Edexcel AS Questions on Electrical Work and Power

Jan 2009 Q1

1 A child's toy is operated by a small motor. The potential difference across the motor is 6.0 V and the current in it is 0.20 A. The energy used by the motor in 120 s is

- ☐ **A** 2.40 J
- ☐ **B** 60.0 J
- ☐ **C** 144 J
- ☐ **D** 3600 J

Jan 2009 Q19

*19 (a) A 60 W filament light bulb is used as a ceiling light. The bulb is 2.5 m above the floor and is 5.0% efficient at converting electrical energy into visible light.

Calculate the visible light intensity (radiation flux) on the floor directly below the bulb.

Assume that at a distance r from the source the energy is spread over a total area $4\pi r^2$.

(3)

Visible light intensity = ...

(b) Increasingly a different type of light bulb is being used. It is a coiled fluorescent bulb. A 10 W bulb of this type could replace the 60 W filament bulb and give the same visible light intensity on the floor.

Approximately 25% of national power production is used for lighting.

Discuss why some countries have announced that filament bulbs will be banned in the next few years.

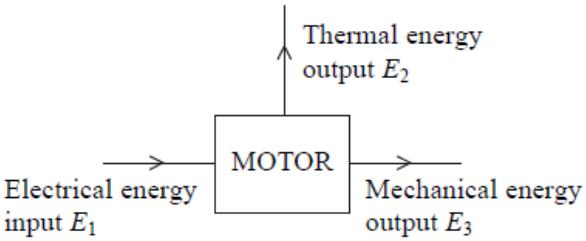
(3)

(Total for Question 19 = 6 marks)

Edexcel AS Questions on Electrical Work and Power

Jan 2010 Q6

6 The diagram shows the energy transfer for an electric motor.



The efficiency of the motor is

☒ **A** $\frac{E_1}{E_2 + E_3}$

☒ **B** $\frac{E_1}{E_2}$

☒ **C** $\frac{E_3}{E_1}$

☒ **D** $\frac{E_2 + E_3}{E_1}$

Jan 2010 Q7

7 An electron is accelerated through a large potential difference and gains a kinetic energy of 47 keV. This energy expressed as joules equals

☒ **A** 7.5×10^{-18} J

☒ **B** 7.5×10^{-15} J

☒ **C** 2.9×10^{20} J

☒ **D** 2.9×10^{23} J

Edexcel AS Questions on Electrical Work and Power

June 2010 Q4

4 A 100 W lamp connected to the 230 V mains is replaced by a lamp which has twice the resistance. The power of the new lamp is

- ☒ **A** 25 W
- ☒ **B** 50 W
- ☒ **C** 200 W
- ☒ **D** 400 W

June 2010 Q15

*15 Many computers operate through an uninterrupted power supply (UPS) to protect them and the information stored on them from power surges or power cuts. A UPS will run the computer from the mains supply until it detects a problem and then the computer will run off the UPS's rechargeable battery.
A UPS is rated by the maximum power that it can provide to the computer. The unit that is used is the volt-amp (VA).

(a) Use expressions for potential difference and current to show that the volt-amp is equivalent to the watt.

(3)

(b) Each cell of the rechargeable battery has an internal resistance. An advertisement for a UPS states that, at an output power to the computer of 700 W, it can provide a continuous supply for 7 minutes.

(i) Calculate how much energy is provided in this time.

(2)

Energy =

(ii) The advertisement also states that if the output power is halved, the supply will last for 23 minutes. Without doing any calculations, explain why halving the power output more than doubles the time.

(3)

(Total for Question 15 = 8 marks)

Edexcel AS Questions on Electrical Work and Power

Jan 2011 Q1

1 The amount of electrical energy transferred when a charge of 8 mC moves through a potential difference of 12 V is

- ☒ **A** 1500 J
- ☒ **B** 96 J
- ☒ **C** 9.6×10^{-2} J
- ☒ **D** 6.7×10^{-4} J

Jan 2011 Q15

15 (a) A kettle is rated at 1 kW, 220 V.

Calculate the working resistance of the kettle.

