HKDSE Essentials

Third Edition

Pearson Longman

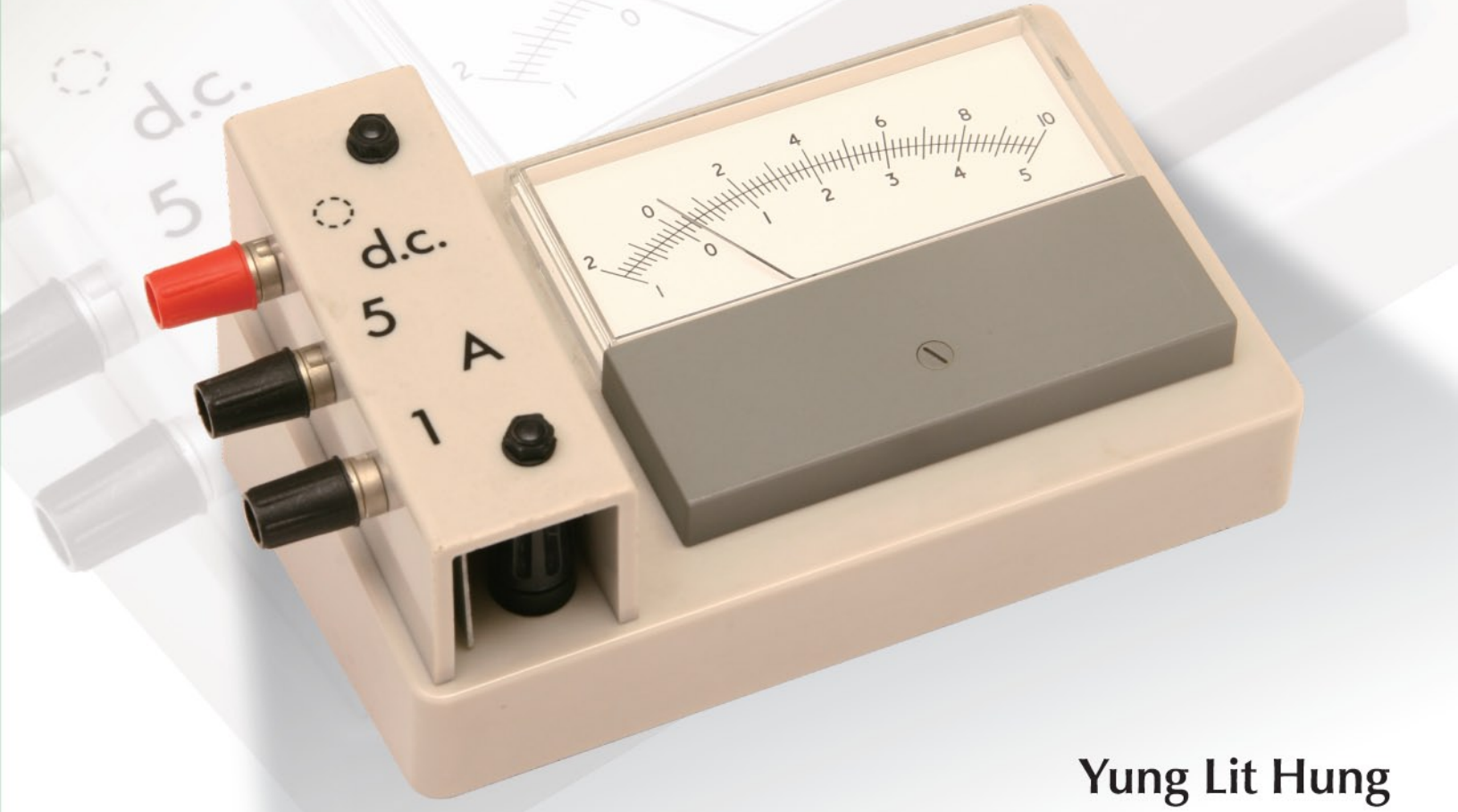
Physics

Exam Exercises

Electricity and Magnetism

With Solution Guide booklet

for Physics and Combined Science



Yung Lit Hung

ALWAYS LEARNING

PEARSON

Contents

Tips for Scoring Higher

Tips:

Practice makes perfect, only if you are on the right track.

