ohm (Ω) / *Ohms (Ω)*
(d) 1 V, 1 A / *1 V, 1 A*

2.

Ruang A *Column A*	**Ruang B** *Column B*
(a) Konduktor Ohm ialah *The Ohmic conductor is*	konduktor yang tidak mematuhi hukum Ohm. *conductors that do not obey Ohm's law.*
(b) Konduktor bukan Ohm ialah *The non-ohmic conductor is*	konduktor yang mematuhi hukum Ohm. *conductors that obey Ohm's law.*

3. Tujuan / *Aim*:
voltan, dawai konstantan
voltage, constantan wire
(ii) voltan, mentol berfilamen
voltage, filament bulbs

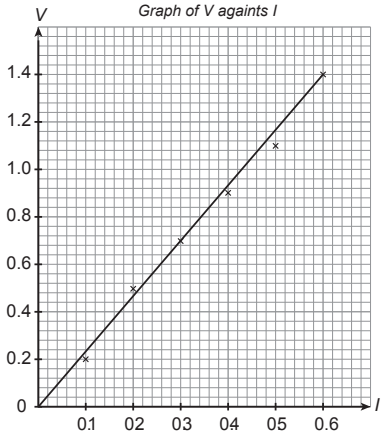
Pemboleh ubah / *Variables*:
Arus, *I* / *Current, I*
Voltan, *V* / *Voltage, V*
Panjang dan ketebalan dawai konstantan
Constantan wire length and thickness

(i) **Mengkaji hubungan *V* dengan *I* bagi dawai konstantan**
To study the relationship between V and I for a constantan wire

Keputusan / *Results*:

Arus, *I* / A *Current I/ A*	0	0.1	0.2	0.3	0.4	0.5	0.6
Beza kepayaan, *V* / V *Potential difference ,V/V*	0	0.2	0.5	0.7	0.9	1.1	1.4

Graf *V* melawan *I*
Graph of V againts I



Perbincangan / *Discussion*:

1. Semakin tinggi arus, semakin tinggi beza keupayaan merentasi konduktor.
The higher the current, the higher potential difference across the conductor.

2. Bertambah / *Increases*

3. (a) mata, berserenjang / *eye, perpendicular*
(b) dimatikan, suhu / *turned off, temperature*

Kesimpulan / *Conclusion*:

bertambah, bertambah, dimalarkan
increases, increases, constant

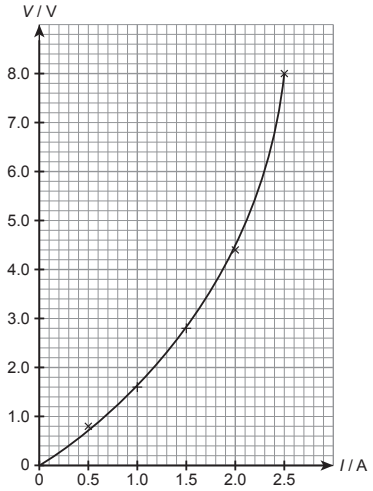
(ii) **Mengkaji hubungan *V* dengan *I* bagi mentol berfilamen**
To study the relationship between V and I for filament bulbs

Pemboleh ubah / *Variables*:

Arus, *I* / *Current, I*
Voltan, *V* / *Voltage, V*
Panjang filamen / *Length of filament*

Keputusan / *Results*:

Arus, *I* / A *Current, I/ A*	0	0.5	1.0	1.5	2.0	2.5
Beza kepayaan, *V* / V *Potential difference ,V/V*	0	0.8	1.6	2.8	4.4	8.0



Perbincangan / *Discussion*:

1. meningkat, meningkat, meningkat
increases, increases, increases

2. tidak mematuhi / *does not obey*

3. meningkat, meningkat
increases, increases

4.

Jenis litar: Litar bersiri ***Type of circuit:*** *Series circuit*	**Jenis litar:** Litar selari ***Type of circuit:*** *Paralel circuit*
(a) Arus yang melalui setiap mentol dan perintang adalah sama. *The current flows through each bulb and resistor is the same.* $I = I_1 = I_2$	(d) Jumlah arus dalam litar bersamaan dengan jumlah arus yang melalui perintang dan mentol pada setiap cabang. *The amount of current in the circuit is equal to the amount of current passing through the resistor and bulb on each branch.* $I = I_1 + I_2$

(b) Beza keupayaan yang merentasi sel kering adalah sama dengan jumlah beza keupayaan yang merentasi semua mentol dan perintang. *The potential difference across the dry cell is equal to the sum of the potential differences across all the bulbs and resistors.* $V = V_1 + V_2$	(e) Beza keupayaan yang merentasi sel kering adalah sama dengan beza keupayaan yang merentasi setiap perintang dan mentol *The potential difference across the dry cell is equal to the potential difference across each resistor and bulb* $V =$
(c) Rintangan berkesan *Effective resistance* $R = R_1 + R_2$	(f) Rintangan berkesan *Effective resistance* $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

5. (a) Rintangan berkesan dalam litar selari.
Effective resistance in a parallel circuit.

$$\frac{1}{R} = \frac{1}{12} + \frac{1}{6}$$
$$= \frac{1}{12} + \frac{2}{12} = \frac{3}{12}$$
$$R = \frac{12}{3} = 4\ \Omega$$

Rintangan berkesan dalam seluruh litar = 8 Ω + 4 Ω = 12 Ω
Effective resistance throughout the circuit

(b) Arus dalam litar $I = \frac{V}{R} = \frac{12}{12} = 1$ A, maka $A_1 = 1$ A

$$A_2 = \frac{6}{6+12} \times 1 = 0.33 \text{ A}$$

Maka bacaan A_2 adalah 0.33 A.

