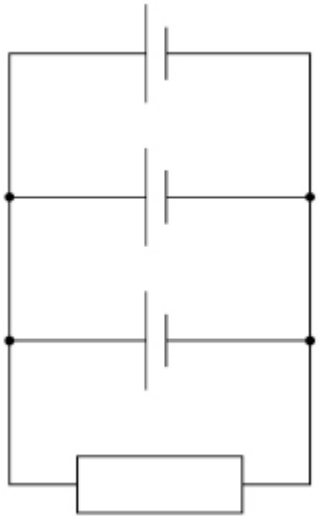
Electromotive Force & Internal Resistance

TOPIC QUESTIONS

Level	A Level
Subject	Physics
Exam Board	AQA
Paper Type	Multiple Choice

Time Allowed : 30min

1. A resistor of resistance R and three identical cells of emf E and internal resistance r areconnected as shown.



What is the current in the resistor?

A $\frac{3E}{(3R+r)}$

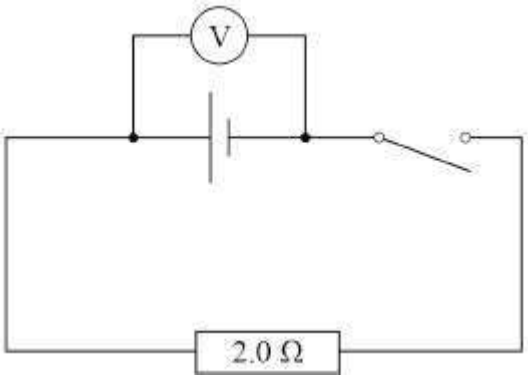
B $\frac{9E}{(3R+r)}$

C $\frac{E}{R}$

D $\frac{3E}{R}$

2. In the circuit, the reading of the voltmeter is V.

   When the switch is closed the reading becomes $\frac{V}{3}$.



What is the internal resistance of the cell?