Three advices

1. Highlight the keywords and data

Use a highlight pen when reading questions. Don't miss the clues.

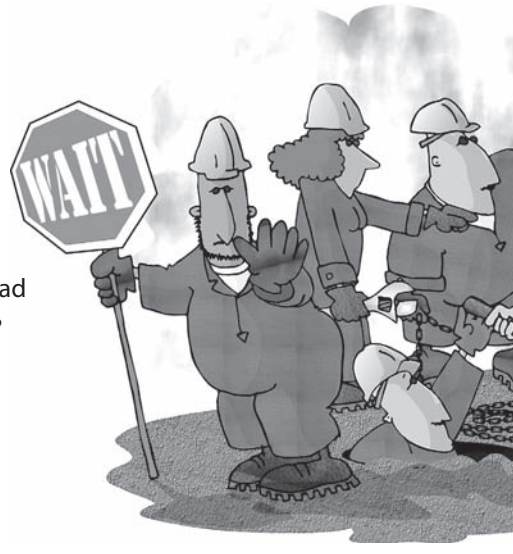
2. Let the equations guide your thinking

Concentrate on the variables and their relations. Don't just put the numerical values into the equations. The *Remember me* section in each topic helps.

3. Read the solution guide

even if you get the right answers. If so, you will learn much more.

Have you read the Preface?



Shoot-the-stars questions

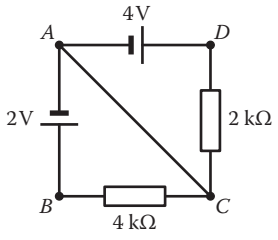
Reason-assertion

	1st statement	2nd statement
1.	Thick wires are used for circuits involving large currents.	Thick wires have small resistance.
2.	The more identical bulbs connected in parallel with a practical cell with some internal resistance, the dimmer the bulbs.	The more identical bulbs connected in parallel with a practical cell, the smaller the current drawn from the cell.
3.	A heating element of a higher power has thicker wires.	By $P = I^2R$, the larger the resistance, the higher the power for the same current.

Reminder:
A. = T T and (1 because of 2)
B. = T T
C. = T F
D. = F T
See p.10 for detailed directions.

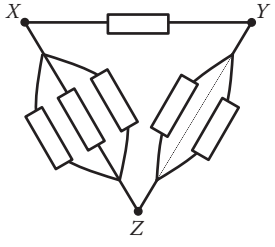
Think and solve

4. Two cells and two resistors are connected as shown. Neglect the internal resistance of the cells. What are (a) the p.d. across AC and (b) the current through AC?



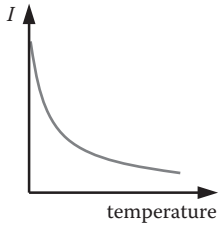
	(a)	(b)
A.	0 V	0 mA
B.	4 V	0 mA
C.	0 V	2.5 mA
D.	4 V	2.5 mA

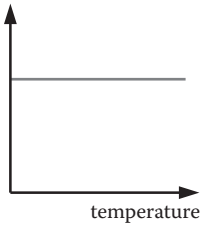
5. Six identical resistors are connected as shown in the figure. Between which two points is the equivalent resistance the max.?

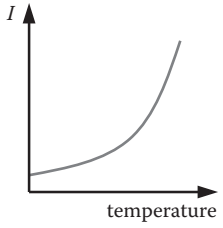


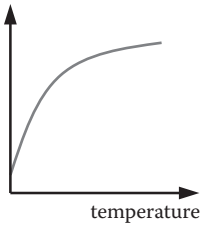
A. X and Y B. X and Z
C. Y and Z D. All are equal.

6. A semiconductor is connected across a 9 V battery. Which of the following graphs best shows the change of current I that the battery delivers as a function of temperature?

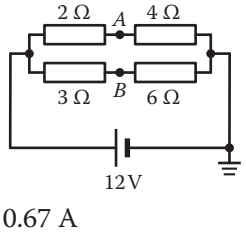
A.


