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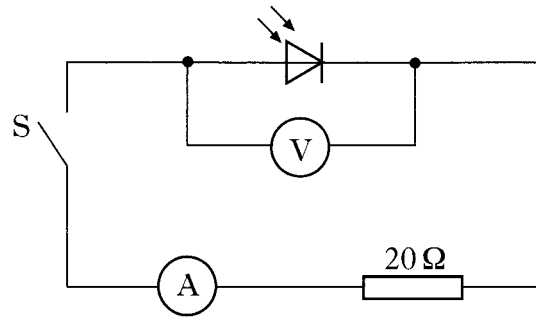
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Past Paper questions

2000 - 2010

2000 Q25.

A photodiode is connected in a circuit as shown below.



Switch S is open.

Light is shone on to the photodiode.

A reading is obtained on the voltmeter.

- (a) (i) State the mode in which the photodiode is operating.
 (ii) Describe the effect of light on the material of which the photodiode is made.
 (iii) The intensity of the light on the photodiode is increased.
 What happens to the reading on the voltmeter?
- (b) Light of a constant intensity is shone on to the photodiode in the circuit shown above.
 The following measurements are obtained with S open and then with S closed.

	S open	S closed
<i>reading on voltmeter/V</i>	0.508	0.040
<i>reading on ammeter/mA</i>	0.00	2.00

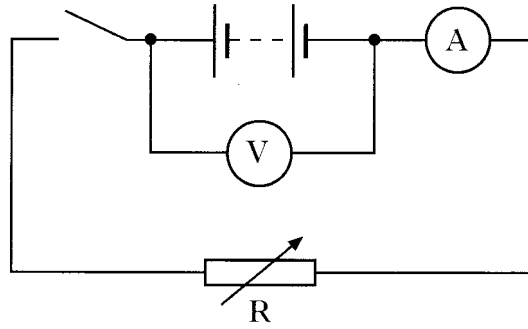
- (i) What is the value of the e.m.f. produced by the photodiode for this light intensity?
 (ii) Calculate the internal resistance of the photodiode for this light intensity.
- (c) In the circuit above, the 20 Ω resistor is now replaced with a 10 Ω resistor.
 The intensity of the light is unchanged.
 The following measurements are obtained.

	S open	S closed
<i>reading on voltmeter/V</i>	0.508	0.021

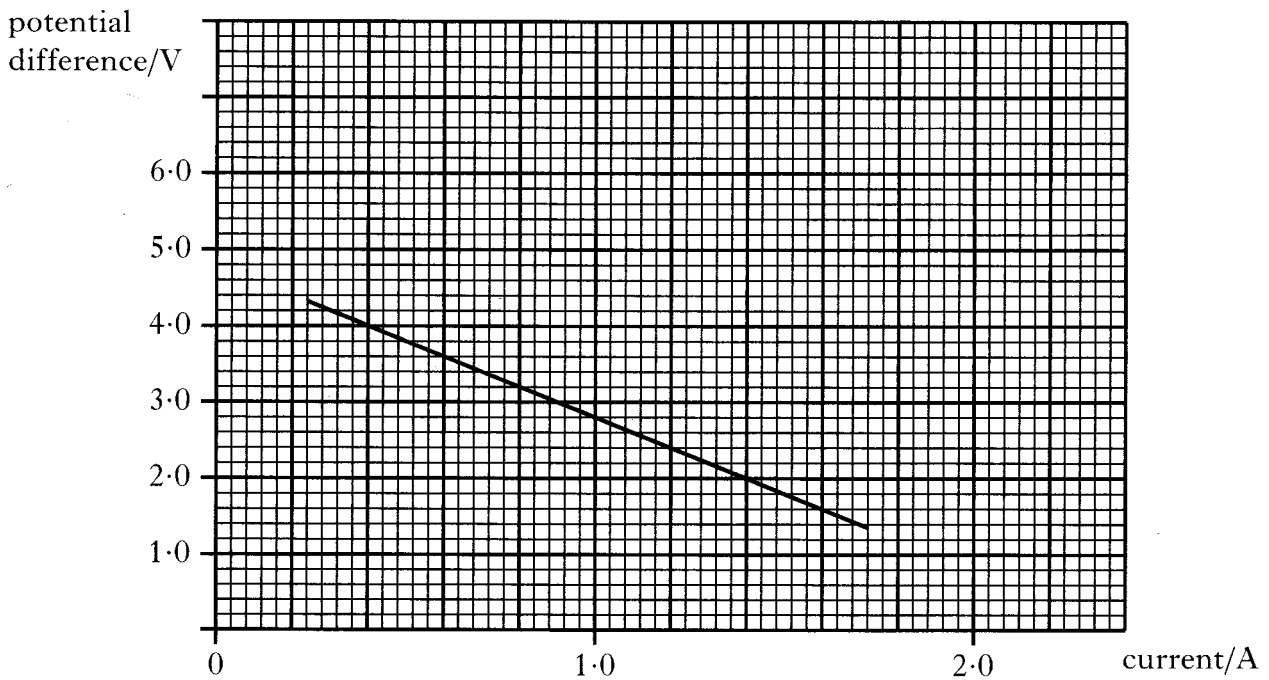
Explain why the reading on the voltmeter, when S is closed, is smaller than the corresponding reading in part (b).

