Q1. 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 $\frac{I}{3}$ ⬭

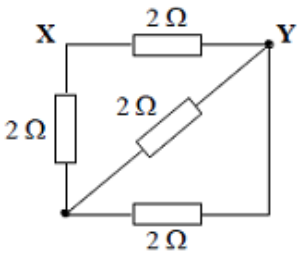
B $\frac{4I}{9}$ ⬭

C $\frac{I}{2}$ ⬭

D $\frac{2I}{3}$ ⬭

(Total 1 mark)

Q2. The diagram shows a network of four 2 Ω resistors.



The effective resistance, in Ω, between **X** and **Y** is

A 0.5

B 1.2

C 1.7

D 2.0

(Total 1 mark)

Q3. Two resistors R_1 and R_2 are made of wires of the same material. The wire used for R_1 has half the diameter and is twice as long as the wire used for R_2.

What is the value of the ratio $\frac{\text{resistance of } R_1}{\text{resistance of } R_2}$?

A 8

B 4

C 1

D 0.5

(Total 1 mark)

Q4. A 1.0 kΩ resistor is thermally insulated and a potential difference of 6.0 V is applied to it for 2.0 minutes. The thermal capacity of the resistor is 9.0 J K^{-1}. The rise in temperature, in K, is

A 1.3×10^{-3}

B 8.0×10^{-3}

C 0.48

D 0.80

(Total 1 mark)

Q5. A 1.5 m length of wire has a cross-sectional area 5.0×10^{-8} m^{2}. When the potential difference across its ends is 0.20 V, it carries a current of 0.40 A. The resistivity of the material from which the wire is made is

A 6.0×10^{7} Ω m

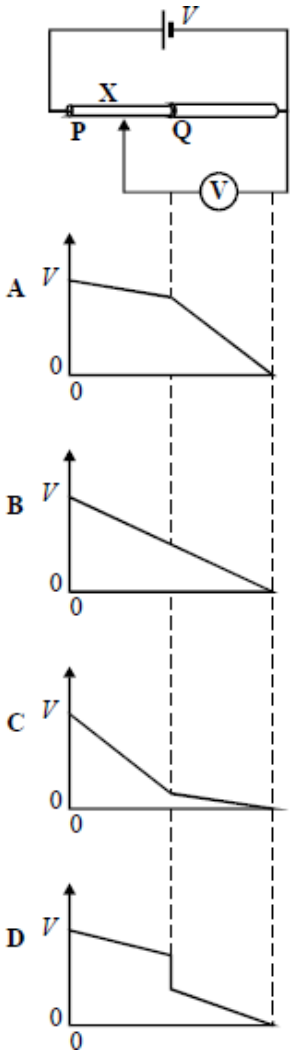
B 1.7×10^{-8} Ω m

C 1.1×10^{6} Ω m

D 9.4×10^{-7} Ω m

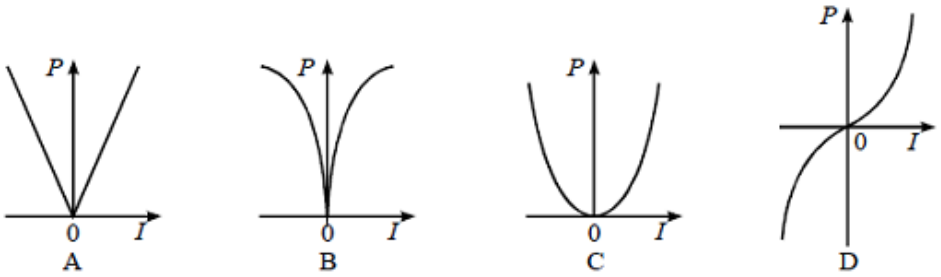
(Total 1 mark)

Q6. The diagram shows two wires, **P** and **Q**, of equal length, joined in series with a cell. A voltmeter is connected between the end of **Q** and a point **X** on the wires. The p.d. across the cell is V. Wire **Q** has twice the area of cross-section and twice the resistivity of wire **P**. The variation of the voltmeter reading as the point **X** is moved along the wires is best shown by



