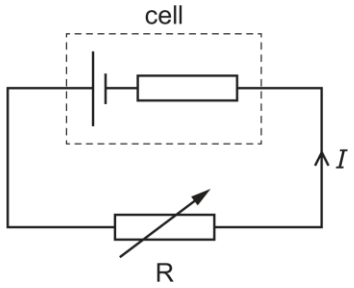
# 10. D.C. Circuits

## 10.1 Practical circuits

## Paper 1

Question Paper

**1** A cell with internal resistance is connected to a variable resistor R as shown.

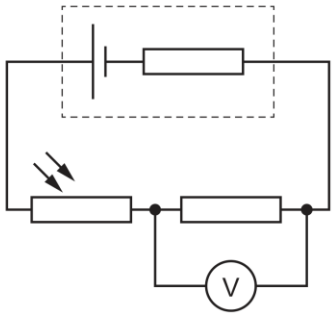



The resistance of R is gradually decreased.

How do the current $I$ and the terminal potential difference (p.d.) across the cell change?

| | current $I$ | terminal p.d. across cell |
|---|---|---|
| **A** | decreases | decreases |
| **B** | decreases | increases |
| **C** | increases | decreases |
| **D** | increases | increases |

**2** A cell with internal resistance is connected to a light-dependent resistor (LDR), a fixed resistor and a voltmeter, as shown.




The voltmeter reading increases.

Which quantity decreases as the voltmeter reading increases?

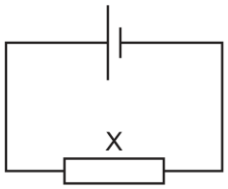
**A** the charge moving through the cell per unit time

**B** the energy transferred to the fixed resistor per unit charge

**C** the intensity of the light incident on the LDR

**D** the terminal potential difference across the cell

**3** The circuit shown contains a cell with negligible internal resistance.




The energy transferred per unit charge in driving charge around the complete circuit is *E*. The potential difference (p.d.) across X is *V*.

The cell is then replaced with a different cell of the same electromotive force (e.m.f.) that has significant internal resistance.

What is the effect on *E* and *V* of replacing the cell?

| | effect on *E* | effect on *V* |
|---|---|---|
| **A** | decreases | decreases |
| **B** | decreases | increases |
| **C** | no change | decreases |
| **D** | no change | increases |

**4** A cell with electromotive force (e.m.f.) 1.50 V delivers a current of 0.26 A to a resistor of resistance 5.0 Ω connected between its terminals.

What is the internal resistance of the cell?

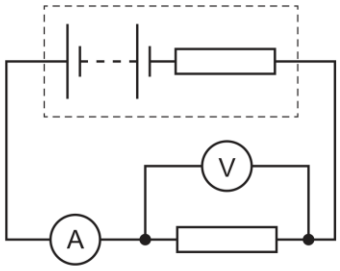
**A** 0.04 Ω **B** 0.20 Ω **C** 0.39 Ω **D** 0.77 Ω

**5** Which circuit symbol represents a microphone?

**A** **B** **C** **D**



**6** A battery with internal resistance is connected to a fixed resistor, an ammeter and a voltmeter, as shown.

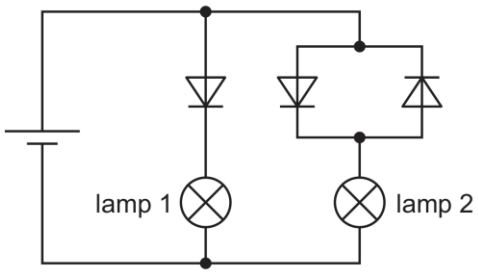



The battery is replaced by a different battery that has the same electromotive force (e.m.f.) but a greater internal resistance.

What happens to the readings on the ammeter and voltmeter?

| | ammeter reading | voltmeter reading |
|---|---|---|
| **A** | decreases | decreases |
| **B** | decreases | stays the same |
| **C** | stays the same | decreases |
| **D** | stays the same | stays the same |

**7** A student assembles the circuit shown.




Which row describes the state of the two lamps?

| | lamp 1 | lamp 2 |
|---|---|---|
| **A** | off | off |
| **B** | on | off |
| **C** | off | on |
| **D** | on | on |

**8** Which statement about the electromotive force (e.m.f.) of a cell is **always** correct?

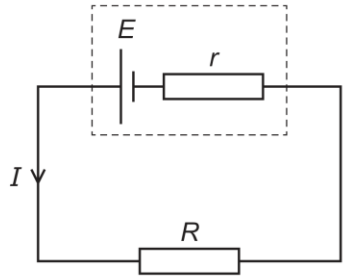
**A** The e.m.f. is the energy converted from electrical to other forms in the cell.