(2)

Resistance = ...

(b) When connected to a 220 V supply, it takes 3 minutes for the water in the kettle to reach boiling point.

Calculate how much energy has been supplied.

(2)

Energy = ...

(c) Different countries supply mains electricity at different voltages. Many hotels now offer a choice of voltage supplies as shown in the photograph.

(i) By mistake, the kettle is connected to the 110 V supply. Assuming that the working resistance of the kettle does not change, calculate the time it would take for the same amount of water to reach boiling point.

(3)

Time = ...

(ii) Explain what might happen if a kettle designed to operate at 110 V is connected to a 220 V supply.

(2)

(Total for Question 15 = 9 marks)

Jan 2011 Q17

17 (a) A student uses a computer for an average of 5 hours every day. The battery supplies a current of 3.5 A to the computer.

Calculate how many electrons flow through the computer's battery in 5 hours.

(4)

Number of electrons = ...

(b) The computer's screen emits visible light photons with an average frequency of 5.5×10^{14} Hz. The power of the light emitted is 10 W.

Calculate the number of photons emitted per second from the computer screen.

(3)

Number of photons = ...

(Total for Question 17 = 7 marks)

June 2011 Q13

13 Mobile phones have a rechargeable battery which is recharged by means of a mains adaptor. One such adaptor has an input power of 4.8 W at a voltage of 230 V.

(a) Calculate the input current to the adaptor when it is in use.

(2)

Input current = ...

(b) The adaptor's output is labelled as 5 V 0.1 A 0.5 V A

(i) Show that the unit V A is equivalent to the watt.

(1)

(ii) Calculate the efficiency of the adaptor.

(2)

Efficiency = ...

(iii) Suggest a reason why the efficiency is less than 100%.

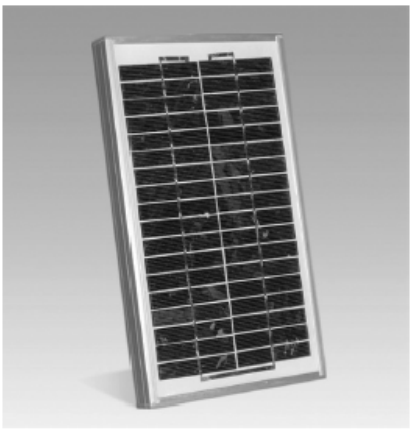
(1)

(Total for Question 13 = 6 marks)

Edexcel AS Questions on Electrical Work and Power

Jan 2012 Q11

11 The photograph shows a solar panel being used to produce electricity.



The solar panel has an efficiency of 15%. The average radiation flux falling on the panel is 210 W m^{-2}.

Assuming that this radiation falls normally on the panel, calculate the area of the panel that would provide an average power output of 500 W.

(3)

Area = ...

(Total for Question 11 = 3 marks)

Edexcel AS Questions on Electrical Work and Power

Jan 2012 Q19

19 Energy is a very important concept in physics. Energy is usually measured in joules, but may be measured in electronvolts (eV) or kilowatt-hours (kW h).

(a) In an X-ray tube an electron is accelerated across a potential difference of 100 000 V. The electron gains 100 000 eV of kinetic energy.

Calculate this energy in joules.

(2)

100 000 eV = ... J

(b) A 1000 W domestic heater dissipates 8 kW h of energy when used for 8 hours.

Calculate the energy dissipated in joules.

(2)

8 kW h = ... J

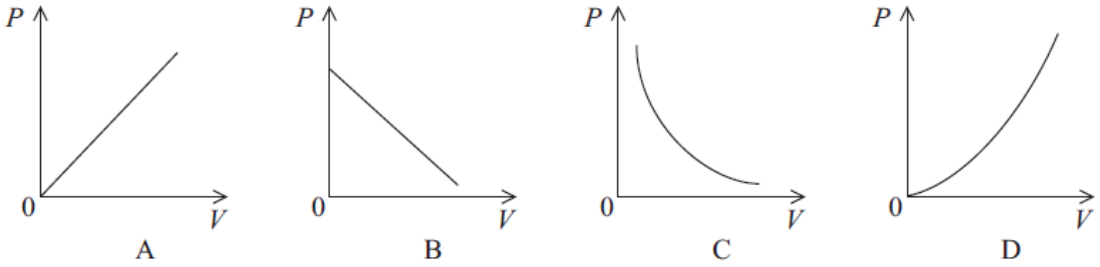
(c) Suggest why, in the above cases, the electronvolt and the kilowatt-hour are more convenient units than the joule.