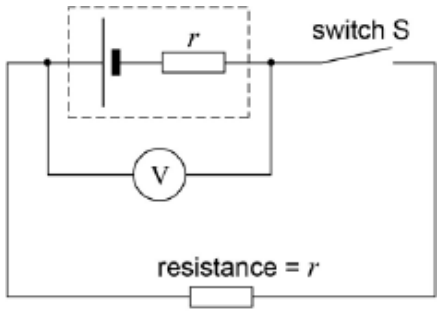
(Total 1 mark)

Q7. A metal wire is maintained at a constant temperature. Which one of the following graphs best represents the relationship between the dissipated power P and the current I in the wire?



(Total 1 mark)

Q8. In the circuit shown, V is a voltmeter with a very high resistance. The internal resistance of the cell, r, is equal to the external resistance in the circuit.



external resistance

Which of the following is not equal to the emf of the cell?

A the reading of the voltmeter when the Switch S is open

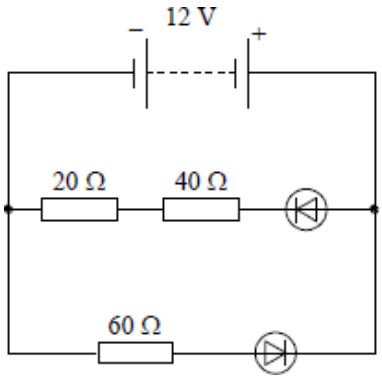
B the chemical energy changed to electrical energy when unit charge passes through the cell

C twice the reading of the voltmeter when the switch S is closed

D the electrical energy produced when unit current passes through the cell

(Total 1 mark)

Q9. The 12 V battery in the circuit shown has negligible internal resistance. The diodes have 'ideal' characteristics.



The current through the battery is approximately

A 0 A

B 0.10 A

C 0.20 A

D 0.40 A

(Total 1 mark)

Q10. Copper metal is a good conductor of electricity because copper atoms in copper metal

A have gained an extra or “free” electron

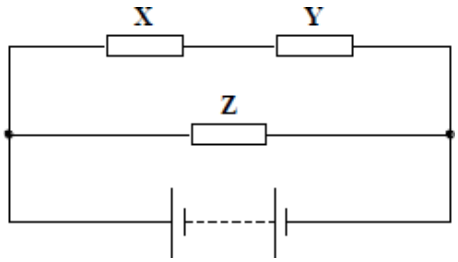
B are ionised so that both ions and “free” electrons can move

C have a negative charge because of the “free” electrons

D have lost an electron to form positive ions and “free” electrons

(Total 1 mark)

Q11. Three identical resistors **X**, **Y** and **Z** are connected across a battery as shown.



The ratio $\frac{\text{power developed in X}}{\text{power developed in Z}}$ is

A $\frac{1}{4}$

B $\frac{1}{2}$

C 1

D 2

(Total 1 mark)

Q12. (a) Define the *electromotive force (emf)* of an electrical power supply.

.....

.....

.....

.....

(2)

(b) Explain why, when a battery is supplying a current to a circuit, the voltage measured between its terminals is less than its emf.

.....

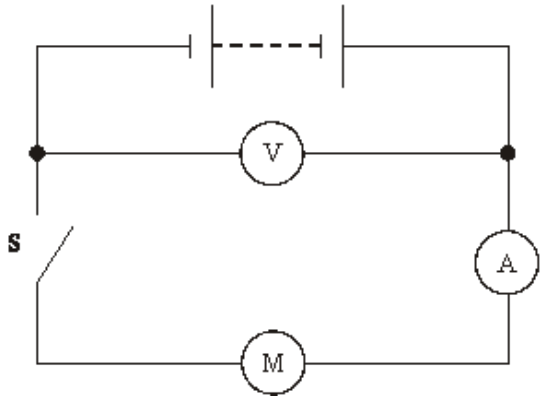
.....

