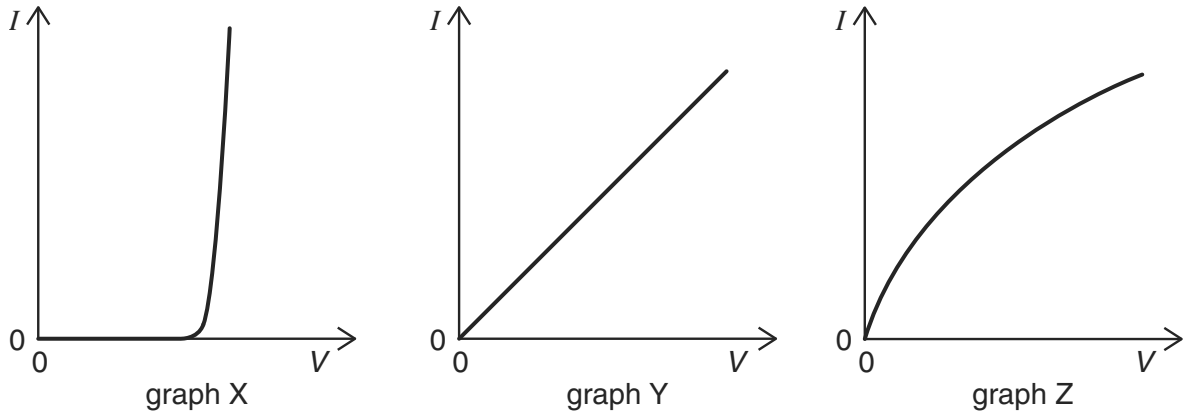
1 The graphs show the variation with potential difference V of the current I for three circuit elements.

9702/1/M/J/02



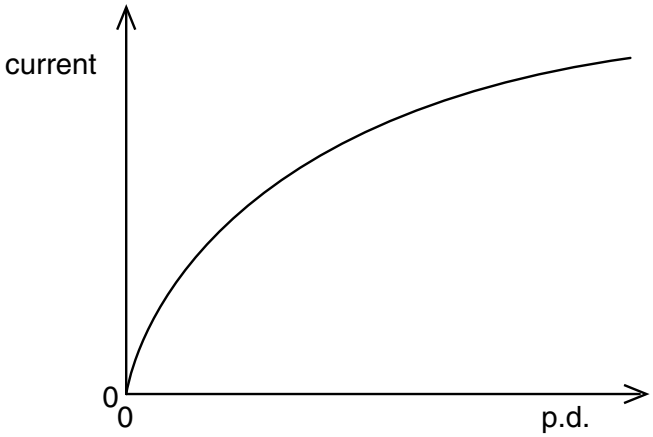
The three circuit elements are a metal wire at constant temperature, a semiconductor diode and a filament lamp.

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

2 The graph shows how the current through a lamp filament varies with the potential difference across it.

9702/1/O/N/02



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 through it.

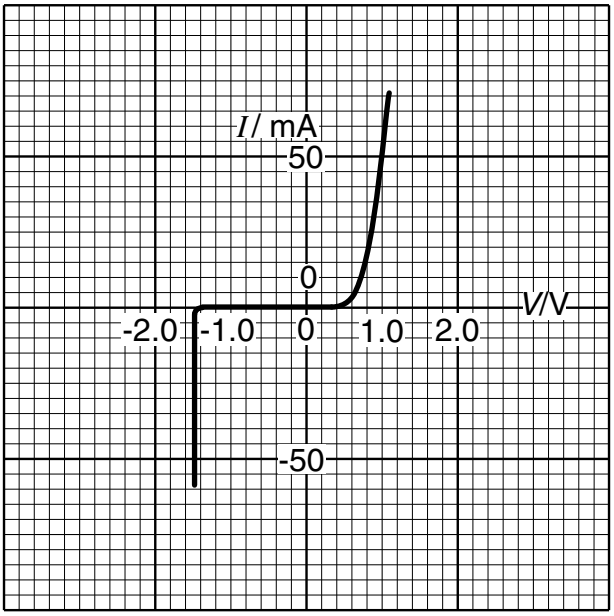
D The resistance of the filament increases with a rise in temperature.

3 The filament of a 240 V, 100 W electric lamp heats up from room temperature to its operating temperature. As it heats up, its resistance increases by a factor of 16. 9702/1/M/J/02

What is the resistance of this lamp at room temperature?