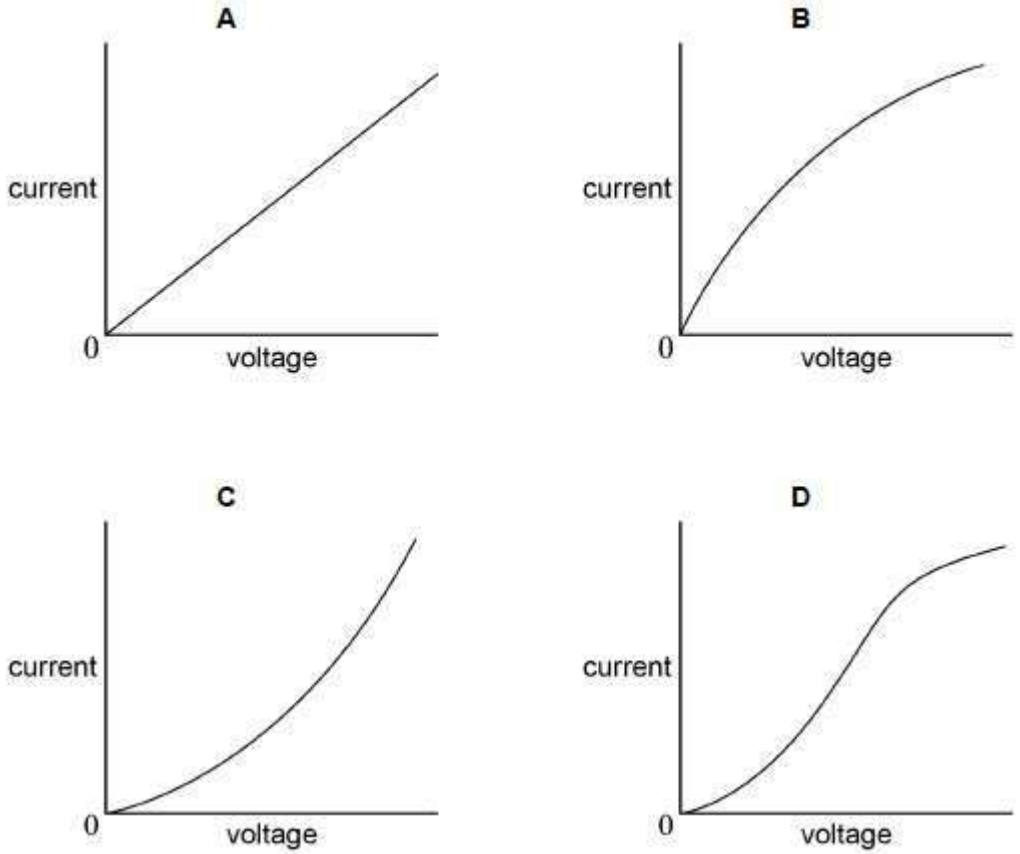
A 0.33 Ω

B 0.67 Ω

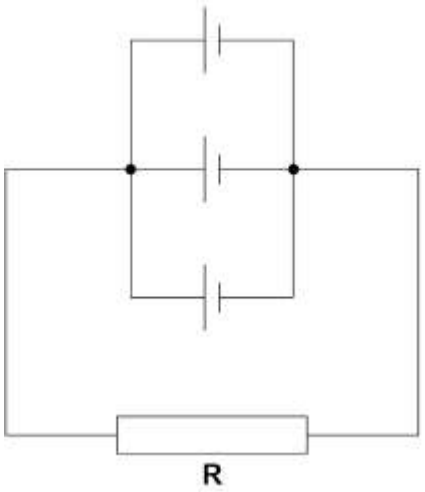
C 4.0 Ω

D 6.0 Ω

3. Which is the current-voltage characteristic graph for a filament lamp up to its working voltage?



4. Three identical cells, each of emf 1.5 V and internal resistance 6.0 Ω, are connected to resistor **R**. The resistance of **R** is 6.0 Ω.



What is the current in **R**?

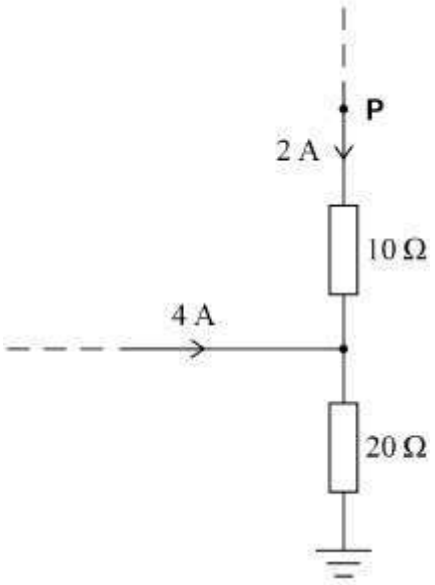
A 0.19 A

B 0.25 A

C 0.56 A

D 0.75 A

5. The diagram shows part of a circuit and the currents in the circuit.



What is the potential difference between point P and earth?

A 60 V

B 100 V

C 120 V

D 140 V

6. When fully charged the 2.0 mF capacitor used as a backup for a memory unit has a potential difference of 5.0 V across it. The capacitor is required to supply a constant current of 1.0 μA and can be used until the potential difference across it falls by 10%. For how long can the capacitor beused before it must be recharged?

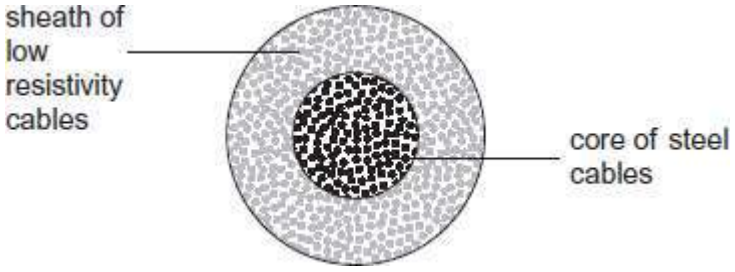
A 10 s

B 100 s

C 200 s

D 1000 s

7. The overhead cables used to transmit electrical power by the National Grid usually consist of a central core of steel cables surrounded by a sheath of cables of low resistivity material, such asaluminium.



What is the main purpose of the steel core?

A To force more current into the outer sheath.

B To provide additional current paths through the cables.

C To reduce the power lost from the cables.

D To increase the mechanical strength of the cables.

8. Three identical cells, each of internal resistance *R*, are connected in series with an external resistor of resistance *R*. The current in the external resistor is *I*. If one of the cells is reversed in the circuit, what is the new current in the external resistor?

A $\frac{I}{3}$

B $\frac{4I}{9}$

C $\frac{I}{2}$

D $\frac{2I}{3}$

9. In a cathode ray tube 7.5×10^{15} electrons strike the screen in 40 s. What current does this represent?

Charge of the electron is 1.6×10^{-19} C.

A 1.3×10^{-16} A

B 5.3×10^{-15} A

C 3.0×10^{-5} A

D 1.2×10^{-3} A

10. A cylindrical conductor of length l, diameter D, and resistivity ρ has a resistance R.

What is the resistance of another cylindrical conductor of length l, diameter $\frac{D}{2}$, and resistivity ρ?

