

GCSE Chemistry A (Gateway Science)
J248/04 Chemistry A C4-C6 and C7 (Higher Tier)

Question Set 4

1 This question is about properties of materials.

Police bullet-resistant vests could be made from steel or Kevlar®.



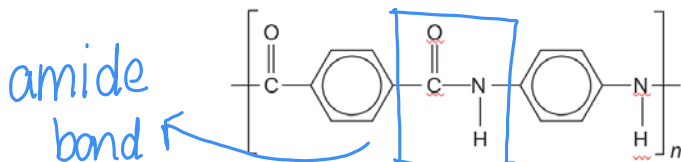
The table shows some information about steel and Kevlar®.

	Steel	Kevlar®
Density (g/cm ³)	7.85	1.44
Relative strength	1	5
Flexibility	low	high
Resistance to corrosion	low	high

(a) Describe and explain two reasons why bullet-resistant vests are made from Kevlar® instead of steel.

- 1 Kevlar has a higher strength = so will resist a greater impact
- 2 Kevlar is more flexible, so can be made into the right shape for a vest more easily [4]

(b) Look at the structure of Kevlar®.



What type of molecule is Kevlar®? polyamide

[1]

- (c) Nanoparticles are being used to make a material that is better than Kevlar[®] at resisting bullets.

Nanoparticles are often made of silicon dioxide.

A silicon dioxide nanoparticle has a diameter of 18 nm. The diameter of a silicon atom is 0.22 nm.

- (i) Estimate how many times larger the silicon dioxide nanoparticle is, compared to a silicon atom.

Give your answer to 1 significant figure.

$$\frac{\text{nanoparticle}}{\text{atom}} = \frac{18}{0.22} = 81.818..$$
$$= 80 \text{ (1sf)}$$

Number of times larger = 80 [3]

- (ii) Silicon dioxide is used as a **catalyst**.

Suggest why 1 g of silicon dioxide is **more effective** as a catalyst when used as nanoparticles rather than as a powder. [3]

Total Marks for Question Set 4: 11

The nanoparticles have a higher surface area than the powder, as each particle has a larger diameter. So, when used as a catalyst, it collides more frequently with the reactants, leading to a faster rate of reaction.

per ← unit time

Resource Materials

The Periodic Table of the Elements

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(0)										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H hydrogen 1.0	2 He helium 4.0	3 Li lithium 6.9	4 Be beryllium 9.0	5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2	11 Na sodium 23.0	12 Mg magnesium 24.3	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57-71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	114 Fl flerovium	116 Lv livermorium				

Key
atomic number
Symbol
name
relative atomic mass

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