.....

.....

(2)

(c) In the circuit shown in the figure below the voltmeter has a very high resistance and the resistance of the ammeter is negligible. The motor M is being tested using a battery with an emf of 9.00 V.



(i) State the reading on the voltmeter when the switch S is open.

voltmeter reading .....

(ii) When S is closed and the motor is allowed to run freely the voltmeter reading is 8.41 V and the ammeter reads 0.82 A. Calculate the internal resistance of the battery.

internal resistance .....

(iii) Explain why the ammeter reading is greater than 0.82 A when the motor does work by lifting a load.

.....

.....

.....

(5)
(Total 9 marks)

Q13. The circuit in **Figure 1** is used to investigate how the potential difference V between the terminals of a cell varies as the current I in the circuit changes. **Figure 2** shows the graph of the results.

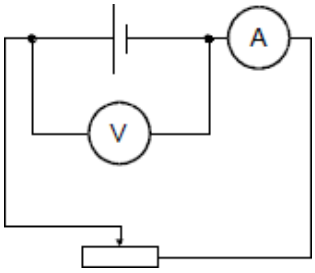


Figure 1

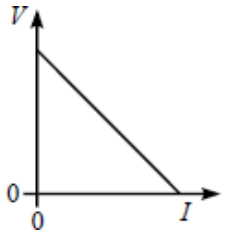


Figure 2

Which one of the following can be deduced from the gradient of the graph?

A The internal resistance of the cell

B The e.m.f. of the cell

C The power dissipated by the cell

D The resistance of the variable resistor

(Total 1 mark)

Q14. The resistance of a metallic conductor increases with temperature because, at higher temperatures,

A more electrons become available for conduction

B the conductor becomes a superconductor

C the amplitude of vibration of lattice ions increases

D the length and cross-sectional area of the conductor both increase

(Total 1 mark)

Q15. In experiments to pass a very high current through a gas, a bank of capacitors of total capacitance 50 μF is charged to 30 kV. If the bank of capacitors could be discharged completely in 5.0 m s what would be the mean power delivered?

A 22 kW

B 110 kW

C 4.5 MW

D 9.0 MW

(Total 1 mark)

Q16. 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 ⬭

(Total 1 mark)

Q17. An electric motor of input power 100 W raises a mass of 10 kg vertically at a steady speed of 0.5 m s^{-1}. What is the efficiency of the system?

A 5% ⬭

B 12% ⬭

C 50% ⬭

D 100% ⬭

(Total 1 mark)

Q18. In parts (i) and (ii) circle the letter that corresponds to the correct answer.

(i) The resistance of a negative temperature coefficient (ntc) thermistor

A increases as temperature increases.

B is constant at temperatures below 0 °C.

C increases as temperature decreases.

D falls to zero when a critical temperature is reached.

(1)

(ii) The unit of potential difference can be expressed as

A $C\ s^{-1}$

B $J\ C^{-1}$

C $V\ A^{-1}$

D $J\ A^{-1}$

(1)
(Total 2 marks)

Q19. 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 $8R$ ⬭

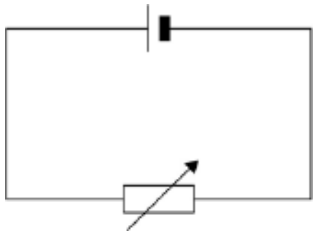
B $4R$ ⬭

C $2R$ ⬭

D R ⬭

(Total 1 mark)

Q20. The cell in the circuit has an emf of 2.0 V. When the variable resistor has a resistance of 4.0 Ω, the potential difference (pd) across the terminals of the cell is 1.0 V.



What is the pd across the terminals of the cell when the resistance of the variable resistor is 12 Ω?