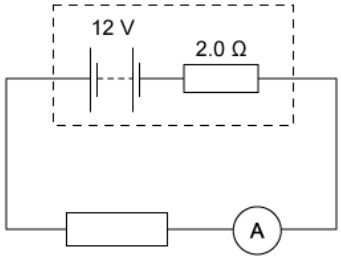
A $8R$

B $4R$

C $2R$

D R

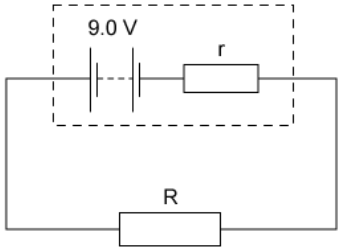
11. A battery of e.m.f. 12 V and internal resistance 2.0 Ω is connected in series with an ammeter of negligibleresistance and an external resistor. External resistors of various different values are used.



Which combination of current and resistor value is **not** correct?

	current / A	external resistor value / Ω
A	1.0	10.0
B	1.2	8.0
C	1.5	6.0
D	1.8	4.0

12. A simple circuit is formed by connecting a resistor of resistance R between the terminals of a battery ofelectromotive force (e.m.f.) 9.0 V and constant internal resistance r.



A charge of 6.0 C flows through the resistor in a time of 2.0 minutes, causing it to dissipate 48 J of thermalenergy.

What is the internal resistance *r* of the battery?A. 0.17 Ω

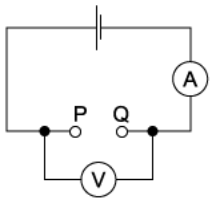
B. 0.33 Ω

C. 20 Ω

D. 160 Ω

13. A student found two unmarked resistors. To determine the resistance of the resistors, the circuit below was setup. The resistors were connected in turn between P and Q, noting the current readings.

The voltage readings were noted without the resistors and with each resistor in turn.



The results were entered into a spreadsheet, as shown.

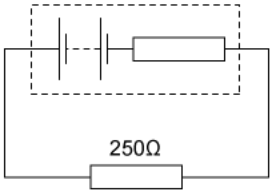
1.5	1.3	28	46
1.5	1.4	14	100

The student forgot to enter the column headings.

Which order of the headings would be correct?

A.	e.m.f / V	*V* / V	*R* / Ω	*I* / mA
B.	*V* / V	e.m.f / V	*R* / Ω	*I* / mA
C.	*V* / V	e.m.f / V	*I* / mA	*R* / Ω
D.	e.m.f / V	*V* / V	*I* / mA	*R* / Ω

14. A battery, with a constant internal resistance, is connected to a resistor of resistance 250 Ω, as shown.

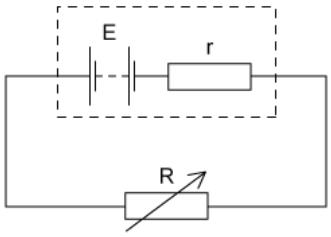


The current in the resistor is 40 mA for a time of 60 s. During this time 6.0 J of energy is lost in the internalresistance.

What is the energy supplied to the external resistor during the 60 s and the e.m.f. of the battery?

	energy / J	e.m.f / V
A	2.4	2.4
B	2.4	7.5
C	24	10.0
D	24	12.5

15. A battery with e.m.f. *E* and internal resistance *r* is connected in series with an external variable resistor.



The value of the external resistance *R* is slowly increased from zero.Which statement is correct? (Ignore any temperature effects.)

A. The potential difference across the external resistance decreases.

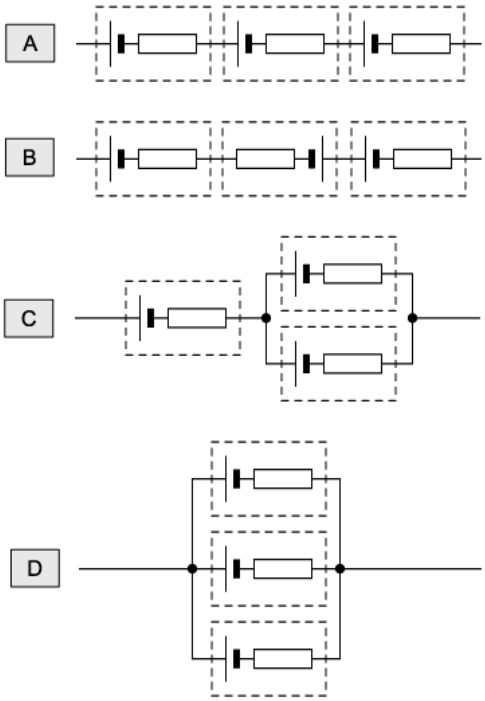
B. The potential difference across the internal resistance increases.

C. The power dissipated in *r* increases and then decreases.

D. The power dissipated in *R* increases and then decreases.

16. Three cells each have an e.m.f. ε = 1.2 V and an internal resistance r = 0.8 Ω.

Which combination of these cells will deliver a total e.m.f. of 1.2 V and a maximum current of 4.5 A?



