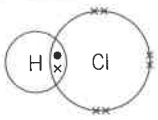
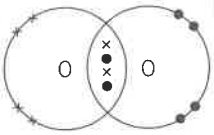
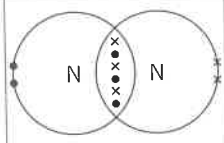
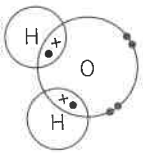
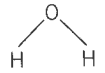
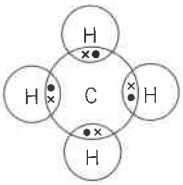
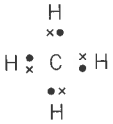
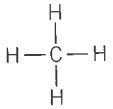
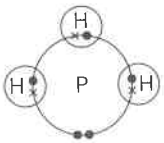
B

hydrogen chloride	HCl			H—Cl	single
oxygen	O_2			O=O	double
nitrogen	N_2			N≡N	triple
water	H_2O				single
methane	CH_4				single

C a SbH_3

b 0.171 (nm)

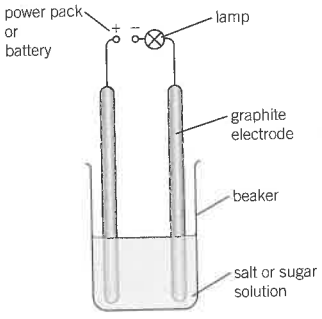
c 

d 1.42×10^{-10} m

e krypton, helium

C3.6

A covalent, intermolecular, weak, little, low, boiling, big, strong, solid, electricity

B a 

make up separate solutions of each substance in small beakers; place the two electrodes in one of the beakers, and switch on the current; if the bulb lights, the substance is sodium chloride; if the bulb does not light, the substance is sugar; repeat the experiment with the other solution

b i sodium chloride has a higher melting point; sodium chloride consists of oppositely charged ions, held together by strong forces of attraction; a large amount of energy is needed to disrupt these forces to make the solid melt

ii glucose is made up of covalent molecules; the intermolecular forces of attraction between the molecules are weak compared to the ionic bonds in sodium chloride, so less energy is needed to disrupt these forces to make the solid melt

iii a sucrose molecule is bigger than a glucose molecule; intermolecular forces increase with the size of molecules, so sucrose has the higher melting point

C3.7

A giant, graphite, high, diamond, soft, conduct, move, delocalised

B a i 4

ii 3

b a carbon atom has 4 electrons in its outer shell; in diamond, all four outer electrons from each carbon atom are used to form covalent bonds; in graphite, only three of the four outer electrons from each carbon atom are used to form covalent bonds; the remaining electron becomes delocalised

C very high melting point – **each atom is joined by strong covalent bonds to four other atoms; large amounts of energy are needed to break all these bonds**

hard – **it takes large amounts of energy to break the strong covalent bonds between the carbon atoms on the surface of diamond**

does not conduct electricity – **it has no charged particles that are free to move**

D a layers of graphite are removed from the pencil when it moves over the paper

b graphite conducts electricity in the same direction as the layers, because its electrons are delocalised between the layers; it does not conduct electricity across the layers because its electrons cannot move from being between a certain two layers to being between a different two layers

C3.8

A element, single, hollow / cage-like, hexagonal, cylindrical, diameter

B a A is buckminsterfullerene; B is a nanotube

b in both structures, each carbon atom is joined to three others by covalent bonds; in the nanotube, the structure is cylindrical. Buckminsterfullerene has a cylindrical shape; nanotubes have variable numbers of carbon atoms, depending on their size; all buckminsterfullerene molecules consist of 60 carbon atoms

C carbon nanotubes in sports equipment – **it has a high tensile strength**

carbon nanotubes in electronic devices – **its structure has delocalised electrons**

fullerenes to deliver drugs – **drug molecules fit inside the cage structure**

graphene in electronic displays – **its structure is flexible with delocalised electrons; graphene is flexible because it is made up of a single layer of carbon atoms**

C3.9

A giant, pattern, electrons, positively, electrostatic, electrons, metal

B from left to right: metal atom, outer electron of metal atom, metal ion, delocalised electron

C a

sodium	1	2,8,1	1	0.218
magnesium	2	2,8,2	2	0.224
aluminium	3	2,8,3	3	0.382

b the structure consists of aluminium ions, Al^{3+}, arranged in regular layers, one on top of another; the outer electrons form a sea of free-moving electrons, which surround the aluminium ions

c delocalised electrons carry the charge through the structure

d relative electrical conductivity increases from Group 1 to Group 3

e the greater the number of delocalised electrons per ion, the higher the electrical conductivity

f calcium is the better conductor because it has two delocalised electrons per ion, but potassium has just one delocalised electron per ion

C3.10

A strong, positive, melting, boiling, layers / rows, soft, alloys, elements, good, delocalised, thermal

B high melting and boiling points – **there are strong forces of attraction between the positive ions and the delocalised negative electrons**