Current of Electricity

TOPIC QUESTIONS (2)

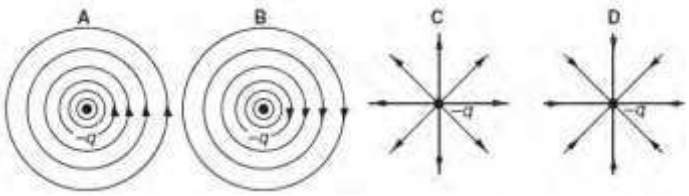
Level	A Level
Subject	Physics
Exam Board	CIE
Paper Type	Multiple Choice

Time Allowed : 1hour 20min

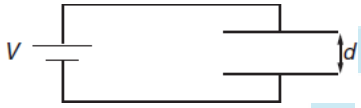
1. A wire carries a current of 2.0 amperes for 1.0 hour. How many electrons pass a point in the wire in this time?

A 1.2×10^{-15} **B** 7.2×10^{3}
C 1.3×10^{19} **D** 4.5×10^{22}

2. Which diagram represents the electric field of a negative point charge –q?



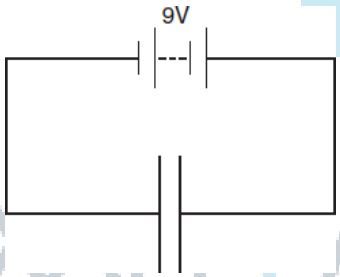
3. A potential difference V is applied between two parallel plates a small distance d apart, and produces an electric field of strength E between the plates.



What is the electric field strength between the plates when both V and d are doubled?

A E / 4 **B** E **C** 2E **D** 4E

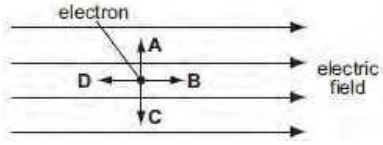
4. In the circuit below, the distance between the two parallel plates is 2.0×10^{-3} m. An electron is situated between the plates.



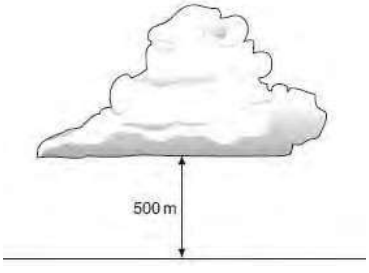
What is the force on the electron?

A 3.2×10^{-22} N **B** 2.9×10^{-21} N
C 8.9×10^{-18} N **D** 7.2×10^{-16} N

5. The diagram shows an electron in a uniform electric field. In which direction will the field accelerate the electron.



6. The diagram shows a thundercloud whose base is 500 m above the ground.



The potential difference between the base of the cloud and the ground is 200 MV. A raindrop with a charge of 4.0×10^{-12} C is in the region between the cloud and the ground.
What is the electrical force on the raindrop?

A 1.6×10^{-6} N B 8.0×10^{-4} N
C 1.6×10^{-3} N D 0.40 N

7. Two wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has a diameter of 2 mm. Wire Q has a diameter of 1 mm.

What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?

A $\frac{1}{4}$ B $\frac{1}{2}$ C 2 D 4

8. What is an equivalent unit to 1 volt?

A 1 J A^{-1} B 1 J C^{-1} C 1 W C^{-1} D 1 W s^{-1}

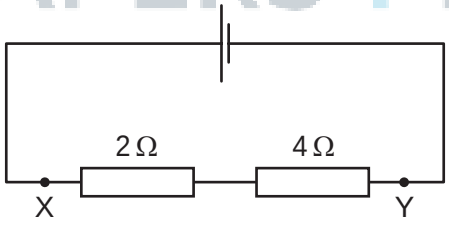
9. The terminal voltage of a battery is observed to fall when the battery supplies a current to an external resistor.
What quantities are needed to calculate the fall in voltage?

A the battery's e.m.f. and its internal resistance
B the battery's e.m.f. and the current
C the current and the battery's internal resistance
D the current and the external resistance

10. The potential difference between point X and point Y is 20 V. The time taken for charge carriers to move from X to Y is 15 s, and, in this time, the energy of the charge carriers changes by 12 J. What is the current between X and Y?

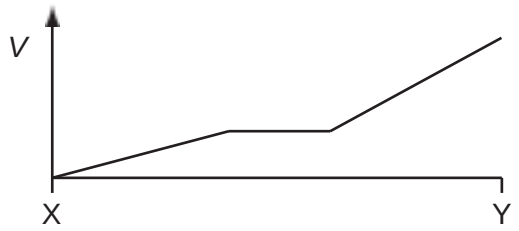
A 0.040 A B 0.11 A C 9.0 A D 25 A

11. A 2 Ω resistor and a 4 Ω resistor are connected to a cell.

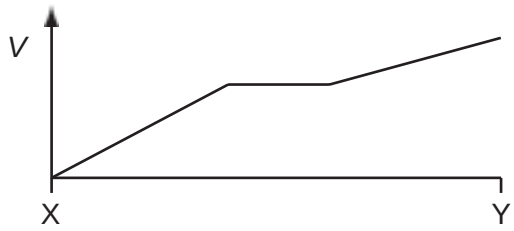


Which graph shows how the potential V varies with distance between X and Y?