**B** The e.m.f. is the energy provided by the cell per unit charge passing through it.

**C** The e.m.f. is the potential difference across the internal resistance of the cell.

**D** The e.m.f. is the potential difference across the terminals of the cell.

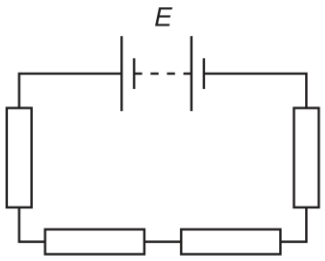
**9** A circuit contains a cell of electromotive force $E$ and internal resistance $r$ connected to a resistor of resistance $R$. The current in the circuit is $I$.




Which equation is correct?

**A** $E - Ir = IR$ **B** $E = Ir - IR$ **C** $E + Ir = IR$ **D** $E = IR$

**10** Some resistors and a battery of electromotive force (e.m.f.) $E$ and negligible internal resistance are connected in series, as shown.




Which statement is correct?

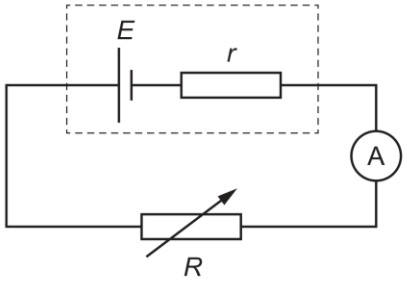
**A** The e.m.f. across each resistor equals the potential difference across the battery.

**B** The potential difference across each resistor equals the e.m.f. $E$ of the battery.

**C** The sum of the e.m.f.s across the resistors equals the potential difference across the battery.

**D** The sum of the potential differences across the resistors equals the e.m.f. $E$ of the battery.

**11** A cell has internal resistance *r* and electromotive force (e.m.f.) *E*. The cell is connected in series with an ammeter and a variable resistor of resistance *R*.




When *R* is 10 Ω the ammeter reads 0.3 A.

When *R* is 5 Ω the ammeter reads 0.4 A.

What is the value of *E*?

**A** 0.5 V **B** 2 V **C** 3 V **D** 6 V

**12** A cell with constant electromotive force (e.m.f.) is connected across a fixed resistor. Over time, the internal resistance of the cell increases.

Which change occurs as the internal resistance of the cell increases?

**A** a decrease in the charge of each charge carrier

**B** a decrease in the potential difference measured across the cell

**C** an increase in the energy dissipated per unit time in the fixed resistor

**D** an increase in the number of charge carriers leaving the cell per unit time

**13** Which ratio has the same units as electromotive force (e.m.f.)?

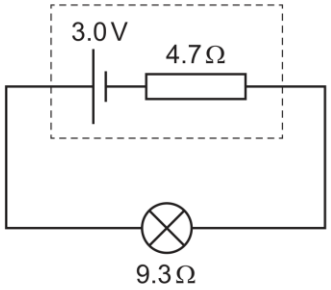
**A** charge per unit energy transferred

**B** charge per unit time

**C** energy transferred per unit charge

**D** energy transferred per unit time

**14** The diagram shows a cell of electromotive force (e.m.f.) 3.0 V and internal resistance 4.7 Ω connected across a lamp. The lamp has a resistance of 9.3 Ω.




What is the power dissipated by the internal resistance of the cell?

**A** 0.22 W **B** 0.43 W **C** 0.64 W **D** 1.0 W

**15** A cell is described as having an electromotive force (e.m.f.) of 6 V.

What does this mean?

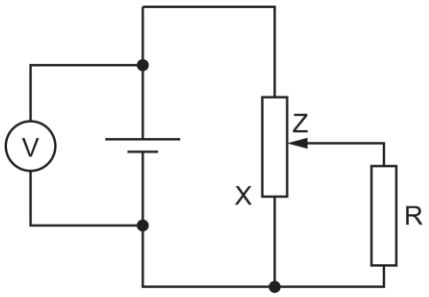
**A** 1 coulomb of charge always dissipates 6 J of energy in the internal resistance of the cell.

**B** 1 electron gains 6 J of energy when passing through the cell.

**C** There is a potential difference of 6 V applied across any external circuit connected to the cell.

**D** When 1 coulomb of charge passes through the cell, 6 J of chemical energy is transformed.

**16** A cell of constant electromotive force (e.m.f.) but with internal resistance is connected to a fixed resistor R using a potentiometer. A voltmeter measures the potential difference (p.d.) between the terminals of the cell.