2001 Q24.

(a) The following circuit is used to measure the e.m.f. and the internal resistance of a battery.



Readings of current and potential difference from this circuit are used to produce the following graph.



Use information from the graph to find:

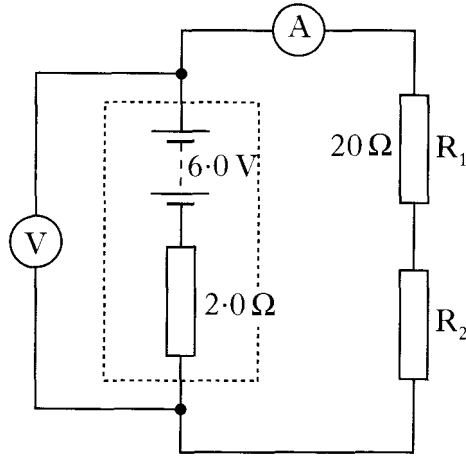
- (i) the e.m.f. of the battery, in volts;
 - (ii) the internal resistance of the battery.
- (b) A car battery has an e.m.f. of 12V and an internal resistance of 0.050Ω .
- (i) Calculate the short circuit current for this battery.
 - (ii) The battery is now connected in series with a lamp. The resistance of the lamp is 2.5Ω . Calculate the power dissipated in the lamp.

2002 Q24.

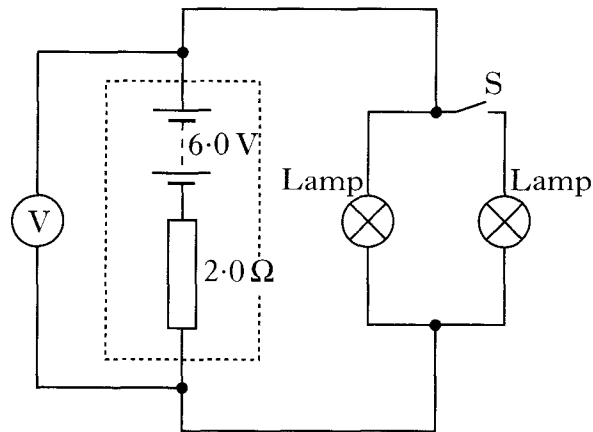
A battery has an e.m.f. of 6.0 V and internal resistance of 2.0 Ω .

- (a) What is meant by an *e.m.f. of 6.0 V*?
- (b) The battery is connected in series with two resistors, R_1 and R_2 . Resistor R_1 has a resistance of 20 Ω .