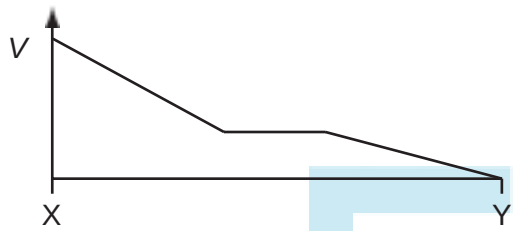
A



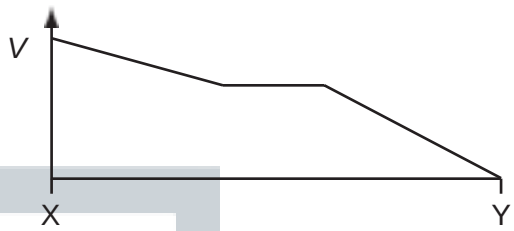
B



C



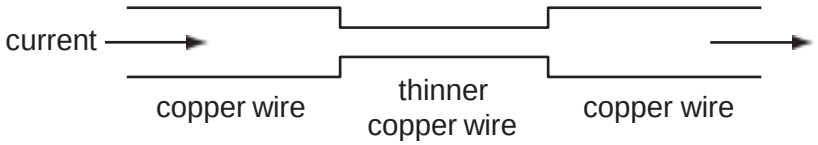
D



12. The current in a component is reduced uniformly from 100 mA to 20 mA over a period of 8.0 s. What is the charge that flows during this time?

A 160 mC B 320 mC C 480 mC D 640 mC

13. An electric current is passed from a thick copper wire through a section of thinner copper wire before entering a second thick copper wire as shown.



Which statement about the current and the speed of electrons in the wires is correct?

A The current and the speed of the electrons in the thinner wire are both less than in the thicker copper wires.

B The current and the speed of the electrons is the same in all the wires.

C The current is the same in all the wires but the speed of the electrons in the thinner wire is greater than in the thicker wires.

D The current is the same in all the wires but the speed of the electrons in the thinner wire is less than in the thicker wire.

14. A low-voltage supply with an e.m.f. of 20 V and an internal resistance of 1.5 Ω is used to supply power to a heater of resistance 6.5 Ω in a fish tank.

What is the power supplied to the water in the fish tank?

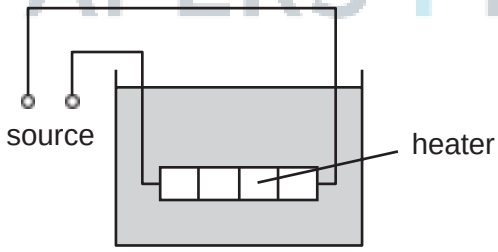
A 41 W B 50 W C 53 W D 62 W

15. A filament lamp has a resistance of 180 Ω when the current in it is 500 mA.

What is the power transformed in the lamp?

A 45 W B 50 W C 90 W D 1400 W

16. The diagram shows a low-voltage circuit for heating the water in a fish tank.



The heater has a resistance of 3.0 Ω. The voltage source has an e.m.f. of 12 V and an internal resistance of 1.0 Ω.

At what rate does the voltage source supply energy to the heater?

A 27 W B 36 W C 48 W D 64 W

17. A copper wire of cross-sectional area 2.0 mm^2 carries a current of 10 A.

How many electrons pass through a given cross-section of the wire in one second?

A 1.0×10^1 B 5.0×10^6 C 6.3×10^{19} D 3.1×10^{25}

18. Which of the following describes the electric potential difference between two points in a wire that carries a current?

A the force required to move a unit positive charge between the points

B the ratio of the energy dissipated between the points to the current

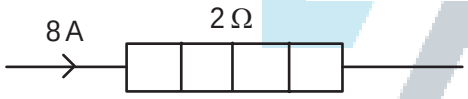
C the ratio of the power dissipated between the points to the current

D the ratio of the power dissipated between the points to the charge moved

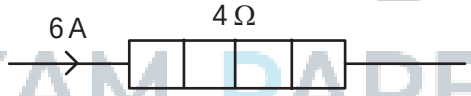
19. The diagram shows four heaters and the current in each.

Which heater has the greatest power dissipation?

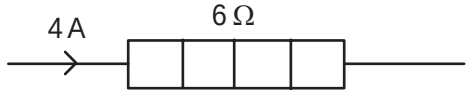
A



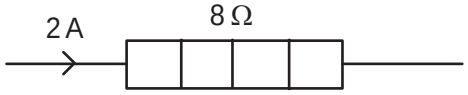
B



C



D



20. What is an equivalent unit to 1 volt?

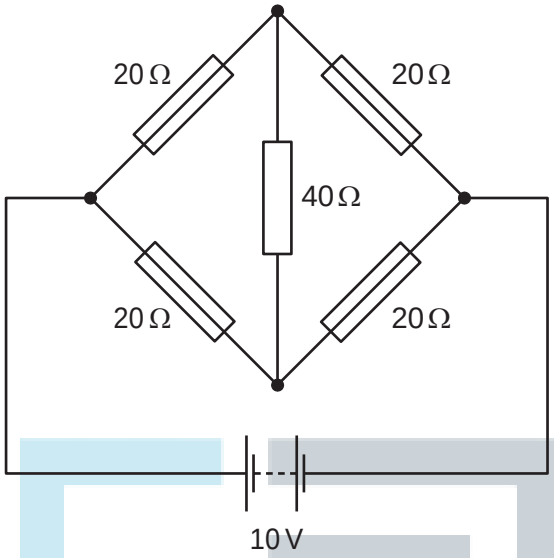
A $1\,JA^{-1}$ B $1\,JC^{-1}$ C $1\,WC^{-1}$ D $1\,Ws^{-1}$

21. Two wires P and Q made of the same material and of the same length are connected in parallelto the same voltage supply. Wire P has diameter 2 mm and wire Q has diameter 1 mm.