B.


C.


D.


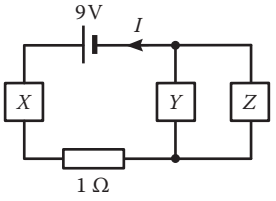
7. Four resistors are connected to a cell as shown. If a 1 Ω resistor is connected across AB, what will be the current flowing through it?



A. zero B. 0.67 A
C. 1.3 A D. 2 A

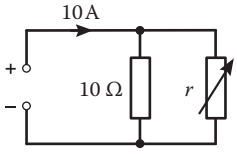
Ans: 1. A **2.** C **3.** B **4.** C **5.** A **6.** D **7.** A

8. Three unknown devices *X*, *Y* and *Z* are connected in a circuit as shown. It is found that *X* and *Y* dissipate 10 W and 8 W respectively, while *Z* supplies 4 W to the circuit. If the battery can provide a max. power of 36 W, what is the current *I* in the main loop?



A. 1 A B. 2 A
C. 2.5 A D. 4 A

9. A rheostat *r* and a 10 Ω resistor are in parallel with a power supply across them. The current from the supply is always kept constant at 10 A. The rheostat *r* is adjusted to maximize the power *P* dissipated by *r*. What is the max. *P*?



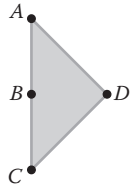
A. 125 W B. 250 W
C. 500 W D. 1000 W

10. Paul has two resistance wires *X* and *Y* made of the same material. He attaches one end of *X* to an end of *Y* to form a longer wire. If the free end of *X* is set at a potential of 8 V, and the free end of *Y* at 1 V, what is the potential at the junction of the two wires approximately?

wire	length	cross-sectional area
X	64 cm	2.3 mm^2
Y	32 cm	4.6 mm^2

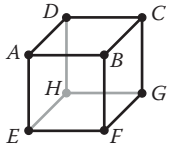
A. 1.4 V B. 2.4 V
C. 3.5 V D. 6.6 V

11. *(Very challenging)* A right-angle triangular plate is as shown and *AB* = *BD* = *BC*. The resistance across *AC* is *r*. What is the resistance across *BD*?



A. 0.25*r* B. 0.5*r*
C. *r* D. 2*r*

12. *(Very challenging)* A cubic frame has 12 identical edges. Each edge has the same resistance *r*. Find the equivalent resistance *R* across (a) cube diagonal *AG* and (b) face diagonal *AF*.



(Hint: Note the equipotential points. They can be shorted without affecting the circuit.) (6 marks)

Ans: 8. C **9.** B **10.** B **11.** A **12a.** 5r/6 **12b.** 3r/4

E7

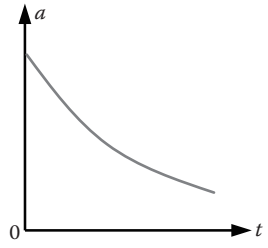
Skill-sharpening Exercises

Unless otherwise specified, take $e = 1.60 \times 10^{-19}$ C, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2 N^{-1} m^{-2} and $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}.

Categories:
- From-a-graph
- Which-graph
- Explain-a-phenomenon
- Describe-a-method
- Design-a-circuit

A. From-a-graph

1. A point charge q is solely under the influence of an elec. field around another charge Q. The graph below shows how its acceleration a varies with time t.

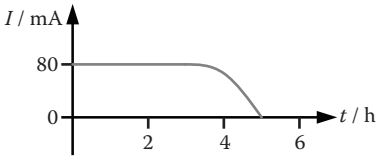


Which of the following statements **MUST** be correct?

(1) The elec. force on q decreases with time.
(2) q is moving away from Q.
(3) q is positive.

A. (1) only
B. (2) only
C. (1) and (2) only
D. (1) , (2) and (3)

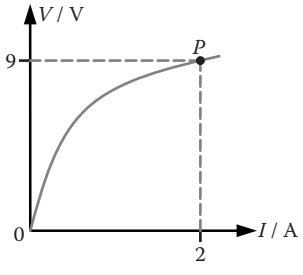
2. A mobile phone uses a battery X that is capable of delivering a constant current of 80 mA for 5 hours. The graph of current against time for another battery Y is as shown.