The reading on the ammeter is 200 mA.



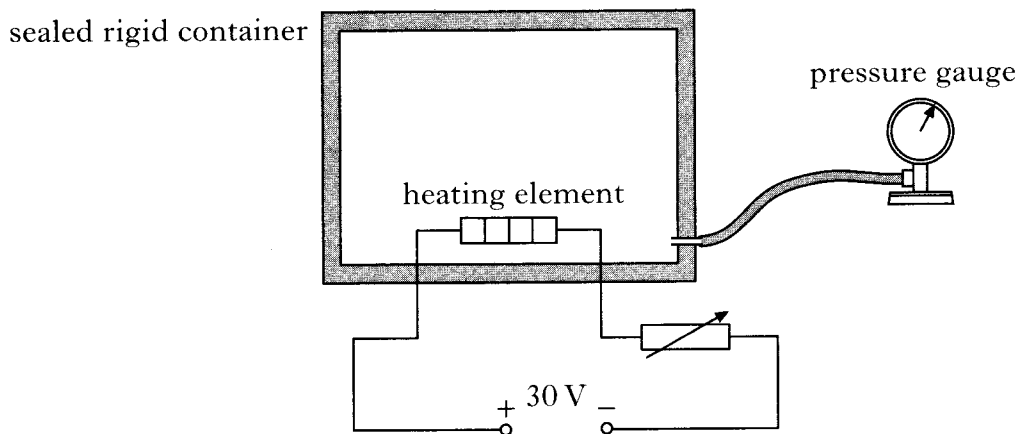
- (i) Show by calculation that R_2 has a resistance of 8.0 Ω .
 - (ii) Calculate the reading on the voltmeter.
- (c) The battery is now connected to two identical lamps as shown below.



Describe and explain what happens to the reading on the voltmeter when switch S is closed.

2003 Q24.

A technician designs the following apparatus to investigate the pressure of a gas at different temperatures.

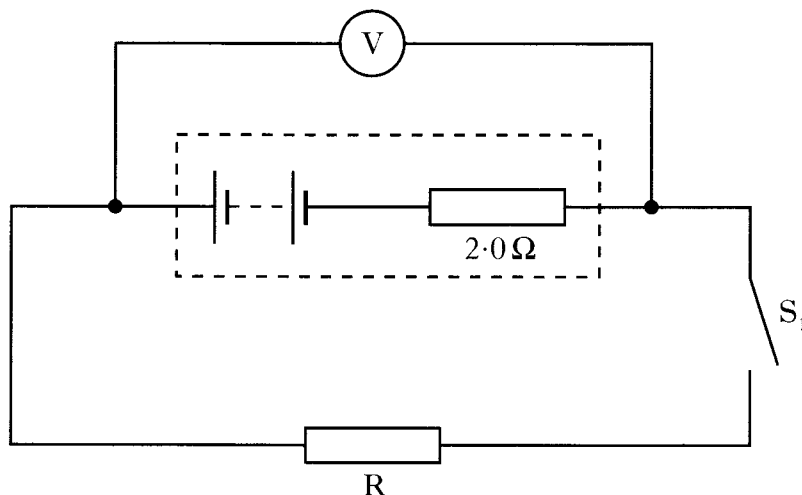


The heating element is used to raise the temperature of the gas.

- (a) Initially the gas is at a pressure of 1.56×10^5 Pa and a temperature of 27°C .
The temperature of the gas is then raised by 50°C .
Calculate the new pressure of the gas in the container.
- (b) The power supply shown above has an e.m.f. of 30V and negligible internal resistance.
The resistance of the heating element is 0.50Ω and the resistance of the variable resistor is set to 1.50Ω .
- (i) Calculate the power output from the heating element.
- (ii) How would your answer to part (b)(i) be affected if the internal resistance of the power supply was **not** negligible? You must justify your answer.

2004 Q24.

A student sets up the circuit shown.