What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?

A $\frac{1}{4}$ B $\frac{1}{2}$ C $\frac{2}{1}$ D $\frac{4}{1}$

22. What is the current in the 40 Ω resistor of the circuit shown?



A zero B 0.13 A C 0.25 A D 0.50 A

23. The wire of a heating element has resistance *R*. The wire breaks and is replaced by a different wire.

Data for the original wire and the replacement wire are shown in the table.

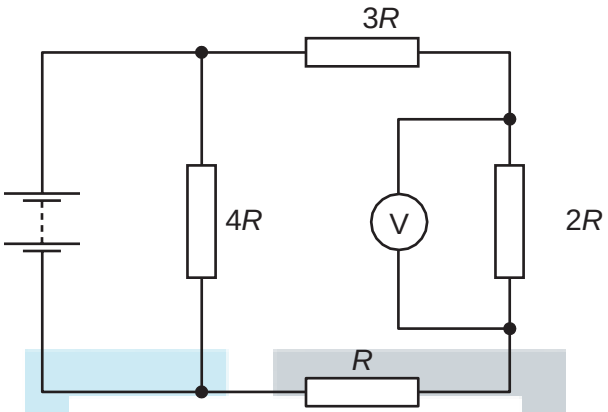
	length	diameter	resistivity of metal
original wire	l	d	ρ
replacement wire	l	$2d$	2ρ

What is the resistance of the replacement wire?

A $\frac{R}{4}$ B $\frac{R}{2}$ C R D $2R$

24. Four resistors of resistance R, $2R$, $3R$ and $4R$ are connected to form a network.

A battery of negligible internal resistance and a voltmeter are connected to the resistor networkas shown.

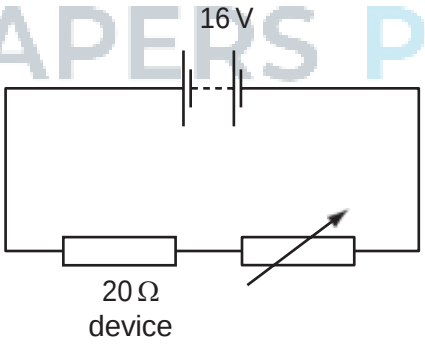


The voltmeter reading is 2 V.

What is the electromotive force (e.m.f.) of the battery?

A 2 V B 4 V C 6 V D 10 V

25. An electrical device of fixed resistance 20 Ω is connected in series with a variable resistor and abattery of electromotive force (e.m.f.) 16 V and negligible internal resistance.

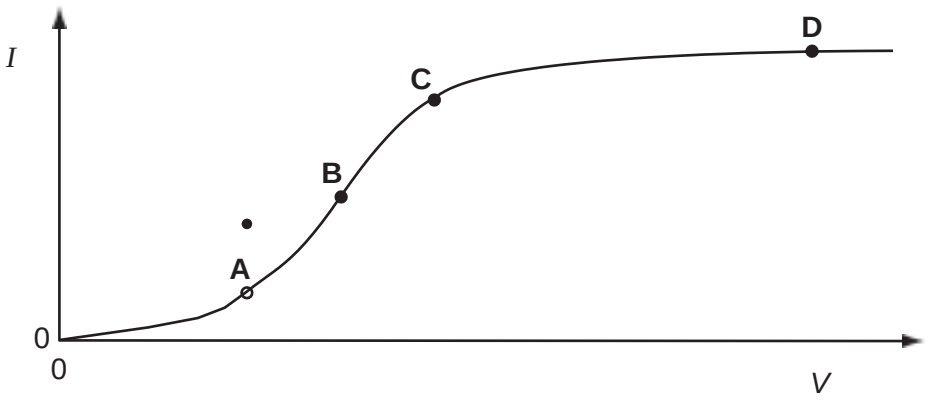


What is the resistance of the variable resistor when the power dissipated in the electrical deviceis 4.0 W?

A 16 Ω B 36 Ω C 44 Ω D 60 Ω

26. The graph shows how the electric current I through a conducting liquid varies with the potential difference V across it.

At which point on the graph does the liquid have the smallest resistance?