(2)

(Total for Question 19 = 6 marks)

June 2012 Q5

5 The graphs show possible variations of power P with potential difference V.



Which graph is correct for a resistor that obeys Ohm's law?

☒ **A**

☒ **B**

☒ **C**

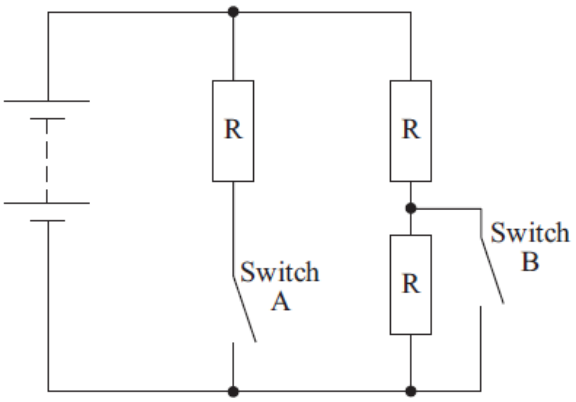
☒ **D**

June 2012 Q11

11 The photograph shows a convector heater designed for use in a home. It operates by air flowing through the heater and passing over its heating elements.

The heater contains three identical heating elements and two switches.

(a) A student models the heater using the circuit below. The power supply has a negligible internal resistance.



The table gives the four possible combinations of the two switches.
Complete the table to show the total circuit resistance for each switch combination.

(3)

Switch combinations	Total circuit resistance
A open. B closed	R
A open. B open	
A closed. B closed	
A closed. B open	

(b) Explain which switch combination dissipates the most energy in a given time.

(2)

(c) The power supply is replaced by one with an internal resistance.

Explain what effect this change will have on the thermal energy output of the heater.

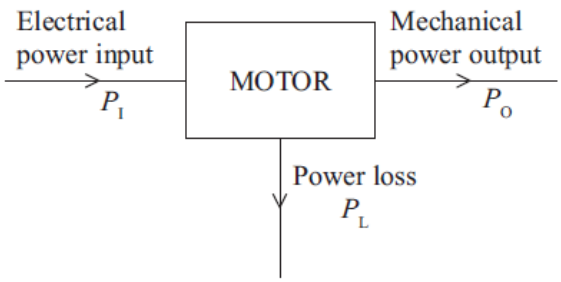
(2)

(Total for Question 11 = 7 marks)

Edexcel AS Questions on Electrical Work and Power

Jan 2013 Q3

3 Electrical power is transferred in a motor as shown.



What is the efficiency of the motor?

☒ **A** $\frac{P_O + P_L}{P_I}$

☒ **B** $\frac{P_I}{P_O}$

☒ **C** $\frac{P_L}{P_I}$

☒ **D** $\frac{P_O}{P_I}$

Jan 2013 Q5

5 An electron is accelerated from rest through a potential difference of 5.0 kV.

The kinetic energy gained by the electron is

☒ **A** 8.0×10^{-16} J

☒ **B** 8.0×10^{-19} J

☒ **C** 3.2×10^{-20} J

☒ **D** 3.2×10^{-23} J

Jan 2013 Q18

18 If certain crystals are subjected to a mechanical stress, a potential difference is generated across them. This is called the piezoelectric effect. These crystals can be produced as very thin films.

Below is a photograph of a T-shirt with a built-in phone charger, which is being tested at a music festival. The white rectangle is a piezoelectric film.

(a) By considering how a sound wave travels through the air, explain how sound can cause a piezoelectric film to generate a potential difference.