A 36 Ω **B** 580 Ω **C** 1.5 kΩ **D** 9.2 kΩ

4 The variation with potential difference V of the current I in a semiconductor diode is shown below. 9702/1/O/N/02



What is the resistance of the diode for applied potential differences of +1.0 V and –1.0 V?

	resistance	
	at +1.0 V	at –1.0 V
A	20 Ω	infinite
B	20 Ω	zero
C	0.05 Ω	infinite
D	0.05 Ω	zero

5 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. 9702/01/M/J/04

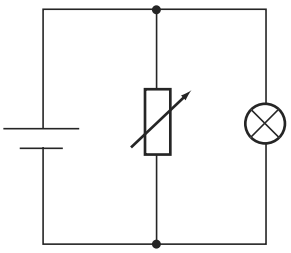
What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?

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

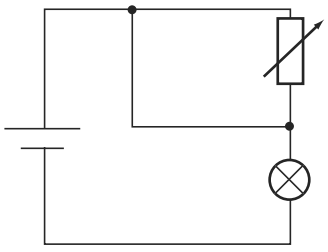
6 Which diagram shows a potential divider circuit that can vary the voltage across the lamp?

9702/01/O/N/03

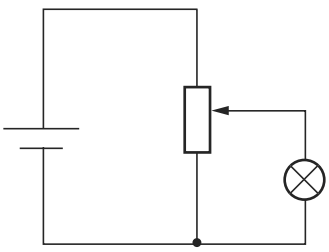
A



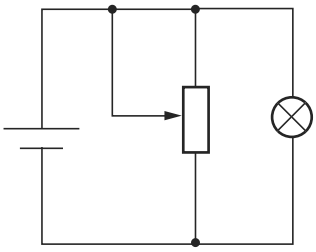
B



C



D



7 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. 9702/01/O/N/04

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.

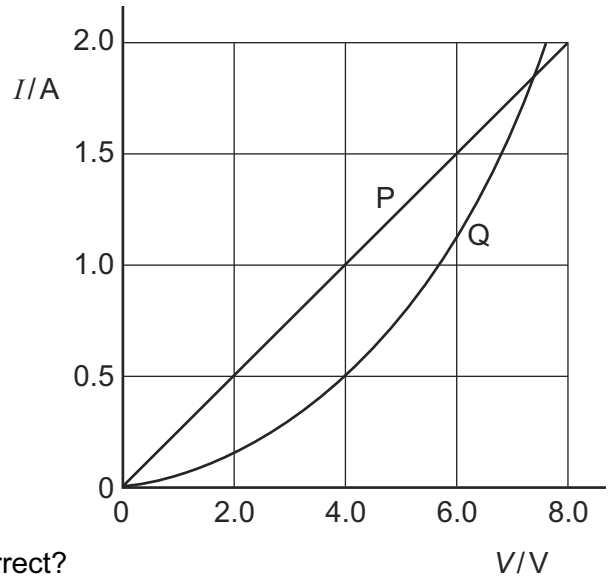
A I **B** $2I$ **C** $4I$ **D** $8I$

8 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. 9702/01/M/J/05

What is its new resistance?

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

9 The I-V characteristics of two electrical components P and Q are shown below. 9702/01/M/J/05



Which statement is correct?

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

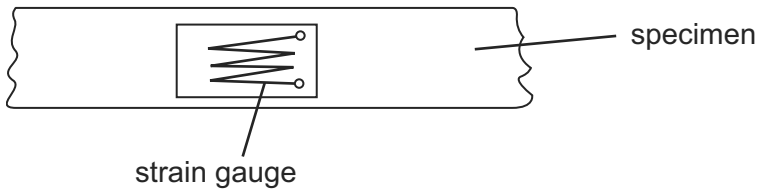
B The resistance of Q increases as the current in it increases.

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.

10 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.

9702/01/O/N/05



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.

11 A metal wire of length 0.50 m has a resistance of 12 Ω.

9702/13/O/N/14

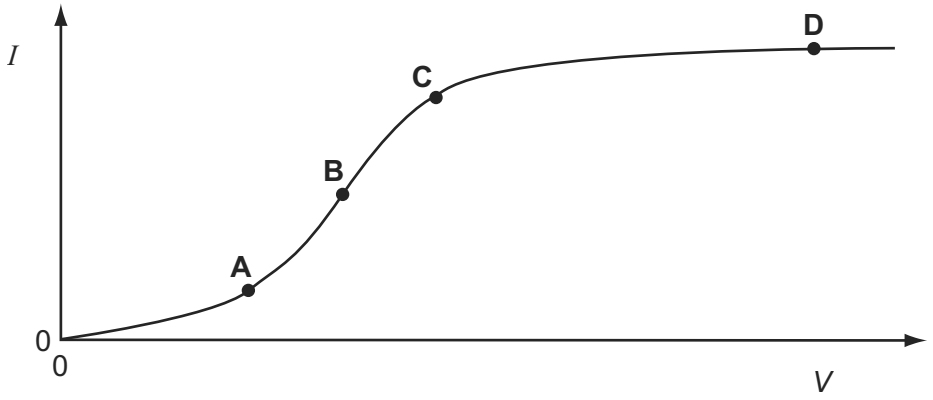
What is the resistance of a wire of length 2.0 m and made of the same material, but with half the diameter?