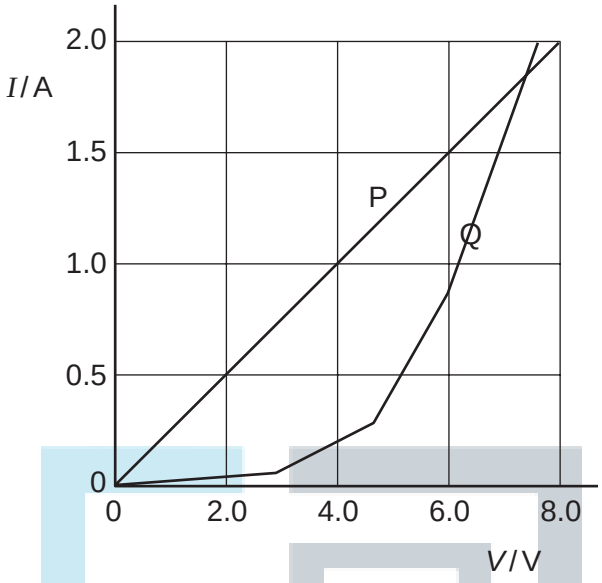


27. A cylindrical piece of a soft, electrically-conducting material has resistance R. It is rolled out so that its length is doubled but its volume stays constant.

What is its new resistance?

A $\frac{R}{2}$ B R C $2R$ D $4R$

28. The *I*-*V* characteristics of two electrical components P and Q are shown below.



Which statement is correct?

A P is a resistor and Q is a filament lamp.

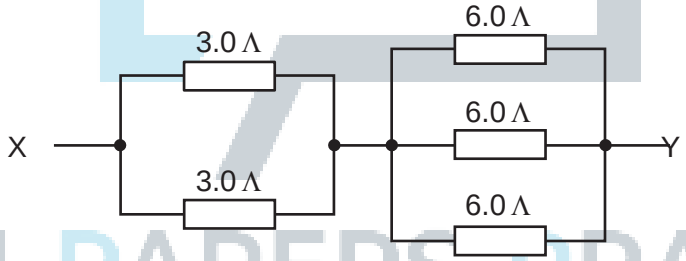
B The resistance of Q increases as the current in it increases.C At 1.9 A the resistance of Q is approximately half that of P. D At 0.5 A the power dissipated in Q is double that in P.

29. When a potential difference V is applied between the ends of a wire of diameter d and length l ,the current in the wire is I.

What is the current when a potential difference of $2V$ is applied between the ends of a wire of the same material of diameter $2d$ and the length $2l$? Assume that the temperature of the wire remains constant.

A I B $2I$ C $4I$ D $8I$

30. A network of resistors consists of two 3.0 Ω resistors and three 6.0 Ω resistors.



What is the combined resistance of this network between points X and Y?

A 0.86 Ω B 1.2 Ω C 3.5 Ω D 24 Ω

31. The resistance of a device is designed to change with temperature.

What is the device?

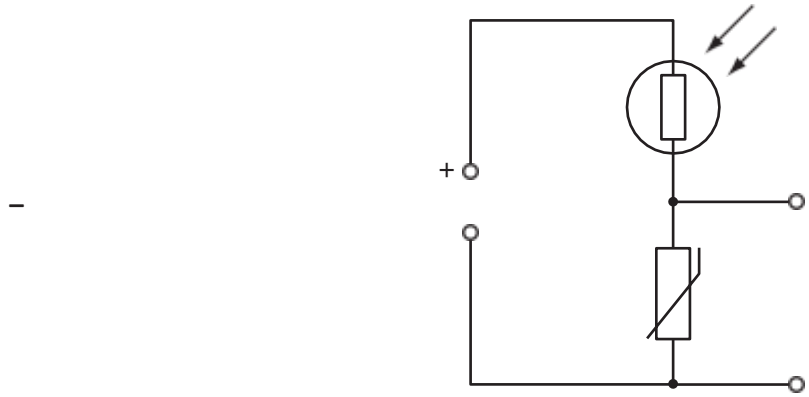
A a light-dependent resistor

B a potential divider

C a semiconductor diode

D a thermistor

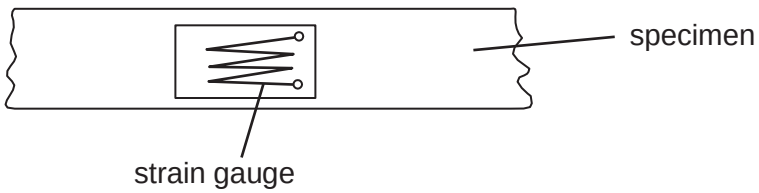
32. The diagram shows a light-dependent resistor (LDR) and a thermistor forming a potential divider.



Under which set of conditions will the potential difference across the thermistor have the greatest value?

	illumination	
A	low	low
B	high	low
C	low	high
D	high	high

33. Tensile strain may be measured by the change in electrical resistance of a strain gauge. A strain gauge consists of folded fine metal wire mounted on a flexible insulating backing sheet. The strain gauge is firmly attached to the specimen, so that the strain in the metal wire is always identical to that in the specimen.



When the strain in the specimen is increased, what happens to the resistance of the wire?

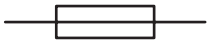
A It decreases, because the length decreases and the cross-sectional area increases.

B It decreases, because the length increases and the cross-sectional area decreases.

C It increases, because the length decreases and the cross-sectional area increases.

D It increases, because the length increases and the cross-sectional area decreases.

34. An electrical component has the following circuit symbol.



What does this symbol represent?