What is the charge delivered by this battery?

A. the same as that by X
B. greater than that by X
C. less than that by X
D. cannot be determined

3. The voltage-current relation of an elec. component is shown. Which of the following statement(s) is/are correct?

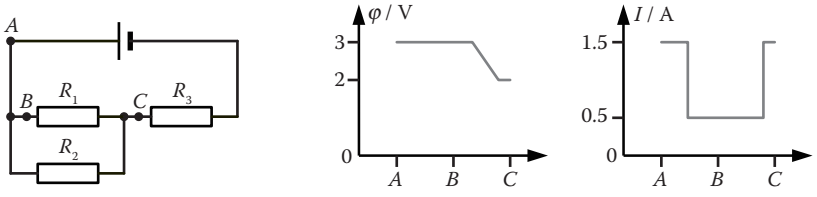


(1) Resistance at P is 4.5 Ω.
(2) The resistance of the component decreases with increasing I.
(3) The component may be a tungsten wire.

A. (2) only
B. (3) only
C. (1) and (2) only
D. (1) and (3) only

Ans: 1. C. **2.** C **3.** C

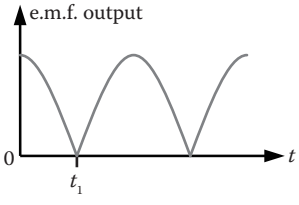
4. Three resistors, R_1, R_2 and R_3 are connected to an ideal cell. The variation of potential and current along path *ABC* is shown below.



Find the resistance of R_2 and R_3. Assume the wires have no resistance.

	R_2	R_3
A.	2 Ω	1.33 Ω
B.	1 Ω	1.33 Ω
C.	2 Ω	0.67 Ω
D.	1 Ω	0.67 Ω

5. The graph shows the output e.m.f. of a simple generator.

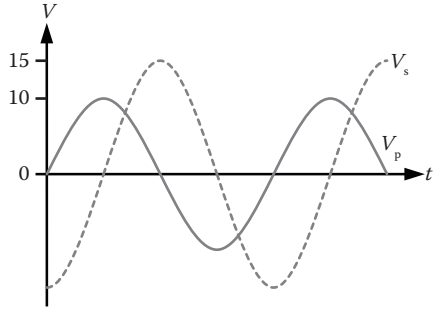


Which of the following statements are correct?

(1) The generator consists of a commutator, instead of slip rings.
(2) The no. of magn. field lines through the generator coil is max. at $t = t_1$.
(3) The curve becomes negative (turns upside down) if the generator coil is rotated in the opposite direction.

A. (1) and (2) only B. (1) and (3) only
C. (2) and (3) only D. (1), (2) and (3)

6. In a transformer, the primary and secondary voltages have the relation with time as shown.

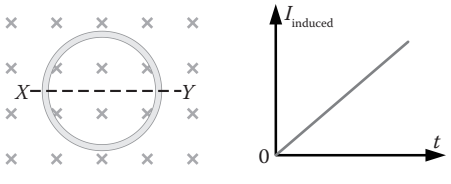


What is the turns ratio $N_p : N_s$?

A. 30 : 10 B. 15 : 10
C. 1 : 0.667 D. 2 : 3

(For full-X physics only)

7. A wire loop is placed in a uniform magn. field.



Which of the following will give an induced current as shown?

(1) The magn. field changes at an increasing rate.
(2) The area enclosed by the coil shrinks at a constant rate.
(3) The coil rotates about *XY*.