A 12 Ω **B** 48 Ω **C** 96 Ω **D** 192 Ω

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

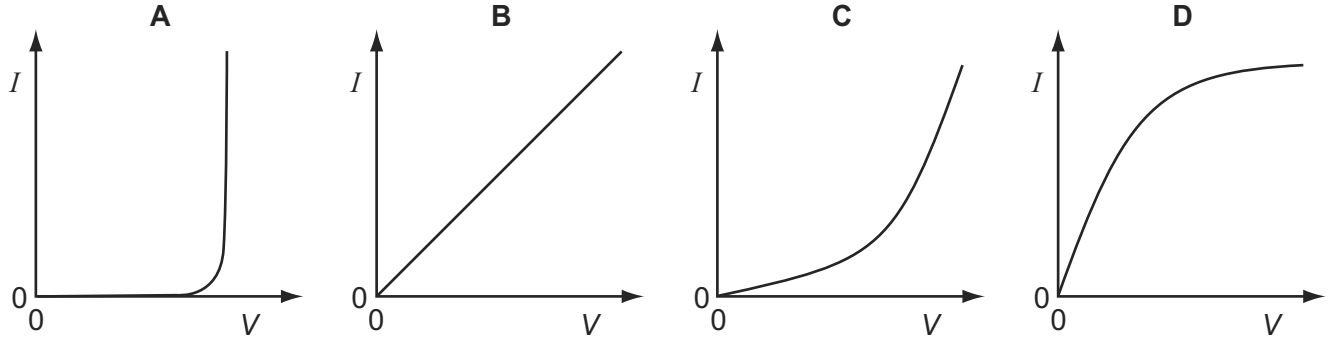
9702/01/O/N/05

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

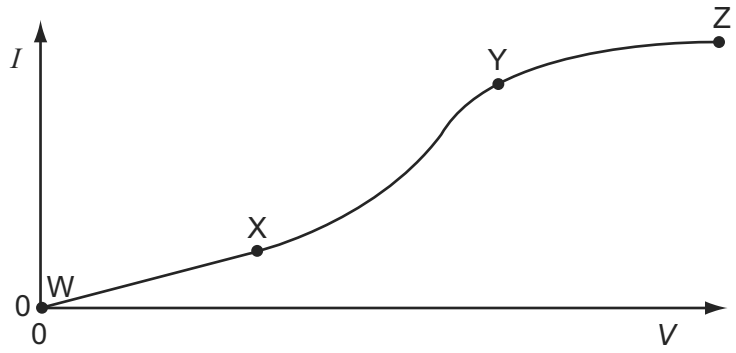


13 Which graph shows the $I - V$ characteristic of a filament lamp?

9702/01/O/N/06



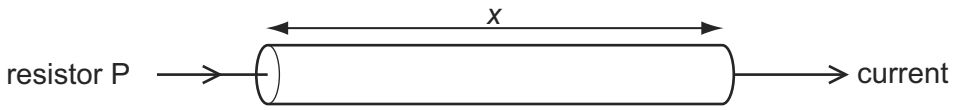
14 An electrical component has a potential difference V across it and a current I through it. A graph of I against V is drawn and is marked in three sections WX, XY and YZ. 9702/01/O/N/06



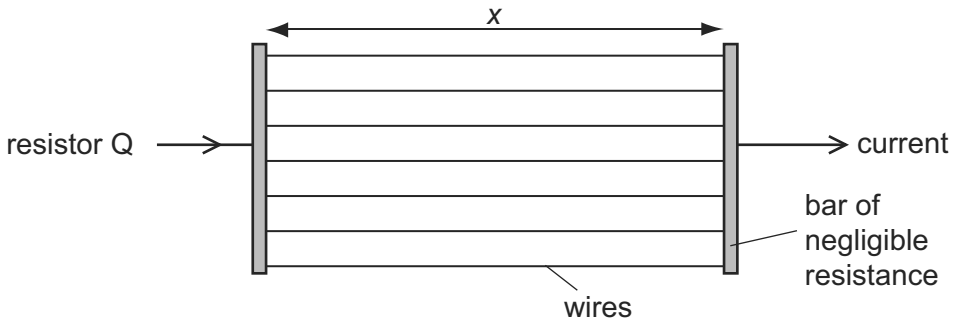
In which ways does the resistance of the component vary within each of the three sections?