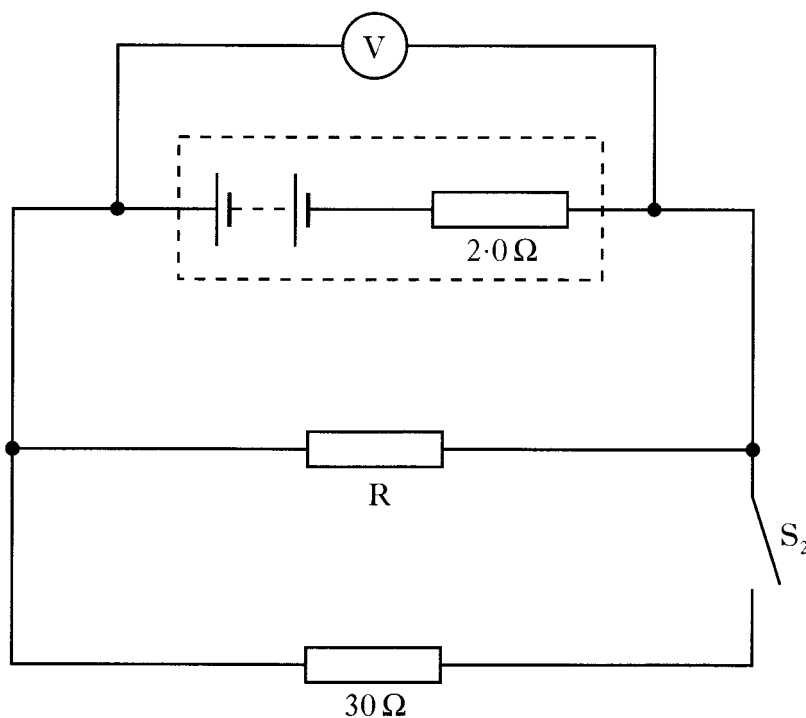


The internal resistance of the battery is 2.0Ω .

With S_1 open, the student notes that the reading on the voltmeter is 9.0 V .

The student closes S_1 and notes that the reading on the voltmeter is now 7.8 V .

- (a) (i) Calculate the resistance of resistor R .
(ii) Explain why the reading on the voltmeter decreases when S_1 is closed.
- (b) The student adds a 30Ω resistor and a switch S_2 to the circuit as shown.

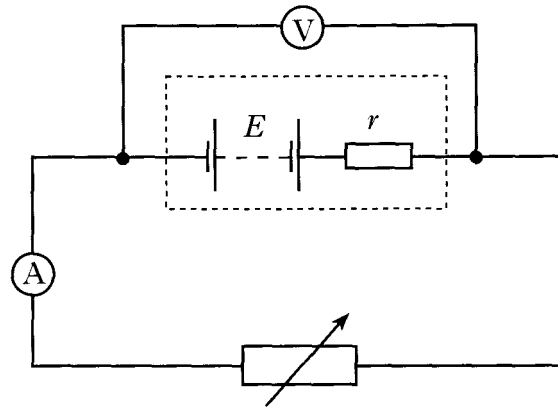


The student now closes S_2 .

