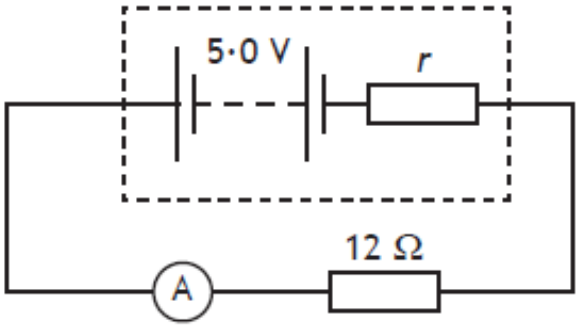
Higher Physics: 29th January 2018

Electrical Sources and Internal Resistance

A circuit is set up as shown.



The e.m.f of the battery is 5.0V.
The reading on the ammeter is 0.35A.

The internal resistance r of the battery is:

a) 0.28 Ω
b) 0.80 Ω
c) 1.15 Ω
d) 2.3 Ω
e) 3.2 Ω

The e.m.f of a battery is the:

a) total energy supplied by the battery.
b) voltage lost due to the internal resistance of the battery.
c) total charge that passes through the battery.
d) number of coulombs of charge passing through the battery per second.
e) energy supplied to each coulomb of charge passing through the battery.

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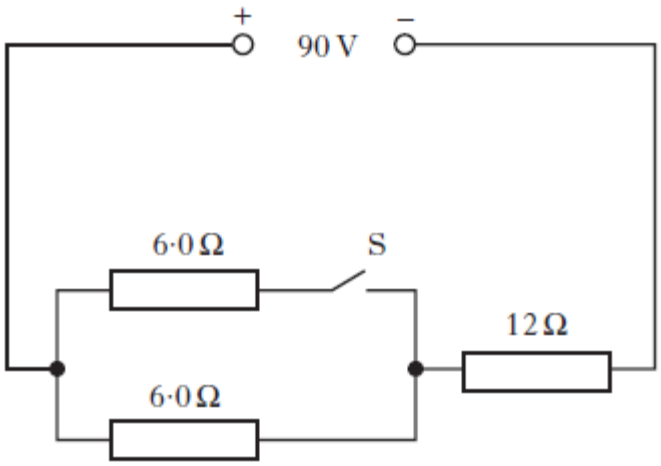
A circuit is set up as shown:



The internal resistance of the supply is negligible.

Which row in the table shows the potential difference (p.d.) across the 12 Ω resistor when switch S is open and when S is closed? (1)

	p.d. across 12 Ω resistor when S is open / V	*p.d. across 12 Ω* resistor when S is closed / V
A	30	18
B	45	45
C	60	45
D	60	72
E	72	60

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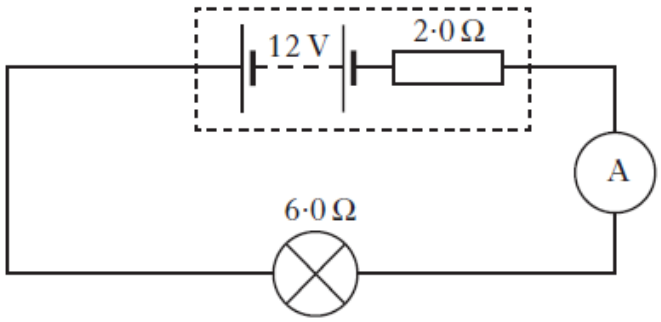
A student carries out two experiments using different power supplies connected to a lamp of resistance 6.0 Ω.

a) In the first experiment, the lamp is connected to a power supply of e.m.f 12 V and internal resistance 2.0 Ω as shown.



Calculate:

i. the reading on the ammeter; (3)

ii. the lost volts; (2)

iii. the output power of the lamp. (3)

b) In the second experiment, the lamp is now connected to a different power supply. This supply has the same e.m.f. as the supply in part a) but a different value of internal resistance.
The output power of the lamp is now greater.
Assuming the resistance of the lamp has not changed, is the internal resistance of the new power supply less than, equal to, or greater than the internal resistance of the original supply?
Justify your answer.