	WX	XY	YZ
A	constant	decreases	increases
B	constant	increases	increases
C	increases	decreases	constant
D	increases	increases	decreases

15 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. 9702/01/M/J/07



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.

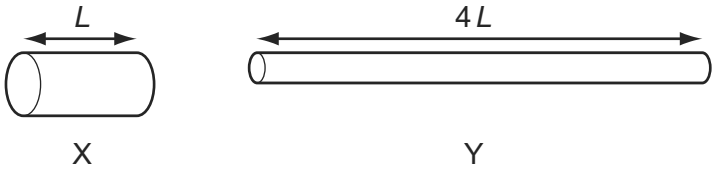
D Q may have a larger or smaller resistance than P, depending on the number of wires made.

16 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. 9702/01/O/N/07

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

A 0.5 **B** 1 **C** 2 **D** 4

17 Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X. 9702/01/M/J/08



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

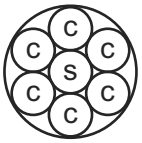
A 4 **B** 8 **C** 16 **D** 64

18 Two wires P and Q made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has diameter 2 mm and wire Q has diameter 1 mm. 9702/01/O/N/08

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** $\frac{4}{1}$

19 An electric power cable consists of six copper wires c surrounding a steel core s. 9702/01/O/N/08



1.0 km of one of the copper wires has a resistance of 10 Ω and 1.0 km of the steel core has a resistance of 100 Ω.

What is the approximate resistance of a 1.0 km length of the power cable?

A 0.61 Ω **B** 1.6 Ω **C** 160 Ω **D** 610 Ω

20 A copper wire is cylindrical and has resistance R. 9702/11/O/N/10

What will be the resistance of a copper wire of twice the length and twice the radius?

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

21 What is the unit of resistivity? 9702/11/M/J/10

A $\Omega\,m^{-2}$ **B** $\Omega\,m^{-1}$ **C** Ω **D** $\Omega\,m$

22 A cylindrical wire 4.0 m long has a resistance of 31 Ω and is made of metal of resistivity $1.0 \times 10^{-6}\,\Omega\,\text{m}$. 9702/11/O/N/09

What is the radius of cross-section of the wire?

A $1.0 \times 10^{-8}\,\text{m}$

B $2.0 \times 10^{-8}\,\text{m}$

C $6.4 \times 10^{-8}\,\text{m}$

D $2.0 \times 10^{-4}\,\text{m}$

23 A power cable has length 2000 m. The cable is made of twelve parallel strands of copper wire, each with diameter 0.51 mm. 9702/12/M/J/13

What is the resistance of the cable? (resistivity of copper = $1.7 \times 10^{-8}\,\Omega\,\text{m}$)

A $0.014\,\Omega$ **B** $3.5\,\Omega$ **C** $14\,\Omega$ **D** $166\,\Omega$

24 A copper wire is to be replaced by an aluminium alloy wire of the same length and resistance. Copper has half the resistivity of the alloy. 9702/12/M/J/14

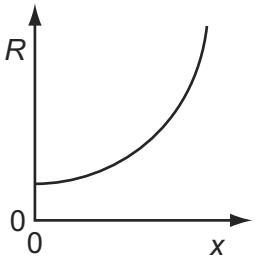
What is the ratio $\dfrac{\text{diameter of alloy wire}}{\text{diameter of copper wire}}$?

A $\sqrt{2}$ **B** 2 **C** $2\sqrt{2}$ **D** 4

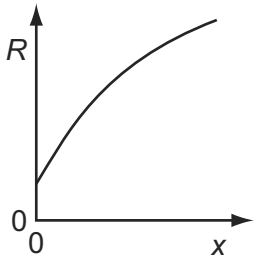
25 When a thin metal wire is stretched, it becomes longer and thinner. This causes a change in the resistance of the wire. The volume of the wire remains constant. 9702/12/M/J/15

Which graph could represent the variation with extension x of the resistance R of the wire?

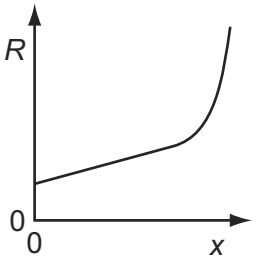
A



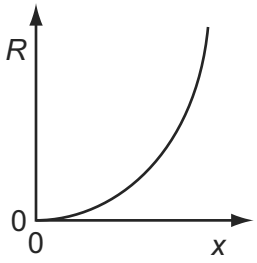
B



C



D



26 A pencil is used to draw a line of length 30 cm and width 1.2 mm. The resistivity of the material in the pencil is $2.0 \times 10^{-5}\,\Omega\,\text{m}$ and the resistance of the line is 40 kΩ. 9702/11/O/N/14

What is the thickness of the line?