(c) $V = IR = 1 \times 8 = 8$ V

6. Arus yang melalui perintang 4 Ω ialah

$$I = \frac{V}{R} = \frac{12}{4} = 3 \text{ A}$$

Current that flows the resistor 4 Ω is

Maka, arus yang mengalir melalui perintang R = 4.2 A – 3 A = 1.2 A
Hence, the curent that flows in resistor R

7. (a) panjang, luas
length, area

(b) menentang
resists

8. (i) **Panjang dawai / *Length of wire***

Hipotesis / *Hypothesis*:
bertambah / *increases*

Pemboleh ubah / *Variables*:

(a) Panjang dawai, *l*
Length of wire, l

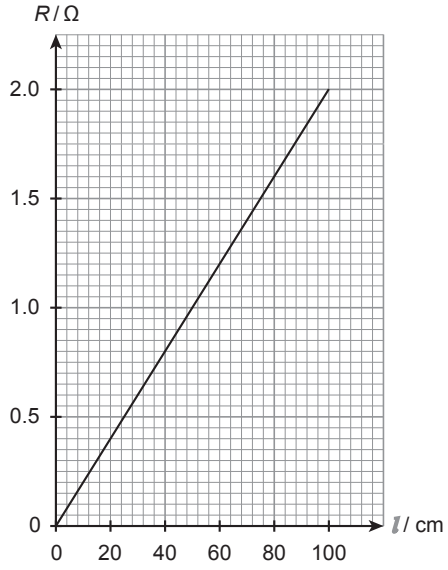
(b) Rintangan, $R = \frac{V}{I}$

Distance, R $\frac{V}{I}$

(c) luas keratan rentas, suhu
cross-sectional area, temperature

Jadual / *Table*

***l*/cm**	***I*/A**	***V*/V**	$R = \frac{V}{I}$
20	0.5	0.2	0.4
40	0.5	0.4	0.8
60	0.5	0.6	1.2
80	0.5	0.8	1.6
100	0.5	1.0	2.0



(ii) **Luas keratan rentas, *A***
Cross-sectional, A

Pemboleh ubah / *Variables*:

(a) Luas keratan rentas dawai, s.w.g.
The cross-sectional area of the wire, s.w.g.

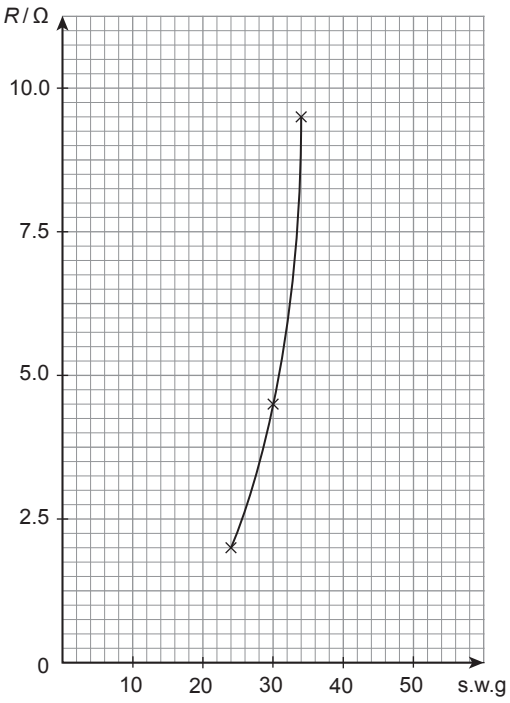
(b) Rintangan, *R*
Resistance,R

(c) panjang dan suhu dawai
Length and temperature of wire

Keputusan / *Results*:

Luas keratan rentas dawai konstantan / s.w.g ***Constantan wire cross-sectional area / s.w.g***	***I* / A**	***V* / V**	$R = \frac{V}{I}$
20	0.5	1.0	2.0
28	0.5	2.2	4.4
32	0.5	4.2	8.4

Graf *R* melawan s.w.g
Graph of R againts s.w.g



(iii) **Kerintangan dawai**
Resistivity of the wire

Hipotesis / *Hypothesis*:

besar, besar
greater, greater

Pemboleh ubah / *Variables*:

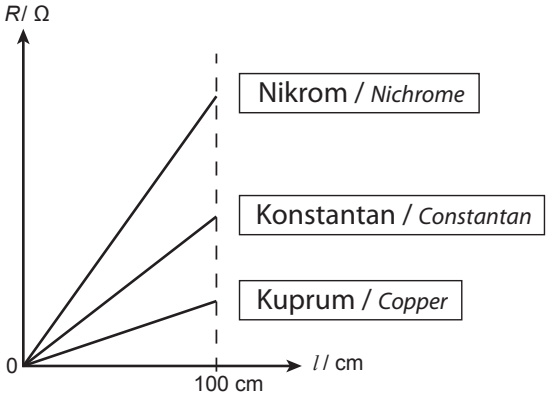
(a) Kerintangan dawai, ρ (jenis bahan)
Resistivity of the wire, ρ (type of material)

(b) Rintangan, $R = \frac{V}{I}$

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

Keputusan / *Results*:

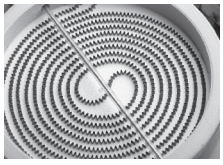
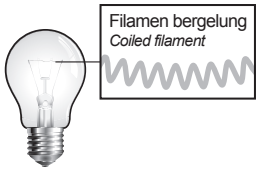
100 cm panjang dawai dengan saiz s.w.g. 32 ***100 cm long wire with size s.w.g. 32***	***I* / A**	***V* / V**	$R = \frac{V}{I}$ / Ω
Kuprum / *Copper*	0.5	0.15	0.3
Konstantan / *Constantan*	0.5	4.20	8.4
Nikrom / *Nichrome*	0.5	12.5	25.0



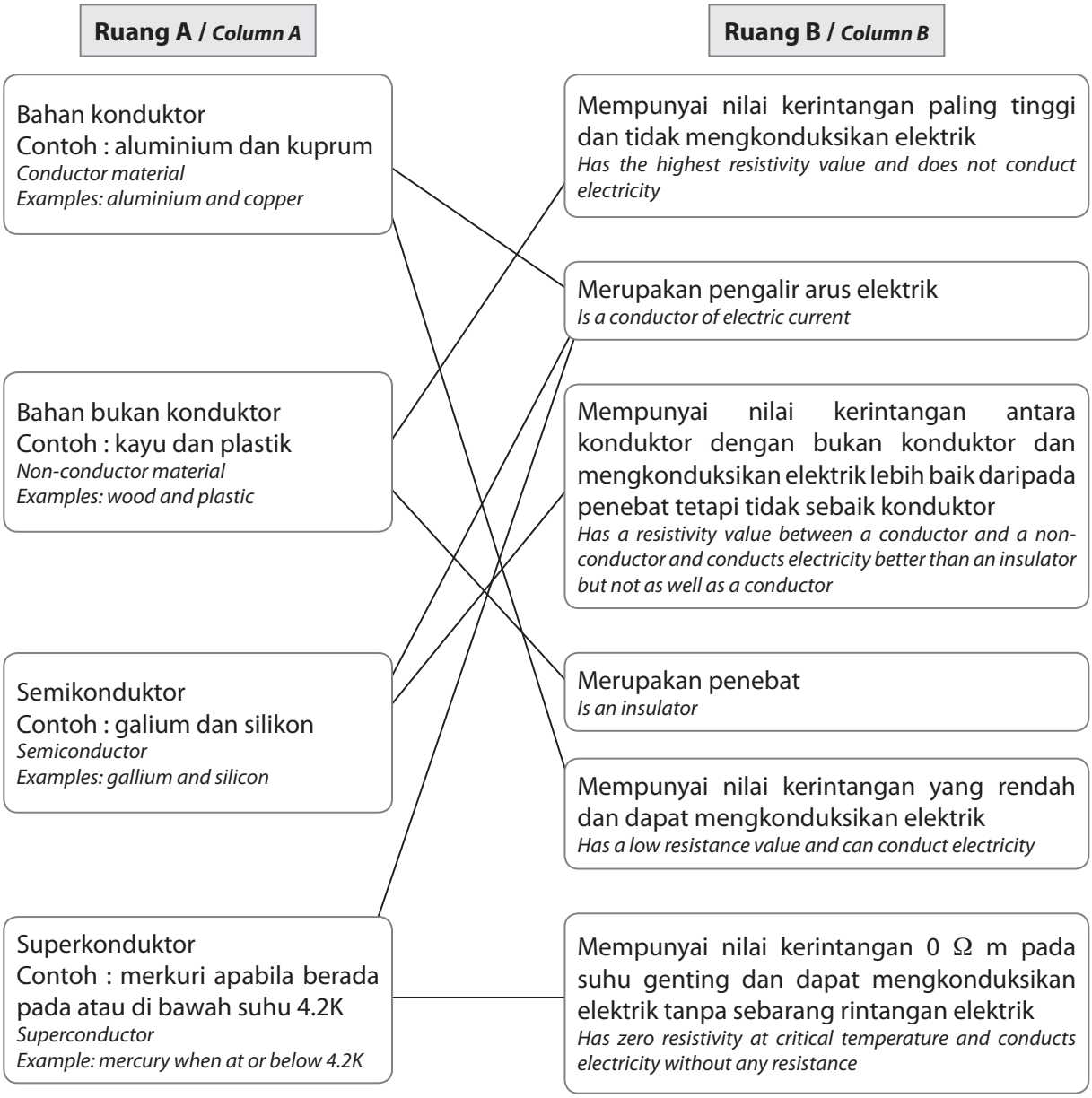
Perbincangan / *Discussion*:
arus yang besar mungkin memanaskan dawai konduktor dalam litar sepanjang masa. Peningkatan suhu akan menyebabkan peningkatan rintangan dawai. Oleh itu, untuk memperoleh keputusan yang lebih baik sepanjang eksperimen, arus kecil harus digunakan.
the big current may heat the wire conductors in the circuit all the time. An increase in temperature will cause an increase in resistance of the wire. Therefore, in order to obtain better results throughout the experiment, small currents should be used.