A 0.25 V ⬭

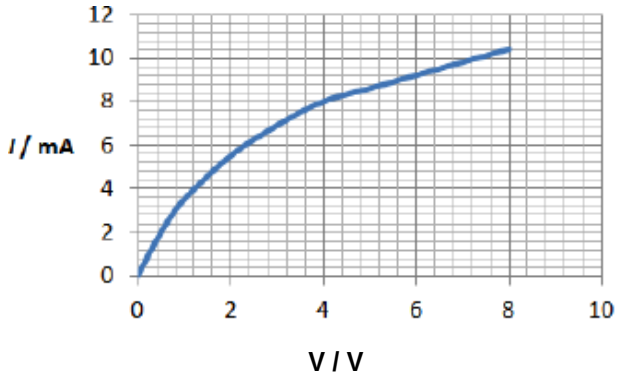
B 0.75 V ⬭

C 1.33 V ⬭

D 1.50 V ⬭

(Total 1 mark)

Q21. The graph shows the current–voltage (*I*–*V*) characteristics of a filament lamp.



What is the resistance of the filament when the potential difference (pd) across it is 4.0 V?

A 500 Ω ⬭

B 1700 Ω ⬭

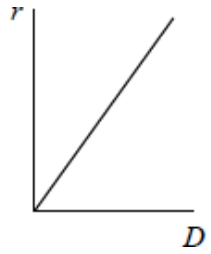
C 2000 Ω ⬭

D 6000 Ω ⬭

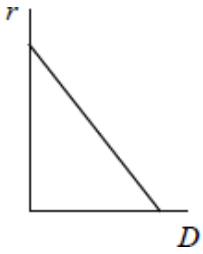
(Total 1 mark)

Q22. Which graph shows how the resistance per unit length *r* of a wire varies with diameter *D* of the wire?

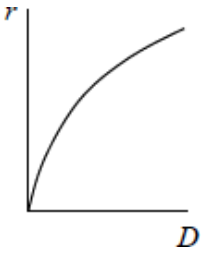
A



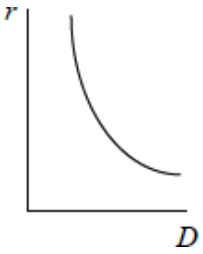
B



C



D



A ☐

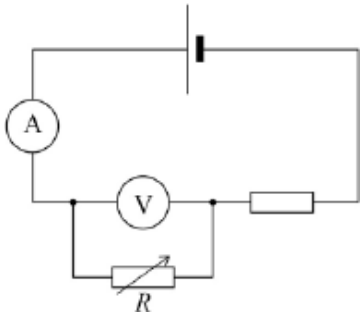
B ☐

C ☐

D ☐

(Total 1 mark)

Q23. In the circuit shown in the diagram the cell has negligible internal resistance.



What happens to the reading of both meters when the resistance of R is decreased?

	Reading of ammeter	Reading of voltmeter	
A	increases	increases	☐
B	increases	decreases	☐
C	decreases	increases	☐
D	unchanged	decreases	☐

(Total 1 mark)

M1. A

[1]

M2. B

[1]

M3. A

[1]

M4. C

[1]

M5. B

[1]

M6. B

[1]

M7. C

[1]

M8. D

[1]

M9. C

[1]

M10. D

[1]

M11. A

[1]

M12. (a) the (total) energy transferred/work done when one unit/coulomb of charge

B1

is moved around a circuit/provided by the supply

B1

2

(b) work is done inside the battery/there is resistance inside the battery

B1

so less energy is available for the external circuit/someoltage is lost between the terminal/mention of lost volts

B1

2

(c) (i) 9.00 V

c.a.o.

B1

(ii) lost voltage = E - V or E = I(R + r)

C1

0.82r = 0.59

C1

5

internal resistance = 0.720 Ω

A1

(iii) because the battery has to provide more energy/power

B1

[9]

M13. A

[1]

M14. C

[1]

M15. C

[1]

M16. C

[1]

M17. C

[1]

M18. (i) C

B1

1

(ii) B

B1

1

[2]

M19. B

[1]

M20. D

[1]

M21. A

[1]

M22. D

[1]

M23. B

[1]