17. A battery is connected to a 20 Ω resistor and a switch in series. A voltmeter is connected across the battery.When the switch is open the voltmeter reads 3.82 V. When the switch is closed the reading is 3.35 V.

What is the internal resistance of the battery?

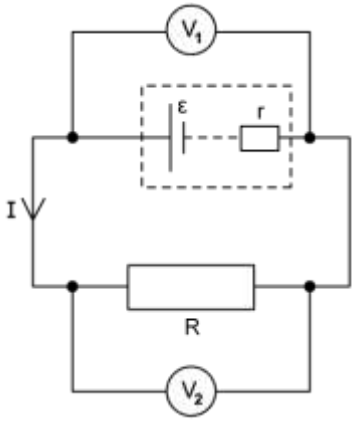
A. 1.3 Ω

B. 1.4 Ω

C. 2.5 Ω

D. 2.8 Ω

18. A cell of emf ε and internal resistance r is connected to an external load of resistance R as shown.



Which of the following statements is **incorrect**?

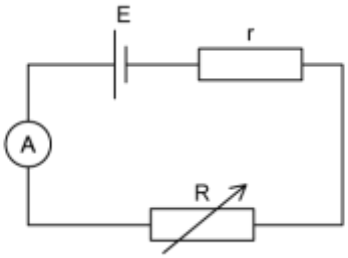
A. $V_1 = V_2$

B. $\varepsilon > V_1$

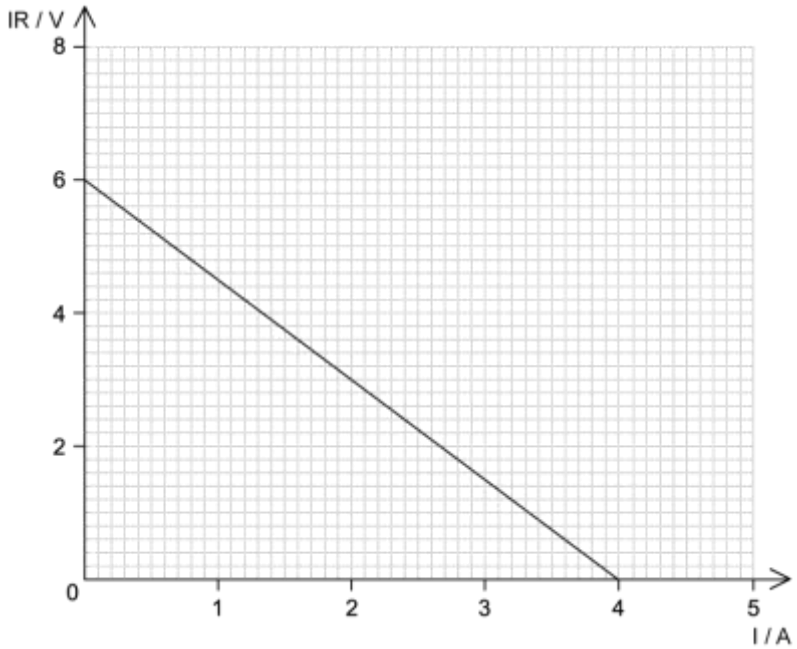
C. $V_2 > \varepsilon$

D. $\varepsilon > V_2$

19. A circuit is set up such that a cell of emf *E* and internal resistance *r* is connected to a variable resistor *R*.



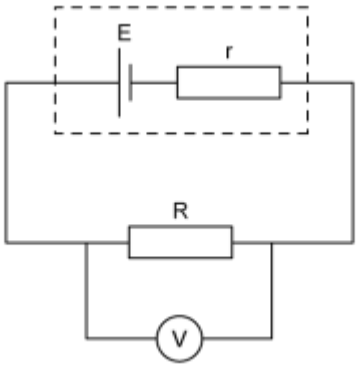
The load resistance *R* is varied such that a graph of the quantity *IR* can be plotted against the current *I*, usingreadings from the ammeter.



Which row, **A** to **D**, gives the correct values for the emf *E* of the cell, its internal resistance *r* and the powerdissipated in the load resistance when the current is 1.5 A, $P_{1.5}$?

	ε / V	*I* / A	$P_{1.5}$ / W
A	6.0	0.7	3.7
B	4.0	1.5	3.7
C	6.0	1.5	5.6
D	6.0	0.7	5.6

20. A cell of emf E and internal resistance r is connected to a load resistor R as shown:



Pairs of values for the reading on the voltmeter V and R is given:

V / V	R / Ω
3.0	2.0
4.0	4.0

What is the internal resistance of the cell?

A. 0.5 Ω

B. 1.0 Ω

C. 2.0 Ω

D. 3.0 Ω