Kesimpulan / *Conclusion*:
bertambah, besar, besar, diterima
increases, greater, greater, accepted

9.

Ruang A / *Column A*	**Ruang B / *Column B***
 Elemen pemanas: Takat lebur tinggi Boleh tahan suhu tinggi *Heating element: High melting point* *Can withstand high temperatures*	Diperbuat daripada dawai tungsten *Made of tungsten wire*
 Lampu berfilamen: Takat lebur tinggi dan boleh tahan suhu tinggi *Filament lamp: High melting point and can withstand high temperatures*	Diperbuat daripada dawai kuprum *Made of copper wire*
 Pendawaian elektrik di rumah: Takat lebur tinggi dan boleh tahan suhu tinggi *Electrical wiring in the home:* *High melting point and can withstand high temperatures*	Diperbuat daripada dawai nikrom *Made of nichrome wire*
	Kerintangan yang kecil 1.68×10^{-8} Ωm hingga 2.68×10^{-6} Ωm *Low resistivity* *1.68×10^{-8} Ωm to 2.68×10^{-6} Ωm*
	Kerintangan tinggi 1.10×10^{-8} Ωm hingga 1.50×10^{-6} Ωm *High resistivity* *1.10×10^{-8} Ωm to 1.50×10^{-5} Ωm*
	Kerintangan tinggi 5.6×10^{-8} Ωm *High resistivity* *5.6×10^{-8} Ωm*

10.



11. (a) rintangan elektrik, kehilangan
electrical resistance, loss

(b) sangat rendah
very low

(c) rintangan sifar, sifar
zero resistance, zero

(e) rintangannya, sifar
its resistance, zero

(f) suhu genting
critical temperature

(g) tenaga
energy

(h)

(i) Boleh mengekalkan arus yang besar
Able to sustain large current

(ii) Motor dan penjana elektrik bersaiz kecil boleh digunakan
Small size motors and generators can be used

(iii) Kehilangan kuasa lebih kecil semasa penghantaran
Smaller power loss during transmission

(iv) Tenaga haba kurang dibazirkan
Less heat energy is wasted

12.

Cadangan / *Suggestion*	**Sebab / *Reason***
Ketumpatan yang rendah *Low density*	Lebih ringan / Jisim kurang / Senang dibawa *Lighter / Less mass / Easy to carry*
Takat lebur yang tinggi *High melting point*	Boleh tahan lebih banyak haba / Tidak mudah melebur *Can withstand more heat / Not easy to melt*
Kadar kakisan yang rendah *Low corrosion rate*	Tidak mudah berkarat / Boleh tahan lama / Tidak mudah patah *Not easy to rust / Can be durable / Not easily broken*
Kerintangan yang tinggi *High resistivity*	Lebih cepat memanas / Menghasilkan lebih banyak haba *Faster heating / Produces more heat*
Z dipilih *Z is choosen*	Kerana *Z* mempunyai ketumpatan yang rendah, takat lebur yang tinggi, kadar pengkakisan yang rendah dan kerintangan yang tinggi *Because Z has low density, high melting point, low corrosion rate and high resistance*

13. Penyelesaian / *Solution*

Diameter dawai / *Diameter of wire*, d = 0.5 mm

Panjang dawai / *Length of wire*, l = 15 m

Rintangan dawai / *Resistance of wire*, R = 75 Ω

Hitung jejari dawai

Calculate the radius of the wire, r

$= \frac{d}{2} = \frac{0.5}{2} = 0.25$ mm

$= 0.25 \times 10^{-3}$ m

Hitung luas keratan rentas dawai

Calculate the cross-sectional area of the wire

$A = \pi r^2 = 3.142 \times (0.25 \times 10^{-3})^2$

$= 1.96 \times 10^{7}$ m^2

Dari rumus, $R = \frac{\rho l}{A}$, susun semula, untuk mendapat nilai $\rho = \frac{RA}{l}$

From the formula, $R = \frac{\rho l}{A}$, rearrange, to get the value of

Gantian dalam rumus / *Substitute in the formula*,

$\rho = \frac{75\ \Omega \times 1.96 \times 10^{-7}\ \text{m}^2}{15\ \text{m}} = 9.8 \times 10^{-7}\ \Omega\ m$

Maka, kerintangan dawai ialah $9.8 \times 10^{-7}\ \Omega$ m.