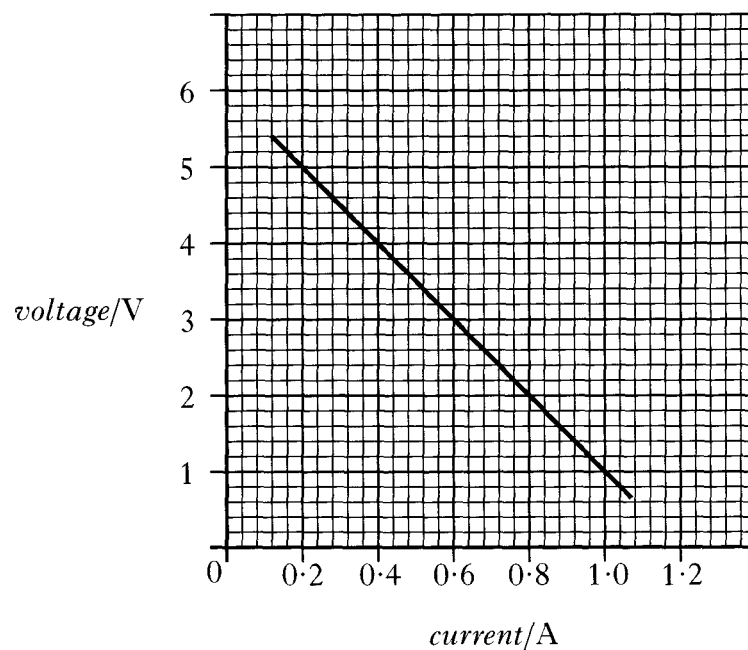
Explain what happens to the reading on the voltmeter.

2005 Q25.

A student sets up the following circuit to find the e.m.f. E and the internal resistance r of a battery.

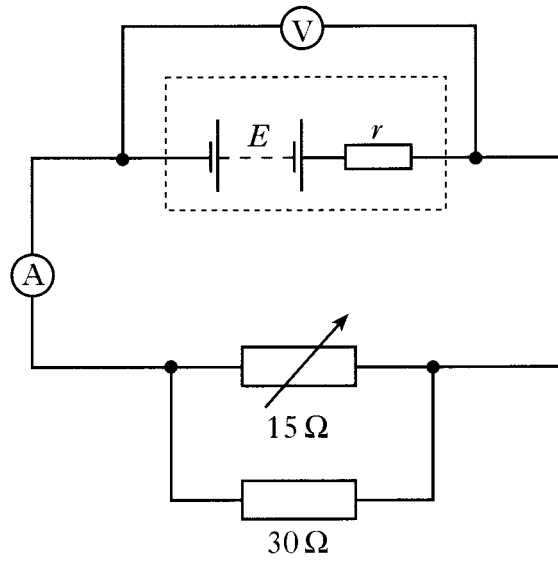


Readings from the voltmeter and ammeter are used to plot the following graph.



- (a) What is meant by the term *e.m.f.*?
- (b) (i) Use the graph to determine:
(A) the e.m.f.;
(B) the internal resistance of the battery.
- (ii) Show that the variable resistor has a value of 15Ω when the current is 0.30A .

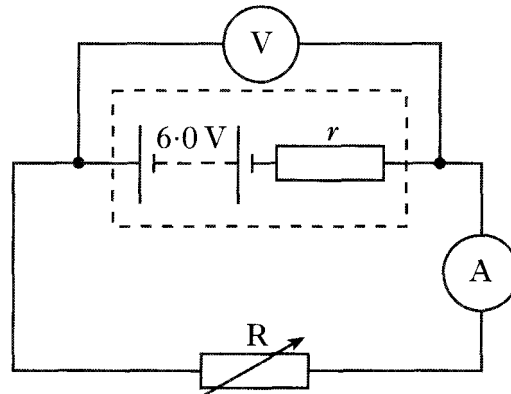
(c) Without adjusting the variable resistor, a $30\ \Omega$ resistor is connected in parallel with it.