(4)

(b) Explain why the crystals used in the T-shirt need to be in the form of a large, thin film.

(3)

(c) When the T-shirt is used at a music festival the sound levels are sufficient to generate about 20 kJ over ten hours. This is enough to charge one phone.

Calculate the electrical power output.

(3)

Power output = ...

(d) Give **one** advantage and **one** disadvantage of this charger compared with a conventional charger.

(2)

(Total for Question 18 = 12 marks)

Edexcel AS Questions on Electrical Work and Power

June 2013 Q2

2 An electric motor with potential difference V and current I lifts a mass m through a height h in time t at a steady speed v.

The efficiency of the motor is given by

☐ **A** $\frac{\frac{1}{2}mv^2}{VIt}$

☐ **B** $\frac{VI}{mg}$

☐ **C** $\frac{VIt}{mv}$

☐ **D** $\frac{mgh}{VIt}$

June 2013 Q7

7 Light is shone perpendicularly onto a photovoltaic cell of area 0.01 m^2. In 60 seconds, the total energy falling on the cell is 3 J.

The radiation flux is

☒ **A** 18 000 W m^{-2}

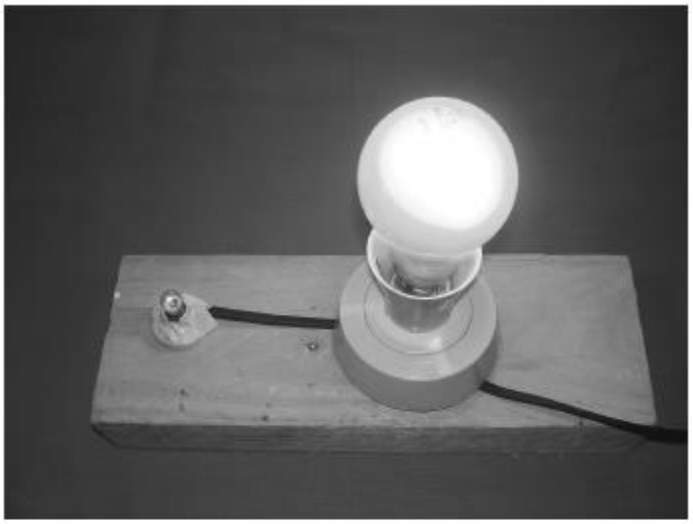
☒ **B** 5 W m^{-2}

☒ **C** 1.8 W m^{-2}

☒ **D** 0.0005 W m^{-2}

June 2013 Q18

18 The photograph shows a piece of apparatus in which a mains light bulb and a torch bulb are both connected to the mains.



Students were surprised to see both bulbs shining normally when the apparatus was switched on.

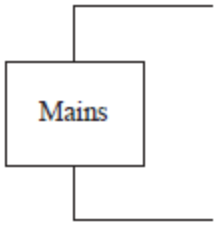
It is impossible to tell from looking at the apparatus whether the bulbs are connected in series or in parallel.

To test this, the apparatus was switched off and the mains bulb was removed. When it was switched on again the torch bulb did not light up. When this was repeated, removing the torch bulb, the mains bulb did not light up.

When the circuit was tried again with both bulbs, they still operated normally.

(a) Complete the circuit diagram to show how the bulbs are connected and explain why they must be connected in this way and not the alternative.

(3)



(b) The mains bulb is marked 40 W, 230 V.

(i) Show that the current in the mains bulb is about 0.2 A when it is operating normally.

(2)

(ii) Calculate the resistance of the mains bulb when it is operating normally.

(2)

Resistance = ...

(iii) The torch bulb is marked 2.5 V, 0.20 A.

Calculate the resistance of the torch bulb when it is operating normally.

(2)

Resistance = ...

(c) Explain, with reference to both current and potential difference, why it is possible to operate both bulbs at the same time from the same power supply.

(2)

(d) Earlier in the question you were asked to calculate the resistances of the bulbs when operating normally.

Explain the effect on the resistances of the bulbs if they are operated at a much smaller current so that neither bulb lights up.

(4)

(Total for Question 18 = 15 marks)