A. (1) only B. (2) only
C. (1) and (2) only D. (2) and (3) only

Ans: 4. B **5.** D **6.** D **7.** A

Exercise 5 (3 min)

1. Which of the following is a possible unit of electric field?

A. $\mathrm{N\,m^{-1}}$
B. $\mathrm{V\,m^{-1}}$
C. $\mathrm{C\,N^{-1}}$
D. $\mathrm{N\,C^{-2}}$

2. Which of the following is the correct unit of the electric constant ε_0?

A. $\mathrm{C^{-1}\,N^{-2}\,m^{-2}}$
B. $\mathrm{C^{2}\,N^{-1}\,m^{-2}}$
C. $\mathrm{C\,N\,m^{-1}}$
D. $\mathrm{C^{2}\,N^{-1}\,m^{-1}}$

3. Which of the following is a possible unit of electric charge?

A. mA h
B. N C
C. $\mathrm{V\,m^{-1}}$
D. $\mathrm{A\,s^{-1}}$

4. Which of the following is a quantity of electric force? Given $\beta = 9 \times 10^3\ \mathrm{N\,m^2\,\mu C^{-2}}$.

A. $\dfrac{1}{\beta}\left(\dfrac{3\ \mu\mathrm{C}}{2\ \mathrm{cm}}\right)$
B. $\beta\left(\dfrac{3\ \mu\mathrm{C}}{2\ \mathrm{cm}}\right)$
C. $\dfrac{1}{\beta}\left(\dfrac{3\ \mu\mathrm{C}}{2\ \mathrm{cm}}\right)^2$
D. $\beta\left(\dfrac{3\ \mu\mathrm{C}}{2\ \mathrm{cm}}\right)^2$

(Q5–6: physics only)

5. Which of the following is a quantity of magnetic field?

A. $\dfrac{10\ \mathrm{N}}{(1\ \mathrm{m})^2 \times 2\ \mathrm{A}}$
B. $\dfrac{\mu_0 \times 2\ \mathrm{A}}{4\pi \times (2\ \mathrm{m})}$
C. $\dfrac{10\ \mathrm{N}}{1\ \mathrm{m} \times 2\ \mathrm{A}}$
D. $\dfrac{\mu_0 \times 2\ \mathrm{A}}{2\pi \times (2\ \mathrm{m})^2}$

6. Which of the following is a quantity of energy?

A. $3 \times 10^8\ \mathrm{m\,s^{-1}} \times 3 \times 10^{-3}\ \mathrm{kg} \times 3 \times 10^8\ \mathrm{m\,s^{-2}}$
B. $0.1\ \mathrm{N} \times 2\ \mathrm{m^2}$
C. $3 \times 10^8\ \mathrm{m\,s^{-1}} \times 3 \times 10^{-3}\ \mathrm{kg} \times 3 \times 10^8\ \mathrm{m\,s^{-1}}$
D. $5\ \mathrm{V} \times 8\ \mathrm{C} / 1\ \mathrm{s}$

Exercise 6 (3 min)

1. Which of the following is a possible unit of voltage?

A. $\mathrm{N\,m^{-1}}$
B. $\mathrm{V\,m^{-1}}$
C. $\mathrm{A\,\Omega^{-1}}$
D. $\mathrm{W^{\frac{1}{2}}\,\Omega^{\frac{1}{2}}}$

2. Which of the following is a possible unit of power?

A. $\mathrm{V\,\Omega}$
B. $\mathrm{V^2\,\Omega^{-1}}$
C. $\mathrm{A\,\Omega}$
D. $\mathrm{A^2\,\Omega^{-1}}$

3. Which of the following is a possible unit of resistance?

A. $\mathrm{W\,V^{-1}}$
B. mV A
C. $\mathrm{kW\,mA^{-2}}$
D. T m A

4. Which of the following is a quantity of work done by electric force on a charge?

A. $\dfrac{2\ \mathrm{m} \times 8\ \mathrm{C}}{4\pi\mu_0 \times (1\ \mathrm{m})^2}$
B. $\dfrac{2\ \mathrm{m} \times (8\ \mathrm{C})^2}{4\pi\varepsilon_0 \times (1\ \mathrm{m})^2}$
C. $\dfrac{2\ \mathrm{m}}{4\pi\varepsilon_0 \times (1\ \mathrm{C})^2}$
D. $\dfrac{8\ \mathrm{C}}{4\pi\varepsilon_0 \times 1\ \mathrm{m}}$

(Q5–6: physics only)