A $1.25 \times 10^{-10}\,\text{m}$

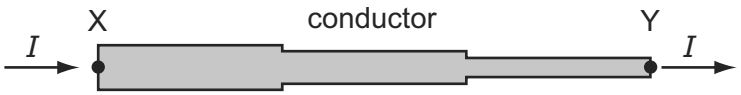
B $1.25 \times 10^{-8}\,\text{m}$

C $1.25 \times 10^{-7}\,\text{m}$

D $1.25 \times 10^{-5}\,\text{m}$

27 A conductor consists of three wires connected in series. The wires are all made of the same metal but have different cross-sectional areas. There is a current I in the conductor.

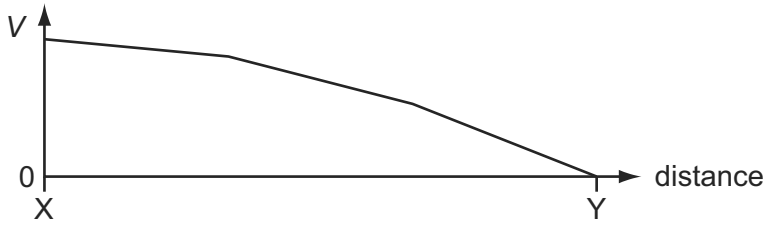
9702/11/O/N/14



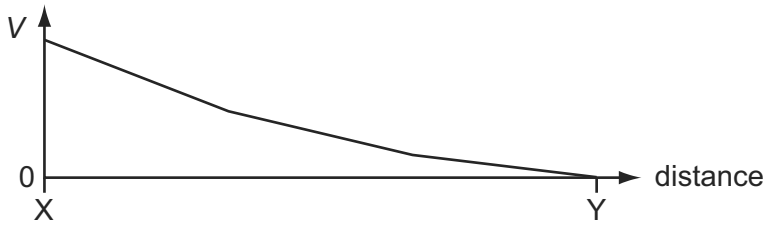
Point Y on the conductor is at zero potential.

Which graph best shows the variation of potential V with distance along the conductor?

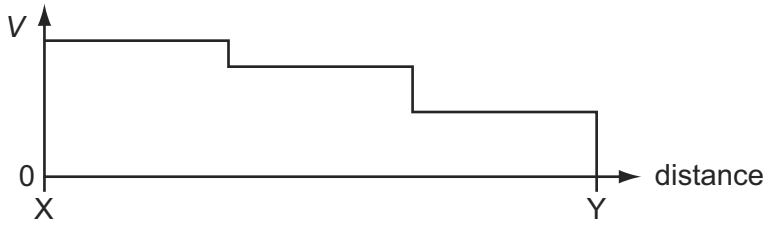
A



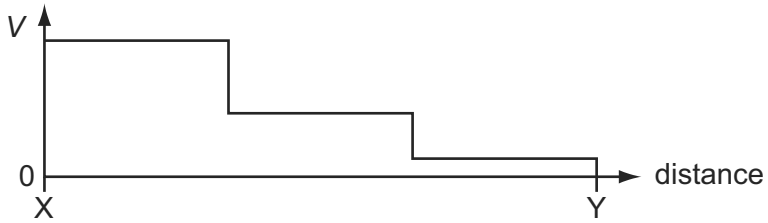
B



C

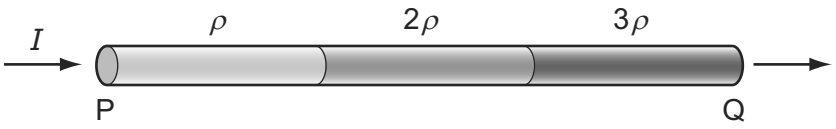


D



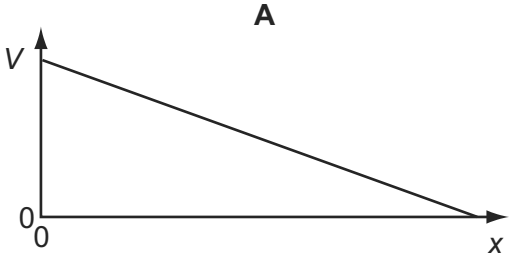
28 A wire PQ is made of three different materials, with resistivities ρ, 2ρ and 3ρ. There is a current I in this composite wire, as shown.

9702/12/O/N/10

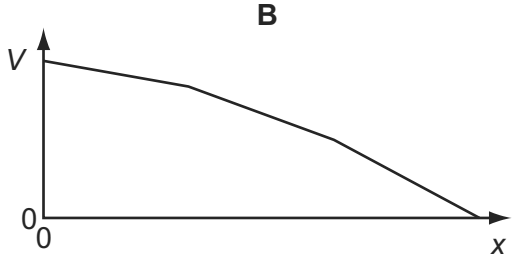


Which graph best shows how the potential V along the wire varies with distance x from P?