Thus, the resistivity of the wire is $9.8 \times 10^{-7}\ \Omega\ m$

3.3 Daya Gerak Elektrik (d.g.e.) dan Rintangan Dalam
Electromotive Force (e.m.f.) and Internal Resistance

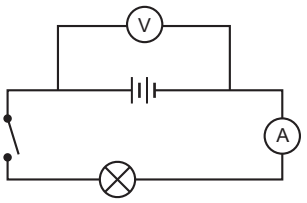
1. (a) tenaga elektrik, tenaga haba dan cahaya
electrical energy, heat and light energy

(b) tenaga kimia, tenaga elektrik
chemical energy, electrical energy

(c) daya gerak elektrik
electromotive force

(d) kerja dilakukan, satu coulomb cas, litar lengkap
work done, coulomb of charge, complete circuit

2. (a)

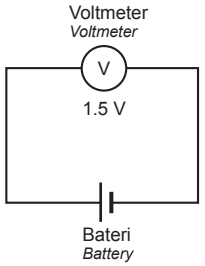
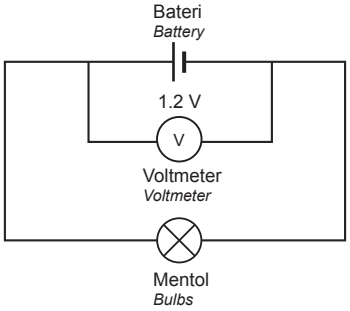


(b) Tidak / *No*

(c) Kerana voltmeter disambung terus kepada bateri.
Because the voltmeter is connected directly across the battery.

(d) Daya gerak elektrik.
Electromotive force.

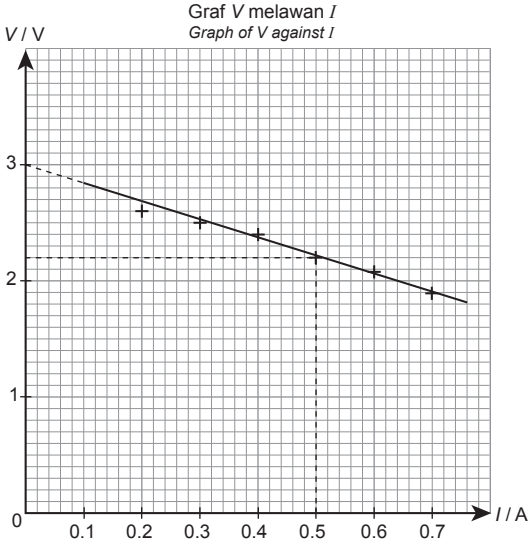
3.

Daya gerak elektrik (d.g.e.) ***Electromotive force (e.m.f.)***	**Beza keupayaan** ***Potential difference***
(a) D.g.e. suatu sel diukur dalam litar terbuka apabila tiada arus mengalir dalam litar. *The e.m.f. of a cell is measured in open circuit when there is no current flowing in the circuit.*	(d) Beza keupayaan diukur dalam litar tertutup apabila arus mengalir di dalam litar. *The potential difference is measured in closed circuit when there is a current flowing in the circuit.*
	
(b) Bacaan voltmeter = 1.5 V ialah ukuran beza keupayaan merentasi sel kering dalam litar terbuka (arus = 0 A). *The voltmeter reading = 1.5 V is a measure of the potential difference across a dry cell in an open circuit (current = 0 A).* (c) Beza keupayaan ini ialah ukuran d.g.e. sel. Maka, d.g.e. sel kering = 1.5 V. D.g.e. suatu sumber elektrik ialah beza keupayaan merentasi sumber itu dalam litar terbuka. *This potential difference is a measure of d.g.e. cell. So, e.m.f of dry cell = 1.5 V. E.m.f. of an electrical source is the potential difference across that source in an open circuit.*	(e) Bacaan voltmeter = 1.2 V ialah ukuran beza keupayaan merentasi mentol dalam litar tertutup (arus ≠ 0 A). *The voltmeter reading = 1.2 V is a measure of the potential difference across a bulb in a closed circuit (current ≠ 0 A).* (f) Beza keupayaan merentasi mentol = 1.2 V. Beza keupayaan ini juga dikenal sebagai beza keupayaan terminal. Jika mentol tidak disambung dalam litar, arus I = 0 A dan beza keupayaan terminal = d.g.e. sel kering. *The potential difference across the bulb = 1.2 V. This is also known as the terminal potential difference. If the bulb is not connected in the circuit, the current I = 0 A and the terminal potential difference = e.m.f. dry cell.*

4. bahan elektrolit di dalam sel kering tersebut, Ohm (Ω) / *electrolyte in the dry cell, Ohm (Ω)*

5. Tujuan / *Aim*:
daya gerak elektrik, rintangan dalam / *electromotive force, internal resistance*

Keputusan / *Results*:



Daripada graf / *From the graph*:
- D.g.e. sel / *E.m.f. cell*, $\varepsilon = \underline{3.0\ V}$
- Rintangan dalam / *Internal resistance* :

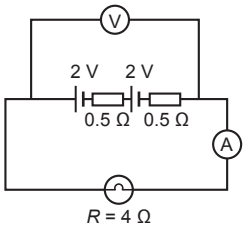
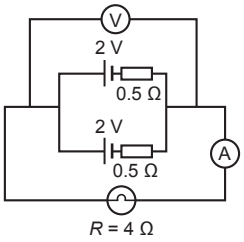
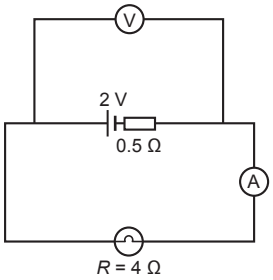
$$r = \frac{3.0 - 2.2}{0.5} = 1.6\ \Omega$$

Perbincangan / *Discussion*

1. arus, daya gerak elektrik (d.g.e.)
current, electromotive force (e.m.f.)

2. dilesapkan, berkurang
dissipated, decreases.

6.

Sel kering secara sesiri ***Dry cells in series***	**Sel kering secara selari** ***Dry cells in parallel***	**Sel kering tunggal** ***Single dry cell***
		
D.g.e berkesan / *Effective e.m.f*: $\varepsilon = 2\ V + 2\ V = 4\ V$	D.g.e berkesan / *Effective e.m.f*: $\varepsilon = 2\ V$	D.g.e berkesan / *Effective e.m.f*: $\varepsilon = 2\ V$

Rintangan dalam berkesan *Effective internal resistance in the circuit* $r = 0.5\ \Omega + 0.5\ \Omega = 1.0\ \Omega$ Jumlah rintangan dalam litar *Total effective internal resistance in the circuit.* $r_T = 4 + 1.0 = 5\ \Omega$	Rintangan dalam berkesan: *Effective resistance internal:* $\frac{1}{r} = \frac{1}{0.5} + \frac{1}{0.5} = 4$ Maka, $r = \frac{1}{4} = 0.25\ \Omega$ Jumlah rintangan dalam litar: *Total effective resistance in the circuit:* $R_T = 4 + 0.25 = 4.25\ \Omega$	Jumlah rintangan dalam litar *Total effective resistance in the circuit:* $R_r = R + r$ $= 4\ \Omega + 0.5\ \Omega$ $= 4.5\ \Omega$
Arus maksimum dalam litar: *Maximum current in the circuit:* $I = \frac{V}{R} = \frac{4}{5} = 0.8A$	Arus maksimum dalam litar: *Maximum current in the circuit:* $I = \frac{V}{R} = \frac{2}{4.25} = 0.47\text{A}$	Arus dalam litar: *Current in the circuit:* $I = \frac{V}{R} = \frac{2}{4.5} = 0.44\ A$
Beza keupayaan terminal: *Terminal potential difference:* $V = IR = 0.8 \times 4 = 3.2\ \text{V}$ Voltan 'hilang' / *Voltage drop*: $V' = Ir = 0.8 \times 1.0 = 0.8\ \text{V}$	Beza keupayaan terminal: *Terminal potential difference:* $V = IR = 0.47 \times 4 = 1.88\ \text{V}$ Voltan 'hilang' / *Voltage drop*: $V' = Ir = 0.47 \times 0.25 = 0.12\ \text{V}$	Beza keupayaan terminal: *Terminal potential difference:* $V = IR = 0.44 \times 4 = 1.8\ \text{V}$ Voltan hilang / *Voltage drop*: $V' = Ir = 0.44 \times 0.5 = 0.2\ \text{V}$

7. (a) paling cerah, paling besar / *brightest, largest*
(b) lebih cerah, lebih kecil, lebih besar
brighter, is smaller, larger
(c) lebih kecil, lebih kecil, tahan lebih lama
smaller, smaller, can last longer

8. (a) mengubah, tenaga elektrik
transform, electrical energy
(b) semikonduktor, tenaga elektrik, cahaya / *semiconductor, electricity, light*
(c) panel suria, bersiri, selari
solar panel, series, parallel
(d) motor, enjin / *battery packs, electric, engine*
(e) bateri, dicaskan / *battery, recharged*
(f) tahan lama, arus / *durable, current*

9. d.g.e , $\varepsilon = 3.0\ \text{V}$
$R = 5\ \Omega$
$V = 2.5\ \text{V}$
$I = \frac{V}{R} = \frac{2.5}{5} = 0.5\text{A}$
$r = \frac{\varepsilon - V}{I} = \frac{3.0 - 2.5}{0.5} = 1.0\ \Omega$

3.4 Tenaga dan Kuasa Elektrik
Electrical Energy and Power

1.