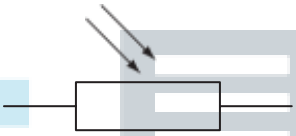
A variable resistor (rheostat)

B fuse

C light-dependent resistor

D thermistor

35. Which electrical component is represented by the following symbol?



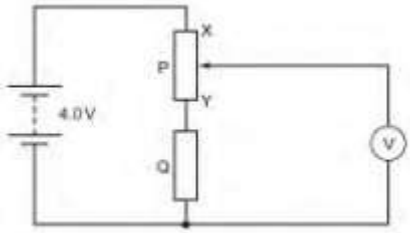
A a diode

B a light-dependent resistor

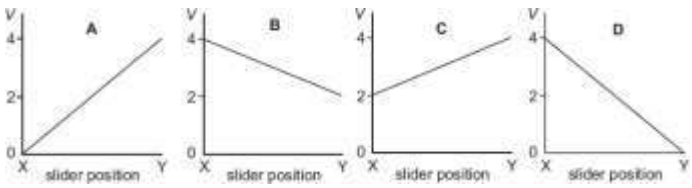
C a resistor

D a thermistor

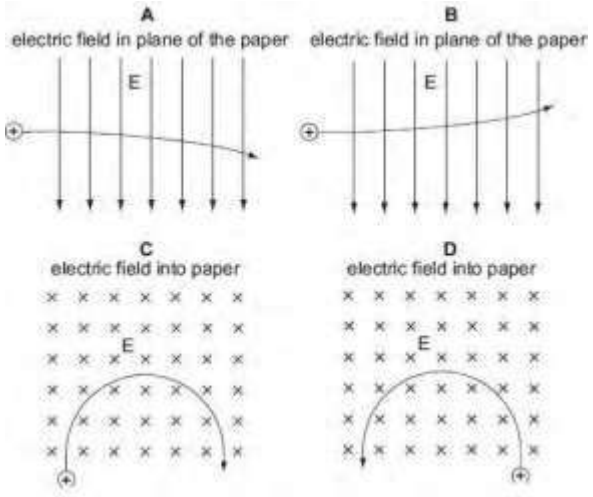
36. In the circuit below, P is a potentiometer of total resistance 10 Ω and Q is a fixed resistor of resistance 10 Ω. The battery has an e.m.f. of 4.0 V and negligible internal resistance. The voltmeter has a very high resistance. The slider on the potentiometer is moved from X to Y and a graph of voltmeter reading V is plotted against slider position.



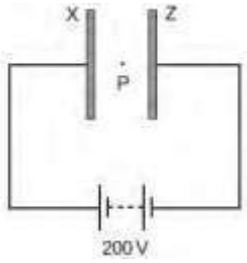
Which graph is obtained?



37. A positively charged particle is projected into a region of uniform electric field E. Which diagram represents the motion ofthe particle in the electric field?



38. Two large parallel plates X and Z are placed 5.0 mm apart and connected as shown to the terminals of a 200 volt d.c. supply.

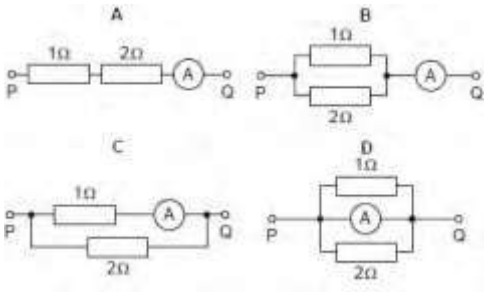


A small oil drop at P carries one excess electron.

What is the magnitude of the electrostatic force acting on the oil drop due to the electric field between the plates?

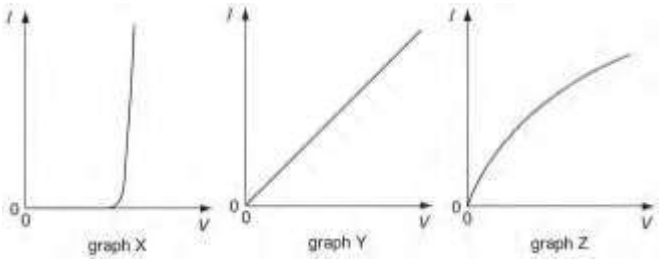
A 6.4×10^{-15} N B 6.4×10^{-18} N C 1.6×10^{-19} N D 4.0×10^{-24} N

39. In each arrangement of resistors, the ammeter has a resistance of 2 Ω.
Which arrangement gives the largest reading on the ammeter when the same potential difference is applied between points P and Q?



40. A source of e.m.f. of 9.0 mV has an internal resistance of 6.0 Ω. It is connected across a galvanometer of resistance 30 Ω.
What will be the current in the galvanometer?
A 250 μA B 300 μA C 1.5 mA D 2.5 Ma

41. The graphs show the variation with potential difference V of the current I for three circuit components.



The components are a metal wire at constant temperature, a semiconductor diode and a filament lamp. Which row of the table correctly identifies these graphs?