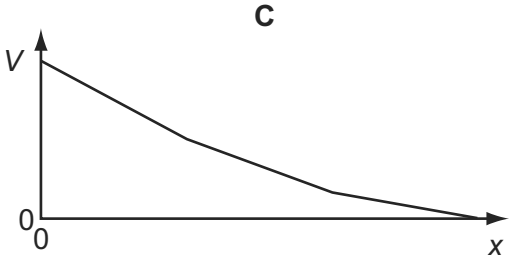
A



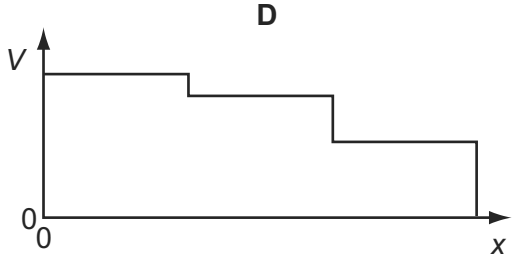
B



C



D



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

9702/11/O/N/13

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

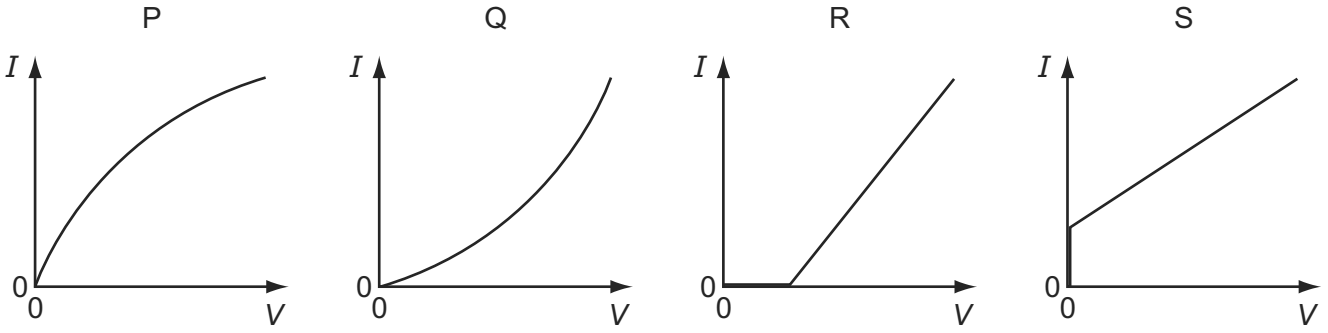
	length	diameter	resistivity of metal
original wire	l	d	ρ
replacement wire	l	$2d$	2ρ

What is the resistance of the replacement wire?

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

30 The graphs show possible current-voltage (I-V) relationships for a filament lamp and for a semiconductor diode.

9702/11/M/J/11

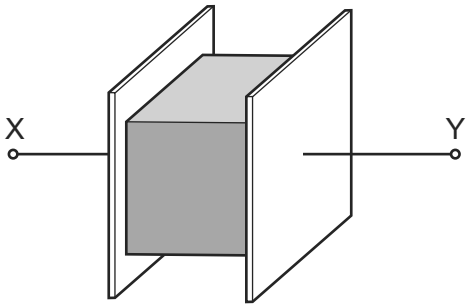


Which row best specifies the correct I-V graphs for the lamp and the diode?

	filament lamp	semiconductor diode
A	P	R
B	P	S
C	Q	R
D	Q	S

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

9702/13/M/J/11



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** $\dfrac{\rho}{V^{\frac{1}{3}}}$ **D** $\dfrac{\rho}{V^{\frac{2}{3}}}$

32 An iron wire has length 8.0 m and diameter 0.50 mm. The wire has resistance R. 9702/11/M/J/12

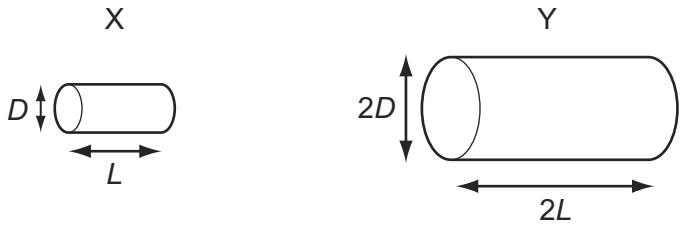
A second iron wire has length 2.0 m and diameter 1.0 mm.

What is the resistance of the second wire?