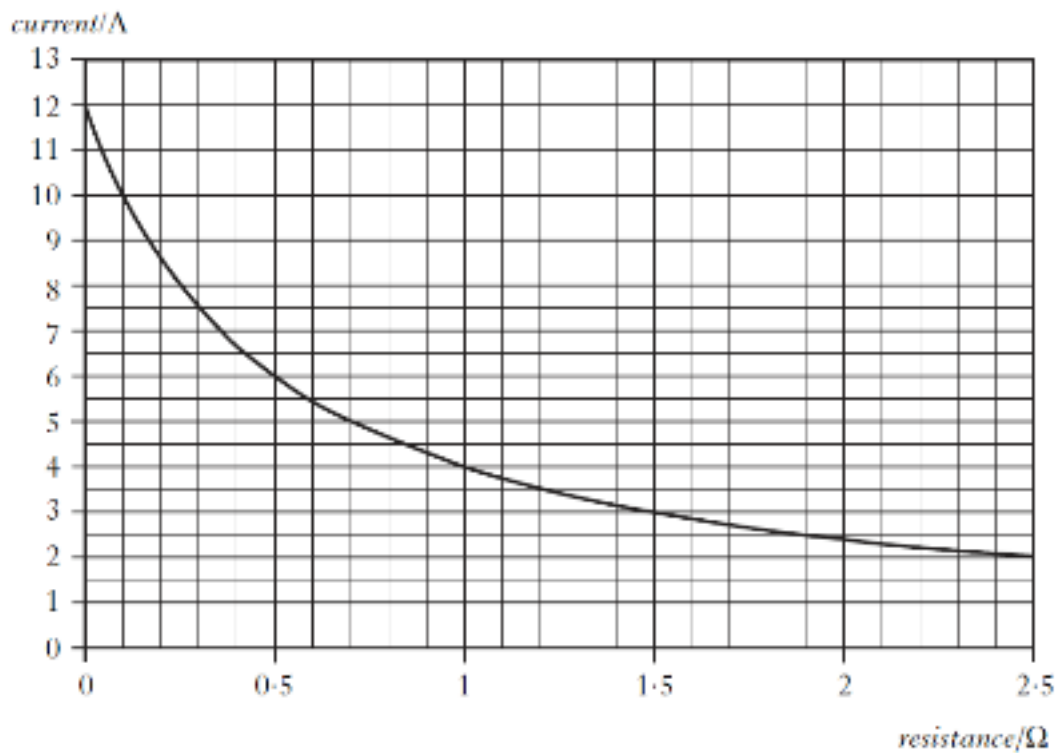
Calculate the new reading on the ammeter.

2009 Q24.

A battery of e.m.f. 6.0 V and internal resistance, r , is connected to a variable resistor R as shown.



The graph shows how the current in the circuit changes as the resistance of R increases.

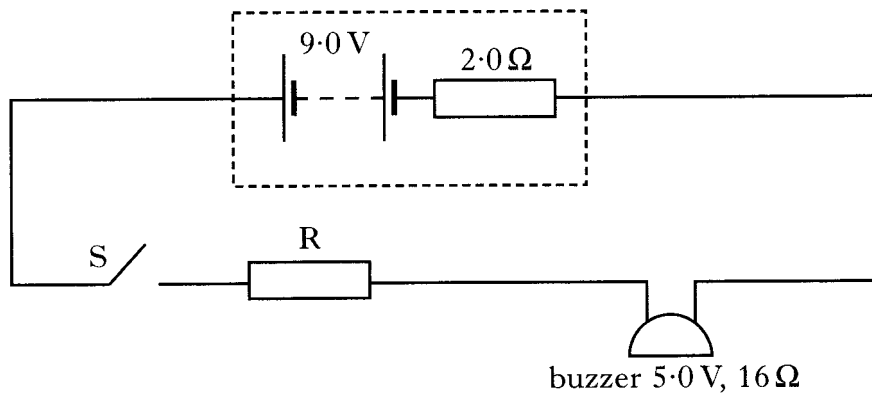


- (a) Use information from the graph to calculate:
- the lost volts in the circuit when the resistance of R is 1.5Ω ;
 - the internal resistance, r , of the battery.
- (b) The resistance of R is now increased.
What effect, if any, does this have on the lost volts?
You must justify your answer.

2010 Q30. (part)

- (d) The alarm circuit in the smoke detector contains a battery of e.m.f. 9.0V and internal resistance $2.0\ \Omega$.

This circuit is shown.



When smoke is detected, switch S closes and the buzzer operates.

The buzzer has a resistance of $16\ \Omega$ and an operating voltage of 5.0V .

Calculate the value of resistor R required in this circuit.