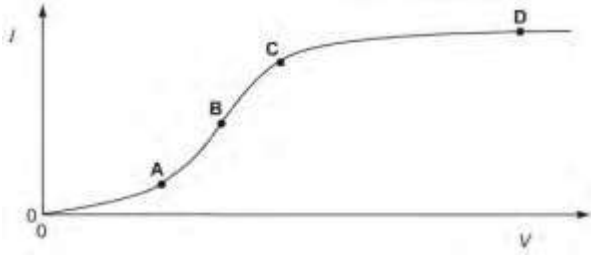
	metal wire at constant temperature	semiconductor diode	filament lamp
A	X	Z	Y
B	Y	X	Z
C	Y	Z	X
D	Z	X	Y

42. Tensile strain may be measured by the change in electrical resistance of a strain gauge. A strain gauge consists of folded fine metal wire mounted on a flexible insulating backing sheet. The strain gauge is firmly attached to the specimen, so that the strain in the metal wire is always identical to that in the specimen.

When the strain in the specimen is increased, what happens to the resistance of the wire?

A It decreases, because the length decreases and the cross-sectional area increases.
B It decreases, because the length increases and the cross-sectional area decreases.
C It increases, because the length decreases and the cross-sectional area increases.
D It increases, because the length increases and the cross-sectional area decreases.

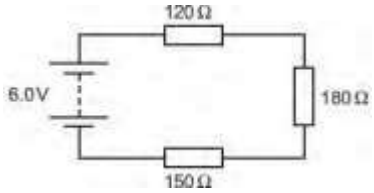
43. The graph shows how the electric current I through a conducting liquid varies with the potential difference V across it. At which point on the graph does the liquid have the smallest resistance?



44. An electrical component has the following circuit symbol.

What does this symbol represent?
A variable resistor (rheostat) B fuse
C light-dependent resistor D thermistor

45. Three resistors are connected in series with a battery as shown in the diagram. The battery has negligible internal resistance.



What is the potential difference across the 180 Ω resistor?

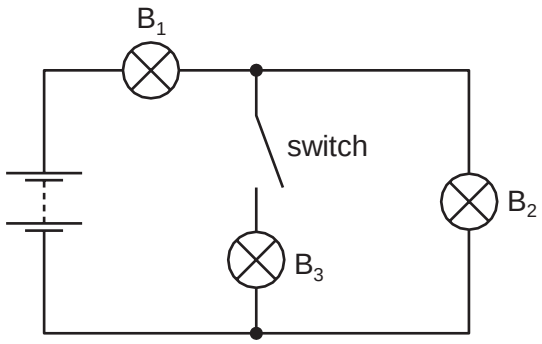
A 1.6 V B 2.4 V C 3.6 V D 6.0 V

46. A pedal bicycle is fitted with an electric motor. The rider switches on the motor for a time of 3.0 minutes. A constant current of 3.5 A in the electric motor is provided from a battery with a terminal voltage of 24 V.

What is the energy supplied by the battery?

A 84 J B 250 J C 630 J D 15 000 J

47. B_1, B_2 and B_3 are three identical lamps. They are connected to a battery with zero internal resistance, as shown.



Initially the switch is closed. The switch is then opened and lamp B_3 goes out.

What happens to the brightness of lamps B_1 and B_2 when the switch is opened?

	brightness of lamp B_1	brightness of lamp B_2
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

48. The combined resistance R_T of two resistors of resistances R_1 and R_2 connected in parallel is given by the formula shown.

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

Which statement is used in the derivation of this formula?

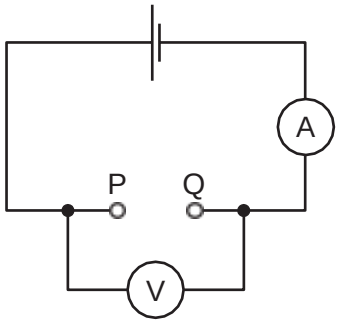
A The currents through the two resistors are equal.

B The potential difference across each resistor is the same.

C The supply current is split between the two resistors in the same ratio as the ratio of their resistances.

D The total power dissipated is the sum of the powers dissipated in the two resistors separately.

49. A student found two unmarked resistors. To determine the resistance of the resistors, the circuit below was set up. The resistors were connected in turn between P and Q, noting the current readings. The voltage readings were noted without the resistors and with each resistor in turn.



The results were entered into a spreadsheet as shown.

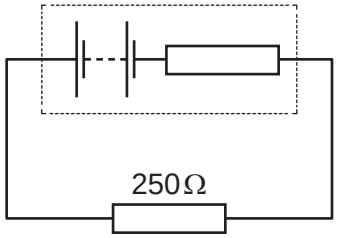
1.5	1.3	28	46
1.5	1.4	14	100

The student forgot to enter the column headings.

Which order of the headings would be correct?

A	e.m.f. / V	V / V	R / Ω	I / mA
B	V / V	e.m.f / V	R / Ω	I / mA
C	V / V	e.m.f / V	I / mA	R / Ω
D	e.m.f. / V	V / V	I / mA	R / Ω

50. A battery, with a constant internal resistance, is connected to a resistor of resistance 250 Ω, as shown.



The current in the resistor is 40 mA for a time of 60 s. During this time 6.0 J of energy is lost in the internal resistance.

What are the energy supplied to the external resistor during the 60 s and the e.m.f. of the battery?