A $\dfrac{R}{16}$ **B** $\dfrac{R}{8}$ **C** $\dfrac{R}{2}$ **D** R

33 Two electrically-conducting cylinders X and Y are made from the same material. 9702/12/O/N/11

Their dimensions are as shown.

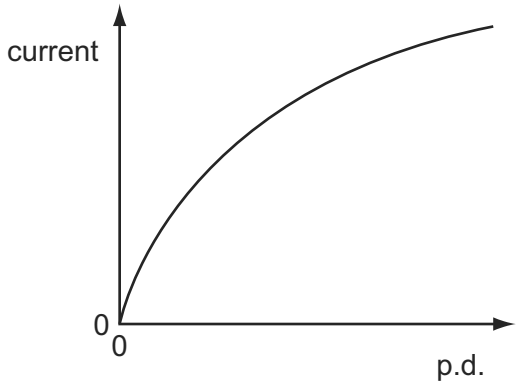


The resistance of each cylinder is measured between its ends.

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** $\frac{1}{4}$

34 The graph shows the variation with potential difference (p.d.) of the current in a lamp filament. 9702/12/O/N/11



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.

35 Which statement about electrical resistivity is correct? 9702/11/O/N/11

A The resistivity of a material is numerically equal to the resistance in ohms of a cube of that material, the cube being of side length one metre and the resistance being measured between opposite faces.

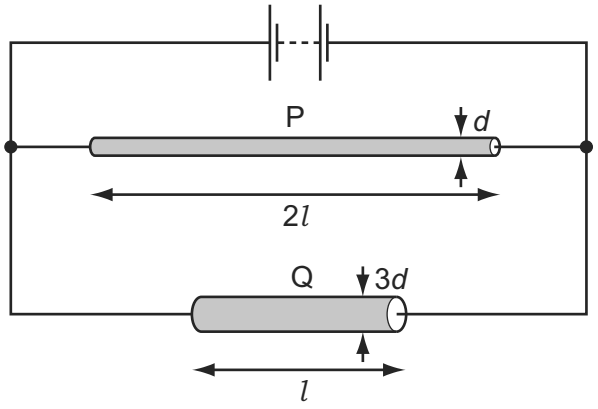
B The resistivity of a material is numerically equal to the resistance in ohms of a one metre length of wire of that material, the area of cross-section of the wire being one square millimetre and the resistance being measured between the ends of the wire.

C The resistivity of a material is proportional to the cross-sectional area of the sample of the material used in the measurement.

D The resistivity of a material is proportional to the length of the sample of the material used in the measurement.

36 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.

9702/12/M/J/13



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** $\frac{1}{18}$

36 A cylindrical wire of length 10 m and diameter 2.0 mm has a resistance of 0.050 Ω. 9702/11/O/N/12

From which material is the wire made?

	material	resistivity / Ω m
A	bronze	1.6×10^{-7}
B	nichrome	1.6×10^{-6}
C	silver	1.6×10^{-8}
D	zinc	6.3×10^{-8}

38 A copper wire is stretched so that its diameter is reduced from 1.0 mm to a uniform 0.5 mm.

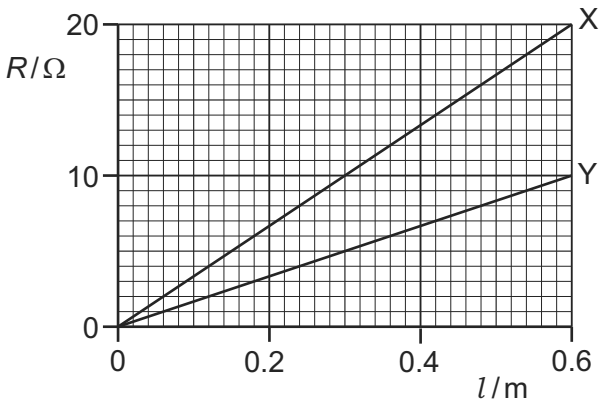
9702/12/O/N/12

The resistance of the unstretched copper wire is 0.2 Ω.

What will be the resistance of the stretched wire?

A 0.4 Ω **B** 0.8 Ω **C** 1.6 Ω **D** 3.2 Ω

39 The graph shows the variation with length l of resistance R for two wires X and Y made from the same material. 9702/12/O/N/12



What does the graph show?

