# Mark scheme – Properties of Materials (H)

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 1 | | | D ✓ | 1 (AO1.1) | |
| | | | **Total** | **1** | |
| 2 | | | A ✓ | 1 (AO1.1) | |
| | | | **Total** | **1** | |
| 3 | | | A ✓ | 1(AO1.1) | |
| | | | **Total** | **1** | |
| 4 | | | C ✓ | 1(AO2.1) | |
| | | | **Total** | **1** | |
| 5 | | | D ✓ | 1(AO1.1) | **Examiner's Comments**<br><br>**Misconception**<br><br>A and B were common misconceptions in this question. |
| | | | **Total** | **1** | |
| 6 | a | i | Ionic ✓<br><br>oppositely charged ions ✓ | 2 (AO1.1) | **ALLOW** oppositely charged particles / has + and - particles<br>**IGNORE** contains anions and cations (in diagram)<br>**IGNORE** oppositely charged atoms / molecules<br>**DO NOT ALLOW** positive nucleus and negative electrons<br><br>**Mark independently** |
| | | ii | **Any two from:**<br><br>Idea of many strong ✓<br><br>covalent bonds ✓<br><br>(which) require a lot of energy to break ✓ | 2 (AO1.1) | **Reference to intermolecular forces / bonds / molecular forces scores 0 for question**<br><br>**ALLOW** many covalent bonds break at high temperatures for 2 marks<br>**ALLOW** idea that each atom has 4 strong covalent bonds for 2 marks<br>**ALLOW** giant covalent structure for 1 mark |
| | | iii | No delocalised electrons / no sea of electrons / | 1 (AO1.1) | **IGNORE** just free electrons |

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| | | | no mobile charge carriers / ions / electrons /<br><br>structure contains atoms ✓ | | |
| | b | | Layers / metal ions ✓<br><br>slide over each other ✓ | 2<br>(AO1.1) | **IGNORE** metal atoms / electrons<br><br>**Mark independently** |
| | | | **Total** | **7** | |
| 7 | a | | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 0.12 OR 0.12:1 OR 1:8.3 award 4 marks**<br><br>Surface area = $6 \times 50^2 = 15000$ ✓<br><br>Volume = $50^3 = 125000$ ✓<br><br>Surface area / volume ratio<br>= 15000 ÷ 125000 ✓<br><br>= 0.12 or 0.12:1 or 1:8.3 ✓ | 4<br><br>(AO3 × 2.2)<br><br>(AO1.2) | **Units not needed**<br><br>**ALLOW** surface area = $1.5 \times 10^4$ $nm^2$<br><br>**ALLOW** volume = $1.25 \times 10^5$ $nm^3$<br><br>**ALLOW** ECF from incorrect surface area and / or volume<br><br>**ALLOW** any **simplified** ratio consistent with 0.12:1<br>eg 3:25 or 1.5:12.5 for 4 marks<br>**DO NOT ALLOW** ratio wrong way round eg 1:0.12<br><br>**Examiner's Comments**<br><br>Many candidates calculated the surface area of the cube as 2,500$nm^2$, failing to multiply this answer by 6. Examiners gave 'error carried forward' so candidates making this mistake were still able to gain 3 marks.<br><br>**AfL**<br><br>It is worth centres stressing to candidates that the award of 'error carried forward' is only possible when an answer is clearly set out. |
| | b | i | Nanoparticles have diameter between 1 - 100 (nm) / idea that (diameter of) DNA is more than 1 (nm) but less than 100 (nm) ✓<br><br>Water (molecule) is too small / 0.27 (nm) is less than 1 (nm) /<br>idea that 0.27 (nm) is not in range 1 – 100 (nm) ✓ | 2(AO1.1) | **ALLOW** has at least one dimension on the nanoscale<br><br>**Examiner's Comments**<br><br>Good responses to this question stated that nanoparticles have a diameter between 1 – 100nm but a water molecule is too small. Lower ability candidates tended to focus on the fact that DNA is a polymer and water is a simple or small molecule, without |

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| | | | | | reference to the size of nanoparticles. Examiners also saw the idea that water is made of 3 atoms but DNA is made of many atoms. |
| | | ii | **FIRST CHECK THE ANSWER ON ANSWER LINE**<br>**If answer = 3100 award 2 marks**<br><br>100000 ÷ 32 ✓<br><br>= 3100 (2 significant figures) ✓ | 2(AO2.2) | **ALLOW** 3125 for 1 mark<br><br>**ALLOW** 0.00032 for 1 mark (correct sig figs from incorrect working out, ie 32 ÷ 100000)<br>**Examiner's Comments**<br><br>  **AfL**<br><br>Centres should stress to candidates that if they are asked to give their answer to a specific number of significant figures, they can only score full marks by doing so. Many candidates scored only 1 mark for giving the answer 3125. |
| | c | | Could be breathed in /<br><br>Idea of absorbed by skin /<br><br>Idea of absorbed into bloodstream /<br><br>Take a long time to break down in the environment ✓ | 1(AO2.1) | **ALLOW** cannot see so may leave (areas of) skin unprotected<br><br>**ALLOW** idea that we don't know the **long term** risks<br><br>**IGNORE** idea that they are not fully understood / there could be side effects / idea that they may react with or irritate skin / harmful to humans<br>**Examiner's Comments**<br><br>Good responses to this question either described specific risks of nanoparticles (e.g. can be breathed in or the idea of absorption through skin or into the bloodstream) or stated that we do not yet know the **long-term** risks of nanoparticles. Answers that did not gain credit were often too vague, e.g. the idea that they are not fully understood or there could be side effects or they may be harmful to humans. |
| | | | **Total** | **9** | |
| 8 | | i | To allow a comparison between with and without the added substance (1) | 1 | |

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| | | ii | Idea that the rate of reaction will change if concentration is changed (1) | 1 | It is a fair test is not sufficient<br><br>**ALLOW** if concentration is increased the rate of reaction is increased<br><br>**ALLOW** to ensure there are the same number of acid particles present / same number of acid particles per unit volume |
| | | iii | Copper<br><br>Because the reaction is faster (1)<br><br>There is no change in appearance (1) | 2 | **No** marks for copper on its own<br>If substance other than copper given then 0 marks for the question |
| | | iv | Measure mass of catalyst before and after (1) | 1 | |
| | | v | (Relative rate) between above 1 and below 10 because of smaller surface area / less exposed particles / less collisions (2) | 2 | **No** marks for the prediction on its own<br><br>**No** marks for whole question if prediction incorrect |
| | | | **Total** | **7** | |
| 9 | a | | strong electrostatic force of attraction between ions (1)<br>must be broken to melt sodium chloride (1) | 2 | |
| | b | | weak intermolecular forces / weak forces between molecules (1)<br>easily broken (1) | 2 | |
| | | | **Total** | **4** | |
| 10 | a | | **graphite** – has a layered structure (1)<br>electrons can move / electrons between layers or delocalised (1)<br>**diamond** – no free electrons or ions (1) | 3 | |
| | b | | it can bond to itself (and make chains and rings) (1) | 1 | |
| | c | | liquid (1)<br>liquid above −114 °C and does not boil until 78 °C (1) | 2 | |
| | | | **Total** | **6** | |
| 11 | | | D | 1 | |
| | | | **Total** | **1** | |
| 12 | | | B | 1 | |
| | | | **Total** | **1** | |
| 13 | | | D | 1 | |
| | | | **Total** | **1** | |