(4)

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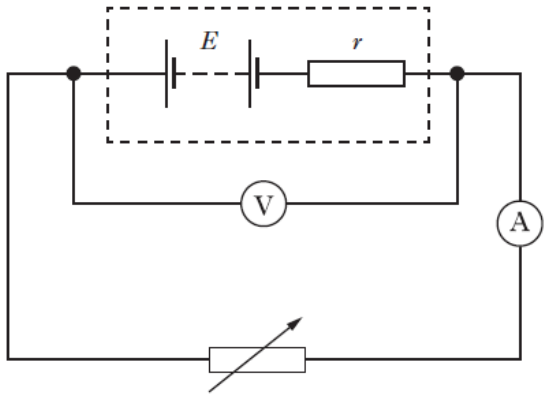
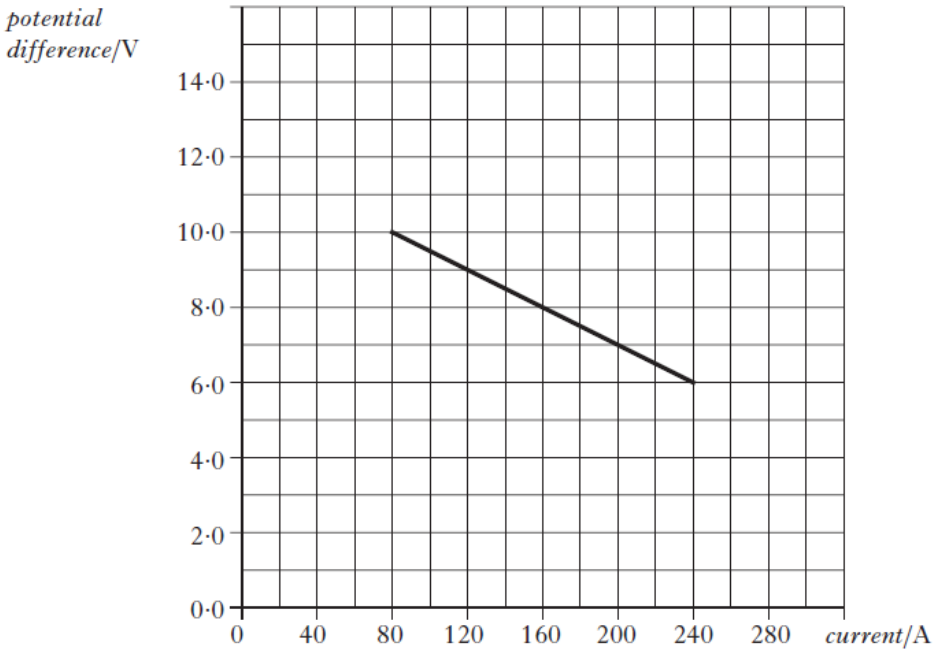
A technician is testing a new design of car battery.

The battery has an e.m.f. E and internal resistance r.

a) In one test, the technician uses this battery in the following circuit.



Readings from the voltmeter and ammeter are used to plot the following graph.

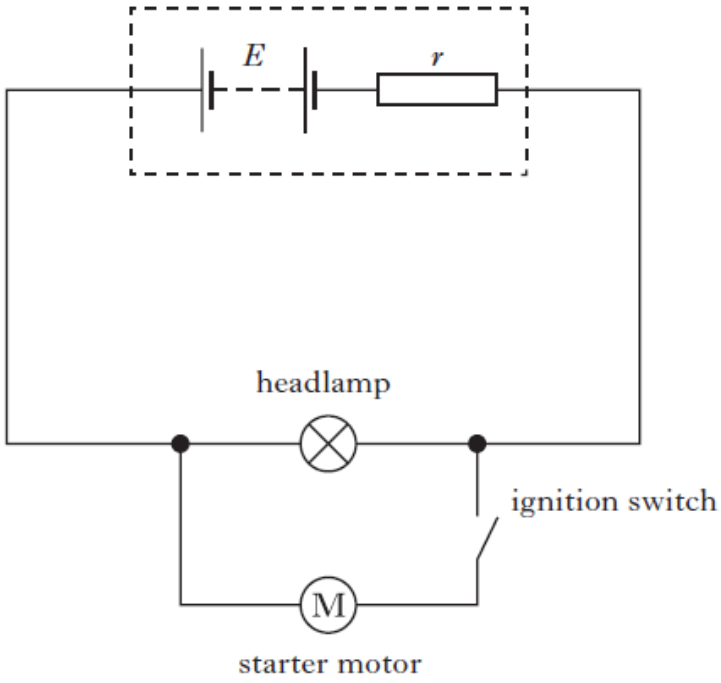


i. Use information from the graph to determine the e.m.f of the car battery. (1)

ii. Calculate the internal resistance of the car battery. (3)

iii. The technician accidentally drop a metal spanner across the terminals of the battery. This causes a short circuit.
Calculate the short circuit current. (3)

b) In a second test, the technician connects the battery to a headlamp in parallel with a starter motor as shown.



The technician notices that the headlamp becomes dimmer when the ignition switch is closed and the starter motor operates.
Explain why this happens. (4)