Which statement explains the change to the reading of the voltmeter as contact Z is moved towards end X of the potentiometer?

**A** The voltmeter reading decreases because the current through the cell decreases.

**B** The voltmeter reading decreases because the current through the cell increases.

**C** The voltmeter reading increases because the current through the cell decreases.

**D** The voltmeter reading increases because the current through the cell increases.

**17** What is the circuit symbol for an oscilloscope?

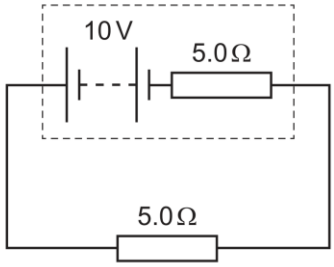
**A** 

**B** 

**C** 

**D** 

**18** A battery of electromotive force (e.m.f.) 10 V and internal resistance 5.0 Ω is connected to a 5.0 Ω load resistor.




Which change occurs when the 5.0 Ω load resistor is replaced with a 50 Ω load resistor?

**A** The current in the circuit increases.

**B** The potential difference across the load resistor increases.

**C** The power dissipated in the internal resistance of the battery increases.

**D** The total power dissipated in the circuit increases.

**19** The electromotive force (e.m.f.) of a cell is 6.0 V. It has negligible internal resistance and is connected across a resistor. The potential difference (p.d.) across the resistor is also 6.0 V.

The e.m.f. and the p.d. have the same numerical value but represent different processes.

Which statement about the different processes is correct?

**A** The e.m.f. is the energy transferred from chemical energy to electrical energy in the cell and the p.d. is the energy transferred from electrical energy to thermal energy in the resistor.

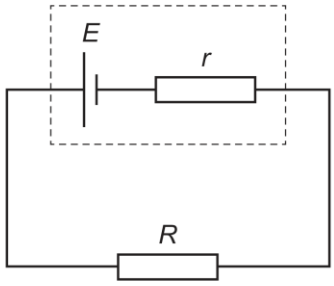
**B** The p.d. is the energy transferred from chemical energy to electrical energy in the cell and the e.m.f. is the energy transferred from electrical energy to thermal energy in the resistor.

**C** The e.m.f. is the energy transferred per unit charge from chemical energy to electrical energy in the cell and the p.d. is the energy transferred per unit charge from electrical energy to thermal energy in the resistor.

**D** The p.d. is the energy transferred per unit charge from chemical energy to electrical energy in the cell and the e.m.f. is the energy transferred per unit charge from electrical energy to thermal energy in the resistor.

**20** A cell of electromotive force (e.m.f.) $E$ and internal resistance $r$ is connected to a resistor of resistance $R$.

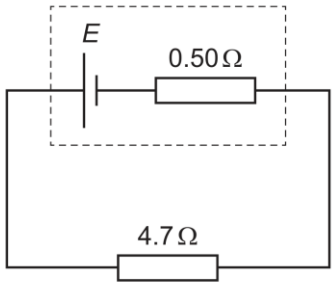
A maximum power $P$ can be dissipated by the resistor without overheating.




What is the maximum value of $E$ if the resistor does not overheat?

**A** $R\sqrt{\frac{P}{(R-r)}}$ **B** $R\sqrt{\frac{P}{(R+r)}}$ **C** $(R-r)\sqrt{\frac{P}{R}}$ **D** $(R+r)\sqrt{\frac{P}{R}}$

**21** A cell of electromotive force (e.m.f.) $E$ and internal resistance $0.50\,\Omega$ is connected to a resistor of resistance $4.7\,\Omega$.

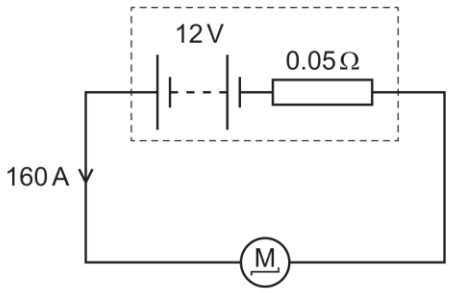



The maximum power that can be dissipated by the resistor without overheating is 0.50 W.

What is the maximum value of $E$ for the resistor **not** to overheat?

**A** 1.4 V **B** 1.5 V **C** 1.7 V **D** 2.9 V

**22** A car battery has an electromotive force (e.m.f.) of 12 V and an internal resistance of 0.05 Ω. The battery is connected to the starter motor of a car. The current in the motor is 160 A.