Daripada definisi beza keupayaan, *V*, yang berkaitan dengan tenaga elektrik yang dilesapkan seunit cas,
From the definition of potential difference,V related to electrical energy dissipated per unit charge,

$$V = \frac{E}{Q}$$

Susun semula,
Rearrange,

Tenaga elektrik
Electrical energy

$$E = V \times Q$$

Daripada definisi arus, *I*, yang berkaitan dengan kadar pengaliran cas,
From the defination of electric current, I related to rate of flow of charge,

$$I = \frac{Q}{t}$$

Susun semula,
Rearrange,

Cas elektrik
Electrical charge

$$Q = I \times t$$

Maka, hubungan antara *E*,*V*,*I* dan *t* ialah
Thus, the relationship between E,V,I and t is

Tenaga elektrik
Electrical energy

$$E = V \times I \times t$$

2.

Daripada definisi kuasa yang berkaitan dengan kadar tenaga yang dipindahkan
From the definition of power that related to rate of energy transfer

Kuasa, $P = \frac{E}{t}$
Power

Ganti $E = VIt$ ke dalam sebutan kuasa *P*
Subtitute E = VIt in term of power P

$$P = \frac{VIt}{t} = V \times I$$

Dari Hukum Ohm, $V = IR$,
Ganti ke dalam kuasa *P*
From Ohms's law, V = IR
Substitute into power P

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

Ganti arus, $I = \frac{V}{R}$
ke dalam kuasa *P*
Substitute current $I = \frac{V}{R}$ *into power P*

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

3. (a) $R = 80\ \Omega$, I = 3.0 A;
$V = IR = 3.0 \times 80 = 240$ V
(b) $P = I^2R = 3.02 \times 80 = 720$ W
(c) $t = 5$ minit / *minute* $= 5 \times 60$ s $= 300$ s
$E = Vlt = 240 \times 3.0 \times 300 = 216\,000$ J

4.

Peralatan elektrik ***Electrical appliances***	**Bilangan** ***Number*** **(A)**	**Kadar kuasa** ***Power rate*** **kW (B)**	**Jam penggunaan (dalam sehari)** ***Hours of use (in a day)*** **(C)**	**Jumlah penggunaan tenaga sebulan / kWj** ***Total energy consumption per month / kWh*** **(A) x (B) x (C)**
Cerek elektrik *Electric kettle*	1	1000 W = 1 kW	$\frac{1}{2}$ j / *hr*	1 kW × $\frac{1}{2}$j x 30 = 15 kWj / *kWh*
Peti sejuk *Refrigerator*	1	150 W = 0.15	24 j / *hr*	0.15 × 24 × 30 = 108 kW j / *kW h*
Periuk nasi *Rice cooker*	1	700 W = 0.7	1 j / *hr*	0.7 × 1 × 30 = 21 kW j / *kW h*
Televisyen *Television*	1	55 W = 0.055	8 j / *hr*	0.055 × 8 × 30 = 13.2 kW j / *kW h*
Ketuhar *Oven*	1	1500 W = 1.5	$\frac{1}{2}$ j / *hr*	1.5 × $\frac{1}{2}$j × 30 = 22.5 kW j / *kW h*
Penyaman udara *Air-conditioner*	2	1500 W = 1.5	2 × 6 j = 12 j / *hr*	1.5 × 12 × 30 = 540 kW j / *kW h*
Lampu *Lamp*	6	60 W = 0.06	6 × 6 j = 36 j / *hr*	0.06 × 36 × 30 = 64.8 kW j / *kW h*
Kipas *Fan*	2	75 W = 0.075	2 × 4 j = 8 j / *hr*	0.075 × 8 × 30 =18 kW j / *kW h*
Jumlah penggunaan tenaga sebulan *Total energy consumption per month*				802.5 kW j / *kW h*

5. $P = 150$ W $= 0.15$ kW , t = 24 j / *h*
$E = Pt = 0.15 \times 24 \times 30 = 108$ kW j / *kW h*
Kos penggunaan elektrik
The cost of using electricity
$= 108 \times 0.24 =$ RM 25.92

6. (a) cekap tenaga
energy efficient
(b) mentol cekap tenaga
energy-efficient bulbs
(c) suis
switch
(d) berkuasa tinggi, manual
high-power, manually
(e) termostat, mematikan, mengurangkan
thermostat, turn, reduce
(f) penapis udara, masuk, keluar
air filter, inlets, outlets

PRAKTIS SPM 3

KERTAS 1

Bahagian A

1. A **2.** C **3.** A **4.** A **5.** C

KERTAS 2

Bahagian A

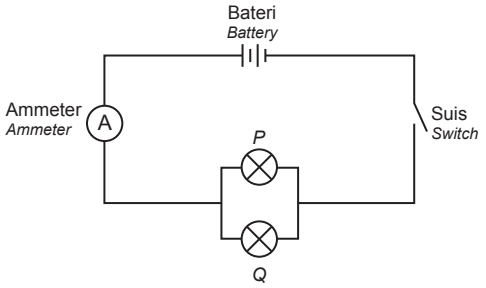
1. (a) ✓ litar bersiri
series circuit

(b) Bacaan ammeter bertambah kerana rintangan berkesan berkurang.
Ammeter reading increases because effective resistance decreases.