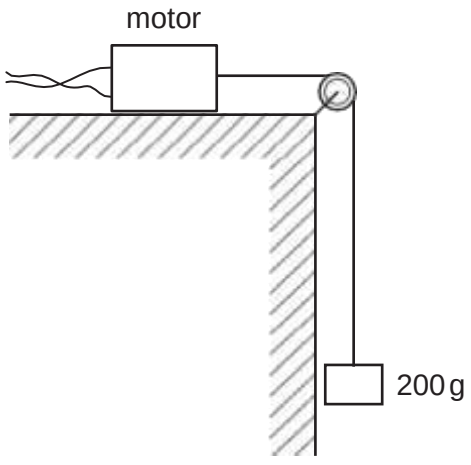
	energy / J	e.m.f / V
A	2.4	2.4
B	2.4	7.5
C	24	10.0
D	24	12.5

51. In a simple electrical circuit, the current in a resistor is measured as (2.50 ± 0.05) mA. The resistor is marked as having a value of 4.7 Ω ± 2 %.

If these values were used to calculate the power dissipated in the resistor, what would be the percentage uncertainty in the value obtained?

A 2 % B 4 % C 6 % D 8 %

52. A small electric motor is mounted on a bench, as shown. The motor is connected to a 6.0 V supply and the current in the motor is 0.50 A. The motor is 50% efficient.



What is the time taken to lift a mass of 200 g up through a height of 90 cm?

A 0.59 s B 0.85 s C 1.2 s D 2.7 s

53. The resistance of a lamp is calculated from the value of the potential difference (p.d.) across it and the value of the current passing through it.

Which statement correctly describes how to combine the uncertainties in the p.d. and in the current?

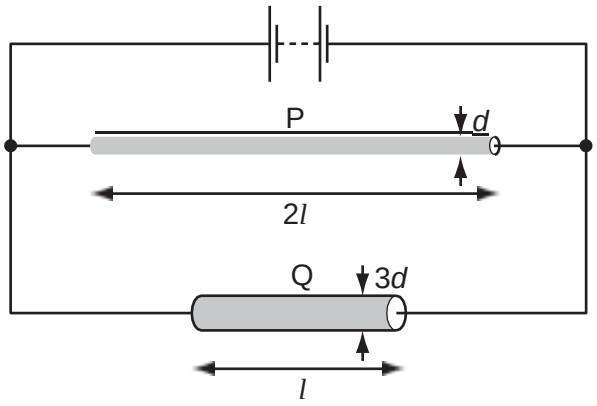
A Add together the actual uncertainty in the p.d. and the actual uncertainty in the current.

B Add together the percentage uncertainty in the p.d. and the percentage uncertainty in the current.

C Subtract the actual uncertainty in the current from the actual uncertainty in the p.d.

D Subtract the percentage uncertainty in the current from the percentage uncertainty in the p.d.

54. Two wires P and Q made of the same material are connected to the same electrical supply. P has twice the length of Q and one-third of the diameter of Q, as shown in the diagram.



What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?

A $\frac{2}{3}$ B $\frac{2}{9}$ C $\frac{1}{6}$ D $\frac{1}{18}$

55. A student takes measurements of the current in a resistor of constant resistance and the potential difference (p.d.) across it. The readings are then used to plot a graph of current against p.d.

There is a systematic error in the current readings.

How could this be identified from the graph?

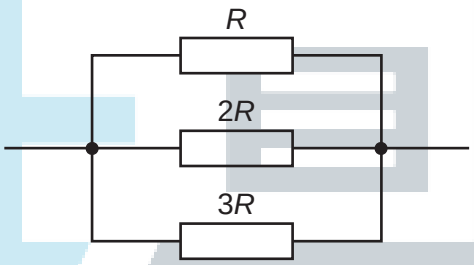
A At least one anomalous data point can be identified.

B The data points are scattered about the straight line of best fit.

C The graph is a curve, not a straight line.

D The straight line graph does not pass through the origin.

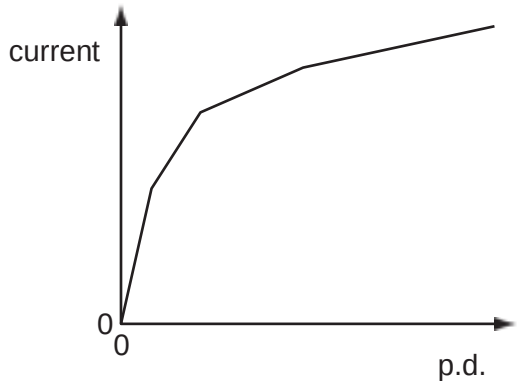
56. Three resistors of resistance R, $2R$ and $3R$ are connected in parallel.



Using I to represent the current through the resistor of resistance R, which row represents the relationships between the currents through the resistors?

	resistor resistance		
	R	$2R$	$3R$
A	I	$\frac{1}{3}I$	$\frac{1}{2}I$
B	I	$\frac{1}{2}I$	$\frac{1}{3}I$
C	I	$\frac{2}{3}I$	$\frac{1}{3}I$
D	I	$2I$	$3I$

57. The graph shows the variation with potential difference (p.d.) of the current in a lamp filament.



Which statement explains the shape of this graph?

A As the filament temperature rises, electrons can pass more easily through the filament.

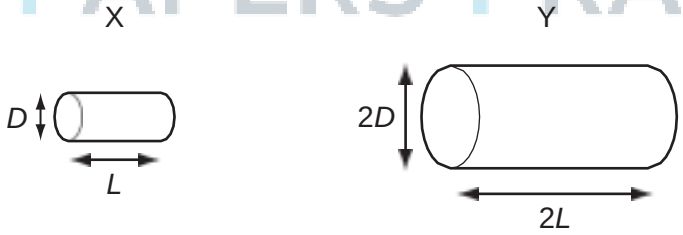
B It takes time for the filament to reach its working temperature.