What is the terminal p.d. across the battery?

**A** 0 V **B** 4 V **C** 8 V **D** 12 V

**23** When a battery is connected to a resistor, the battery gradually becomes warm. This causes the internal resistance of the battery to increase whilst its electromotive force (e.m.f.) stays unchanged.

As the internal resistance of the battery increases, how do the terminal potential difference and the output power change, if at all?

| | terminal potential difference | output power |
|---|---|---|
| **A** | decreases | decreases |
| **B** | decreases | unchanged |
| **C** | unchanged | decreases |
| **D** | unchanged | unchanged |

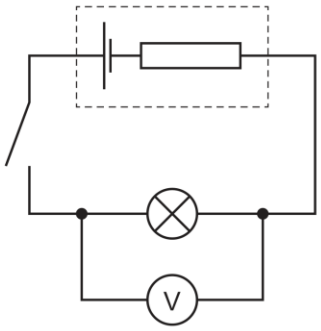
**24** A cell is connected to a resistor of resistance 3.00 Ω. The current in the resistor is 1.00 A.

A second identical resistor is added in parallel. The current becomes 1.93 A.

What are the e.m.f. *E* and internal resistance *r* of the cell?

| | *E* / V | *r* / Ω |
|---|---|---|
| **A** | 0.113 | 3.11 |
| **B** | 3.04 | 0.0358 |
| **C** | 3.11 | 0.113 |
| **D** | 9.34 | 6.34 |

**25** The diagram shows a circuit.




Which statement about the circuit is **not** correct?

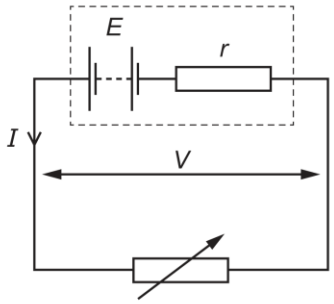
**A** Electromotive force is the energy transferred per unit charge.

**B** Energy is transferred from chemical potential energy in the cell to other forms when the switch is closed.

**C** The electromotive force of the cell is greater than the terminal potential difference when the switch is closed.

**D** When the switch is open, the voltmeter measures the electromotive force of the cell.

**26** A battery has an electromotive force (e.m.f.) $E$ and internal resistance $r$. The battery delivers a current $I$ to a variable resistor and the potential difference (p.d.) across its terminals is $V$.




The variable resistor is adjusted so that $I$ increases.

Why does $V$ decrease?

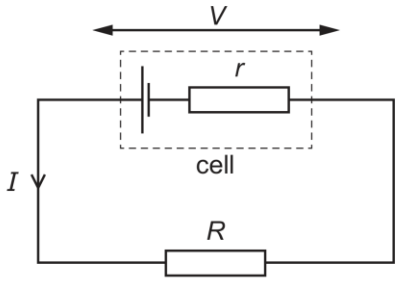
**A** The e.m.f. $E$ decreases.

**B** The internal resistance $r$ increases.

**C** The p.d. across $r$ increases.

**D** The resistance of the variable resistor increases.

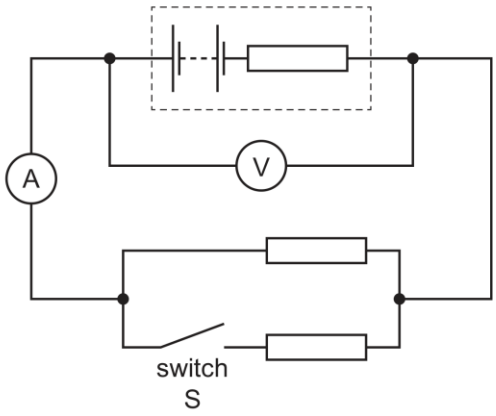
**27** A cell of constant electromotive force drives a current $I$ through an external resistor of resistance $R$. The terminal potential difference (p.d.) across the cell is $V$.




When the internal resistance $r$ of the cell increases, what is the effect on $V$ and on $I$?

| | $V$ | $I$ |
|---|---|---|
| **A** | decreases | decreases |
| **B** | decreases | increases |
| **C** | increases | decreases |
| **D** | increases | increases |

**28** A battery, with internal resistance, is connected to a parallel arrangement of two resistors and a switch S, as shown.




Initially switch S is open.

What happens to the voltmeter and ammeter readings when switch S is closed?

| | voltmeter reading | ammeter reading |
|---|---|---|
| **A** | decreases | increases |
| **B** | decreases | decreases |
| **C** | increases | increases |
| **D** | increases | decreases |