(c) (i) $P = \frac{V^2}{R}$, / $R = \frac{V^2}{P} = \frac{3^2}{6} = \frac{9}{6} = 1.5\ \Omega$

(ii) Jumlah rintangan / *Total resistance*,
$R = 1.5 + 1.5 = 3\ \Omega$
Voltan bateri / *Battery voltage*,
$V = 1.5 + 1.5 = 3\ V$
$V = IR$
$I = \frac{V}{R}$
$= \frac{3}{3}$
$= 1$ A

(d)



Bahagian B

2. (a) Kerja yang dilakukan untuk menggerakkan satu coulomb cas di antara dua titik tersebut.
The work done in moving one coulomb of charge from one point to another.

(b) *V* bertambah dengan *I*, kecerunan graf diwakili oleh rintangan, filamen mentol ialah konductor bukan Ohm.
V increases with I, the gradient of the graph is represented by the resistance, the filament of the bulb is a non -ohmic conductor.

(c) Oleh kerana tenaga yang dilesapkan per saat $P = IV$, apabila arus bertambah, tenaga yang dilesapkan bertambah.
As energy dissipated per second P = IV, when current increases, the energy dissipated increases.

(d)

Ciri – ciri, ***Characteristic***	**Explanation** ***Penerangan***
Saiz rod diameter kecil : nipis *Size of the rod small diameter : thin*	Kerintangan tinggi *High resistance*
Jenis rod logam : Tungsten *Type of metal rod : Tungsten*	Takat lebur dan rintangan tinggi *High melting point and resistance*
Kuasa pemanas : rendah *Power of the heater : low*	Kurang tenaga digunakan *Less energy used*
Struktur rod : rod bergelung *Structure of the rod:coiled rod*	Rod lebih panjang, tidak memenuhi ruang dan rintangan tinggi *Longger rod, does not occupy large space and high resistance*
P dipilih. *P is choosen.*	Nipis, tungsten, kuasa rendah dan rod bergelung *Thin, tungsten, low power, and coiled rod*

(d) (a) 4.5 V

(b) $\frac{1}{r} = \frac{1}{1} + \frac{1}{1} = 2$,

$r = \frac{1}{2}\Omega$

(c) $E = I(R + r)$,

$I = \frac{4.5}{5 + 0.5}$

$= \frac{E}{R + r} = 0.82$ A

(d) $V = IR$
$= 0.82(5)$
$= 4.1\text{V}$

(e) $V = 4.5 - 4.1$
$= 0.4\text{ V}$
atau
$V = Ir = 0.82\ (0.5)$
$= 0.41\text{ V}$

Bahagian C

3. (a) Kerja yang dilakukan oleh satu sumber elektrik untuk menggerakkan satu coulomb cas dalam satu litar lengkap.
Work done by an electrical source to move one coulomb of charge in a complete circuit.

(b) (i) *I* berkurang ketika *V* bertambah.
I decreases as V increases

(ii) *V* adalah tenaga yang diperlukan untuk menggerakkan 1 coulomb cas melalui *R*.
V is the energy required to move 1 coulomb of charge through R.

(iii) Ketika arus bertambah, tenaga yang dipindahkan ke perintang luaran berkurang.
Sebahagian daripada tenaga yang dibekalkan oleh bateri digunakan dalam bateri.
Konsep yang berkenaan ialah rintangan dalam, iaitu rintangan dalam bateri tersebut.
As the current increases, the energy transferred to the external resistor decreases.
Part of the energy supplied by the battery is used inside the battery.
The concept is internal resistance, which is the resistance inside the battery.

(c) (i) Selari / *Parallel*

(ii) Kecerahan setiap mentol adalah sama kerana arus adalah sama.
Kecerahan mentol tidak bergantung kepada bilangan mentol yang sedang digunakan.
Mentol-mentol yang lain masih bernyala jika salah satu daripada mentol itu tidak berfungsi.
The brightness of each bulb is the same because the current is the same.
The brightness of the bulbs does not depend on the number of bulbs in use.
The other bulbs can still light up if any one of them is not working.

(d)

Cadangan / ***Suggestion***	**Sebab** / ***Reason***
Gunakan lampu LED *Use a LED lamp*	Lebih cerah, menghasilkan haba yang kurang. *Brighter, produces less heat.*
Tempatkan semula peyaman udara ke tengah bilik. *Relocate the air conditioner to the middle of theroom.*	Pendinginan yang lebih pantas dan baik. *Faster and better cooling of the whole room.*
Guna tirai atau penutup pada tingkap. *Use curtain or blinds on the window.*	Peredaran udara dingin yang lebih baik. *Better distribution of cool air.*
Guna kipas siling. *Use a ceiling fan.*	Tahan haba daripada Matahari. *Blocks out heat from the Sun.*
Tutup lantai dengan tikar. *Cover the floor with carpet.*	Memperlahankan kekonduksian haba dari lantai ke bilik berkenaan. *Slows down the conduction of heat from the floor to the room.*