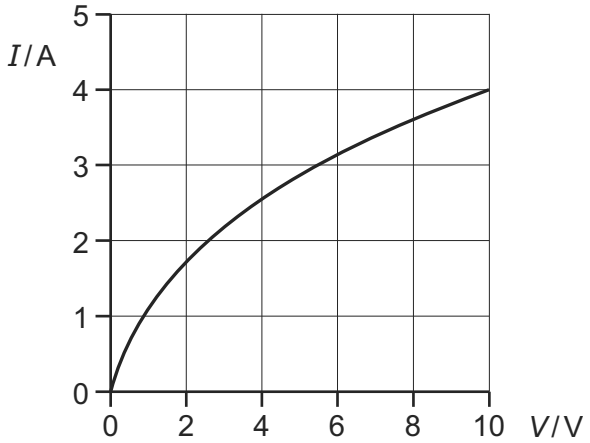
A cross-sectional area of X = 2 × cross-sectional area of Y

B resistivity of X = 2 × resistivity of Y

C when equal lengths of X and Y are connected in series to a battery, power in X = 2 × power in Y

D when equal lengths of X and Y are connected in parallel to a battery, current in X = 2 × current in Y

40 The graph shows how current I varies with voltage V for a filament lamp. 9702/13/M/J/13

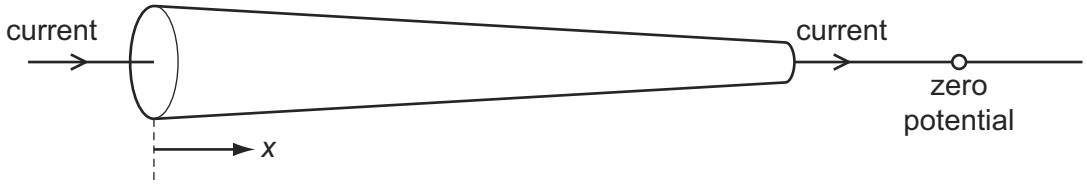


Since the graph is not a straight line, the resistance of the lamp varies with V

Which row gives the correct resistance at the stated value of V?

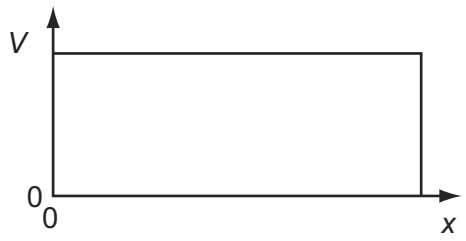
	V/V	R/Ω
A	2.0	1.5
B	4.0	3.2
C	6.0	1.9
D	8.0	0.9

41 The circular cross-sectional area of a metal wire varies along its length. There is a current in the wire. The narrow end of the wire is at a reference potential of zero. 9702/13/M/J/13

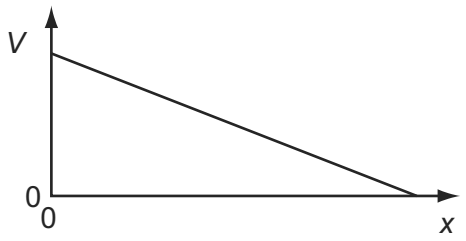


Which graph best represents the variation with distance x along the wire of the potential difference V relative to the reference zero?

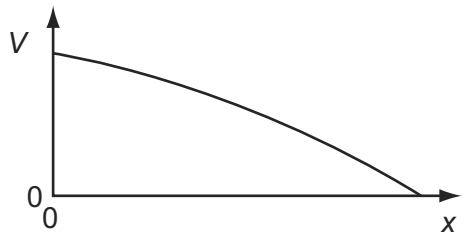
A



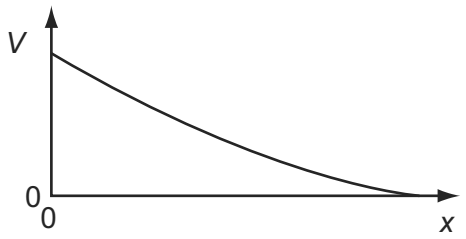
B



C

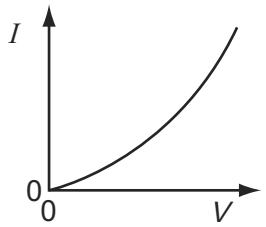


D

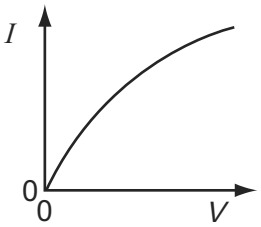


42 Which graph best represents the way the current I through a filament lamp varies with the potential difference V across it? 9702/01/O/N/08

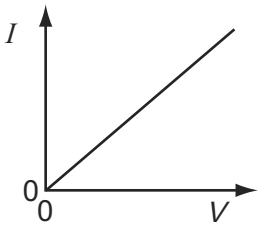
A



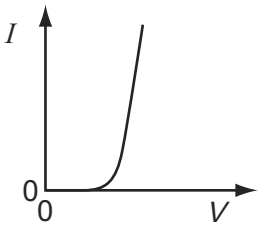
B



C



D



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40	41	42			