Department of Mechanical, Materials and Manufacturing Engineering

The University of Nottingham

Electromechanical Devices MMME2051EMD

Exercise Sheet 1 - Basic electrical principles and laws

1.1 For the circuit shown in Fig 1.1, calculate the current supplied by the battery, voltage across 2.2kΩ resistor, power dissipated in that resistor and power supplied by the battery. (Hint: start by finding the effective resistance of two of the resistors then the current in that pair of resistors).

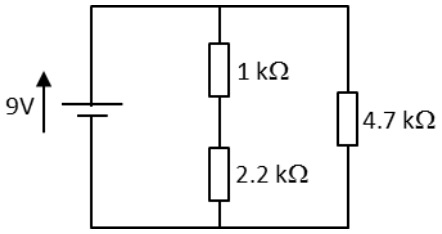


Fig 1.1

4.72mA, 6.19V, 17.4mW, 42.5mW

1.2 The digital outputs from an Arduino microcontroller give a voltage of 5V with respect to ground (Fig, 1.2). It is desired to drive an LED indicator, which needs a current of 13 mA and has a voltage drop of 2.1V across it. To avoid damage a resistor is put in series with the LED. What voltage drop is required across a resistor? What resistor is needed to get desired current?

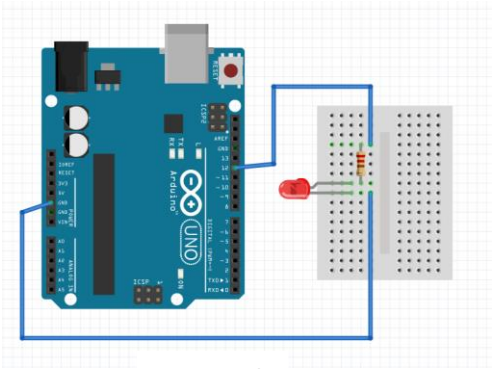
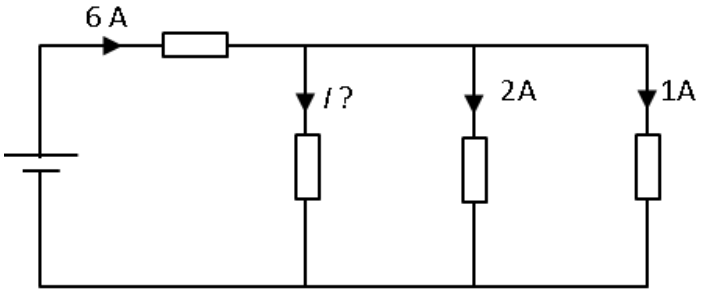


Fig. 1.2

2.9 V; 223 Ω

1.3 What is the unknown current shown in Fig. 1.3?



3A

1.4 Fig. 1.4 shows a car battery connected to a lamp which is drawing 3A and a heater (shown as a resistor) which is drawing 8A. A generator is supplying 10A (via a resistor) to the circuit in an attempt to charge the battery. What is the current *I* and which direction is it in? Is the battery charging or discharging? (Hint: direction of *I* is not shown but you can choose convention for positive *I* arbitrarily then find actual direction from sign of answer).

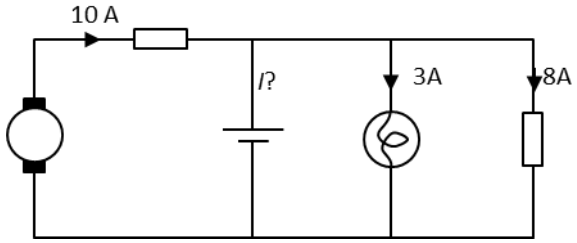


Fig. 1.4

Current is 1A in an upward direction: battery is discharging.

1.5 For the circuit shown in Fig 1.5, calculate the equivalent resistance across the battery, current *I*, voltage across 2.2kΩ resistor, power dissipated in 4.7kΩ resistor and power supplied by the battery.

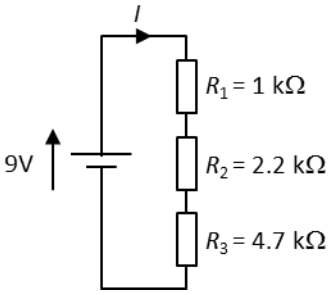


Fig 1.5

7.9 kΩ, 1.14mA, 2.51V, 6.1mW, 10.3mW.

1.7 For the circuit shown in Fig 1.7, calculate the equivalent resistance across the battery, the current supplied by the battery, current through 2.2kΩ resistor, power dissipated in 4.7kΩ resistor and power supplied by the battery.

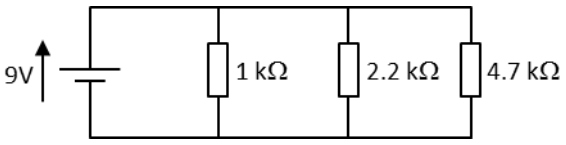


Fig 1.7

0.6 kΩ or 600Ω, 15mA, 4.1mA, 17.2mW, 135mW.

1.8 A DC motor is fed with a current of 1.5 A from a 12 V battery via a diode with a voltage drop of 0.7 V and via wiring of resistance 1.5 Ω (Fig. 1.8). What is the potential difference *V* across the motor?

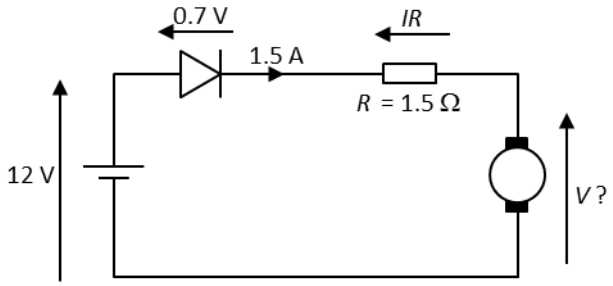


Fig. 1.8

9.05 V

Consolidation/revision question

1.9 For the circuit shown in Fig 1.5, the supply voltage is measured as 11.5V and the total current drawn is 2.5A. If the resistor is known to have a resistance of 12Ω, what is the current *I* flowing in the lamp? (Hint: use Ohm's law followed by Kirchhoff's current law).

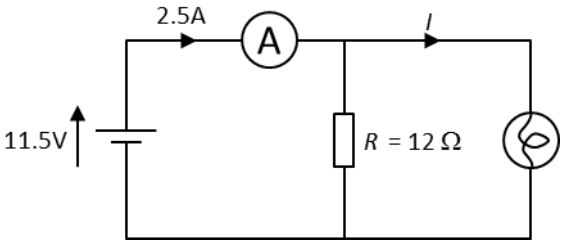


Fig 1.9

1.54 A.