C The power output of the filament is proportional to the square of the current in it.

D The resistance of the filament increases with a rise in temperature.

58. Two electrically-conducting cylinders X and Y are made from the same material.

Their dimensions are as shown.

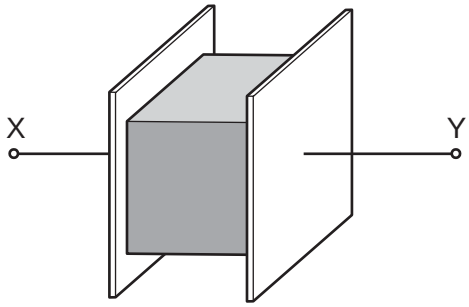


The resistance of each cylinder is measured between its ends.

What is the ratio $\frac{\text{resistance of X}}{\text{resistance of Y}}$?

A $\frac{2}{1}$ B $\frac{1}{1}$ C $\frac{1}{2}$ D $\frac{1}{4}$

59. The resistance of a metal cube is measured by placing it between two parallel plates, as shown.



The cube has volume V and is made of a material with resistivity ρ. The connections to the cube have negligible resistance.

Which expression gives the electrical resistance of the metal cube between X and Y?

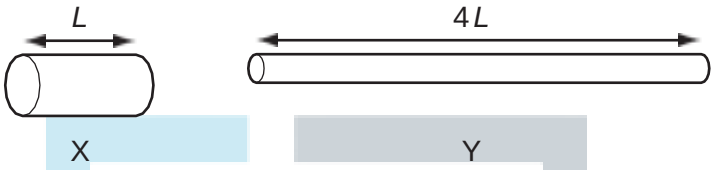
A $\rho V^{\frac{1}{3}}$ B $\rho V^{\frac{2}{3}}$ C $\frac{\rho}{V^{\frac{1}{3}}}$ D $\frac{\rho}{V^{\frac{2}{3}}}$

60. A cylindrical piece of a soft, electrically-conducting material has resistance R. It is rolled out so that its length is doubled but its volume stays constant.

What is its new resistance?

A. $\frac{R}{2}$ B R C $2R$ D $4R$

61. Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X.



What is the ratio $\frac{\text{resistance of wire Y}}{\text{resistance of wire X}}$?

A 4 B 8 C 16 D 64

62. Two heating coils X and Y, of resistance R_X and R_Y respectively, deliver the same power when 12 V is applied across X and 6 V is applied across Y.

What is the ratio R_X / R_Y?

A ¼ B ½ C 2 D 4

63. Two wires P and Q have resistances R_P and R_Q respectively. Wire P is twice as long as wire Q and has twice the diameter of wire Q. The wires are made of the same material.

What is the ratio $\frac{R_P}{R_Q}$?

A 0.5 B 1 C 2 D 4

64. What is a correct statement of Ohm's law?

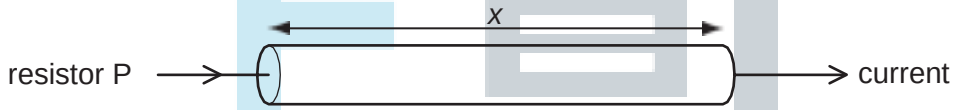
a. The potential difference across a component equals the current providing the resistance and other physical conditions stay constant.

b. The potential difference across a component equals the current multiplied by the resistance.

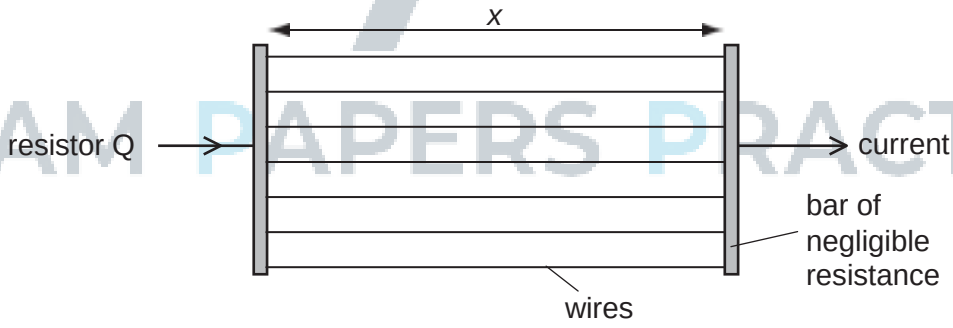
c. The potential difference across a component is proportional to its resistance.

d. The potential difference across a component is proportional to the current in it providing physical conditions stay constant.

65. A researcher has two pieces of copper of the same volume. All of the first piece is made into a cylindrical resistor P of length x.



All of the second piece is made into uniform wires each of the same length x which he connects between two bars of negligible resistance to form a resistor Q.



How do the electrical resistances of P and Q compare?

A. P has a larger resistance than Q.

B. Q has a larger resistance than P.

C. P and Q have equal resistance.

D. Q may have a larger or smaller resistance than P, depending on the number of wires made.