5. Which of the following may be a quantity of induced e.m.f. by a magnetic field?

A. $50\ \mathrm{Hz} \times 2\ \mathrm{m^2} \times 100 \times 2\pi \times 8\ \mathrm{T}$
B. $(8\ \mathrm{T})^2 \times 0.5\ \mathrm{m} \times 3.5\ \mathrm{m\,s^{-1}}$
C. $0.5\ \mathrm{m} \times 5\ \mathrm{C} \times 3.5\ \mathrm{m\,s^{-1}}$
D. $8\ \mathrm{T} \times 2\ \mathrm{m^2}\ /\ (0.2\ \mathrm{s})^2$

6. Which of the following is a quantity of mass?

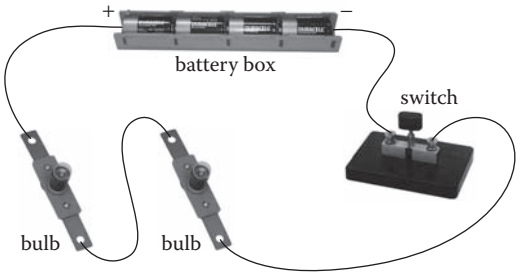
A. 931.5 MeV
B. $931.5\ \mathrm{eV} / (3 \times 10^8\ \mathrm{m\,s^{-1}})$
C. $931.5\ \mathrm{MeV} / (3 \times 10^8\ \mathrm{m\,s^{-2}})$
D. $1.492 \times 10^{-10}\ \mathrm{J} / (3 \times 10^{10}\ \mathrm{cm\,s^{-1}})^2$

Ans: (Ex 5) 1. B **2.** B **3.** A **4.** D **5.** C **6.** C **(Ex 6) 1.** D **2.** B **3.** C **4.** B **5.** A **6.** D

A3 Drawing circuit diagrams

Draw circuit diagrams to represent the following circuits.

1.



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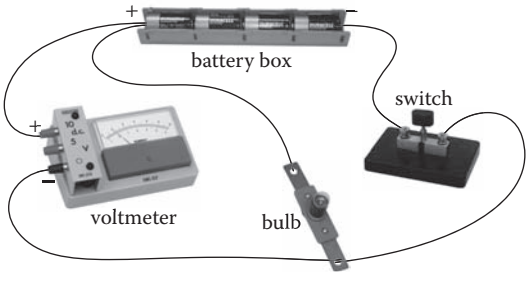

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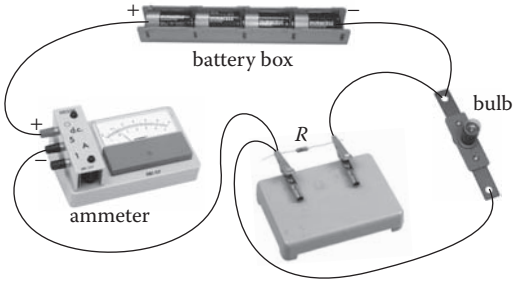
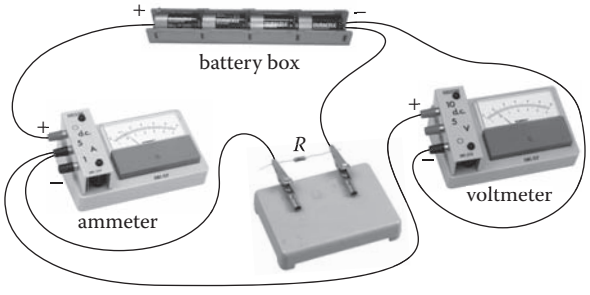
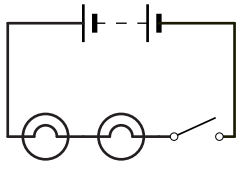


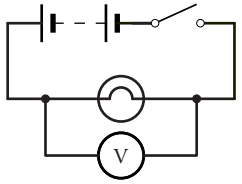
4.



Ans: 1.



2.



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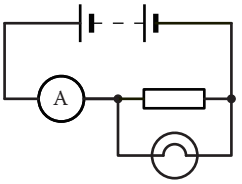

4.