



A-level

CHEMISTRY

Data Booklet

7405

Insert

**This Data Booklet is provided with AQA A-level
Chemistry question papers.**

[Turn over]

The Periodic Table of the Elements

| 1 | 2 | Key | | | | | | |
|-------------------|-------------------|------------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| (1) | (2) | relative atomic mass | | | | | | |
| | | symbol | | | | | | |
| | | atomic (proton) number | | | | | | |
| | | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| 6.9 Li 3 | 9.0 Be 4 | | | | | | | |
| 23.0 Na 11 | 24.3 Mg 12 | | | | | | | |
| 39.1 K 19 | 40.1 Ca 20 | 45.0 Sc 21 | 47.9 Ti 22 | 50.9 V 23 | 52.0 Cr 24 | 54.9 Mn 25 | 55.8 Fe 26 | 58.9 Co 27 |
| 85.5 Rb 37 | 87.6 Sr 38 | 88.9 Y 39 | 91.2 Zr 40 | 92.9 Nb 41 | 96.0 Mo 42 | [97] Tc 43 | 101.1 Ru 44 | 102.9 Rh 45 |
| 132.9 Cs 55 | 137.3 Ba 56 | 138.9 La * 57 | 178.5 Hf 72 | 180.9 Ta 73 | 183.8 W 74 | 186.2 Re 75 | 190.2 Os 76 | 192.2 Ir 77 |
| [223] Fr 87 | [226] Ra 88 | [227] Ac † 89 | [267] Rf 104 | [270] Db 105 | [269] Sg 106 | [270] Bh 107 | [270] Hs 108 | [278] Mt 109 |

| |
|-----|
| 1.0 |
| H |
| 1 |

* 58 – 71 Lanthanides

| | | | | |
|-------------------|-------------------|-------------------|-------------------|-------------------|
| 140.1 Ce 58 | 140.9 Pr 59 | 144.2 Nd 60 | [145] Pm 61 | 150.4 Sm 62 |
| 232.0 Th 90 | 231.0 Pa 91 | 238.0 U 92 | [237] Np 93 | [244] Pu 94 |

† 90 – 103 Actinides

3

| | | | 3 | 4 | 5 | 6 | 7 | 0 |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | | (13) | (14) | (15) | (16) | (17) | (18) |
| | | | 10.8 | 12.0 | 14.0 | 16.0 | 19.0 | 20.2 |
| | | | B | C | N | O | F | Ne |
| | | | 5 | 6 | 7 | 8 | 9 | 10 |
| (10) | (11) | (12) | 27.0 | 28.1 | 31.0 | 32.1 | 35.5 | 39.9 |
| | | | Al | Si | P | S | Cl | Ar |
| | | | 13 | 14 | 15 | 16 | 17 | 18 |
| 58.7 | 63.5 | 65.4 | 69.7 | 72.6 | 74.9 | 79.0 | 79.9 | 83.8 |
| Ni | Cu | Zn | Ga | Ge | As | Se | Br | Kr |
| 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 |
| 106.4 | 107.9 | 112.4 | 114.8 | 118.7 | 121.8 | 127.6 | 126.9 | 131.3 |
| Pd | Ag | Cd | In | Sn | Sb | Te | I | Xe |
| 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 |
| 195.1 | 197.0 | 200.6 | 204.4 | 207.2 | 209.0 | [209] | [210] | [222] |
| Pt | Au | Hg | Tl | Pb | Bi | Po | At | Rn |
| 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 |
| [281] | [281] | [285] | [286] | [289] | [289] | [293] | [294] | [294] |
| Ds | Rg | Cn | Nh | Fl | Mc | Lv | Ts | Og |
| 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 |
| 152.0 | 157.3 | 158.9 | 162.5 | 164.9 | 167.3 | 168.9 | 173.0 | 175.0 |
| Eu | Gd | Tb | Dy | Ho | Er | Tm | Yb | Lu |
| 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 |
| [243] | [247] | [247] | [251] | [252] | [257] | [258] | [259] | [262] |
| Am | Cm | Bk | Cf | Es | Fm | Md | No | Lr |
| 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 |

[Turn over]

| | | | | | |
|----|----|------------|----|----|--------------|
| 1 | H | Hydrogen | 31 | Ga | Gallium |
| 2 | He | Helium | 32 | Ge | Germanium |
| 3 | Li | Lithium | 33 | As | Arsenic |
| 4 | Be | Beryllium | 34 | Se | Selenium |
| 5 | B | Boron | 35 | Br | Bromine |
| 6 | C | Carbon | 36 | Kr | Krypton |
| 7 | N | Nitrogen | 37 | Rb | Rubidium |
| 8 | O | Oxygen | 38 | Sr | Strontium |
| 9 | F | Fluorine | 39 | Y | Yttrium |
| 10 | Ne | Neon | 40 | Zr | Zirconium |
| 11 | Na | Sodium | 41 | Nb | Niobium |
| 12 | Mg | Magnesium | 42 | Mo | Molybdenum |
| 13 | Al | Aluminium | 43 | Tc | Technetium |
| 14 | Si | Silicon | 44 | Ru | Ruthenium |
| 15 | P | Phosphorus | 45 | Rh | Rhodium |
| 16 | S | Sulfur | 46 | Pd | Palladium |
| 17 | Cl | Chlorine | 47 | Ag | Silver |
| 18 | Ar | Argon | 48 | Cd | Cadmium |
| 19 | K | Potassium | 49 | In | Indium |
| 20 | Ca | Calcium | 50 | Sn | Tin |
| 21 | Sc | Scandium | 51 | Sb | Antimony |
| 22 | Ti | Titanium | 52 | Te | Tellurium |
| 23 | V | Vanadium | 53 | I | Iodine |
| 24 | Cr | Chromium | 54 | Xe | Xenon |
| 25 | Mn | Manganese | 55 | Cs | Caesium |
| 26 | Fe | Iron | 56 | Ba | Barium |
| 27 | Co | Cobalt | 57 | La | Lanthanum |
| 28 | Ni | Nickel | 58 | Ce | Cerium |
| 29 | Cu | Copper | 59 | Pr | Praseodymium |
| 30 | Zn | Zinc | 60 | Nd | Neodymium |

| | | | | | |
|----|----|------------|-----|----|---------------|
| 61 | Pm | Promethium | 90 | Th | Thorium |
| 62 | Sm | Samarium | 91 | Pa | Protactinium |
| 63 | Eu | Europium | 92 | U | Uranium |
| 64 | Gd | Gadolinium | 93 | Np | Neptunium |
| 65 | Tb | Terbium | 94 | Pu | Plutonium |
| 66 | Dy | Dysprosium | 95 | Am | Americium |
| 67 | Ho | Holmium | 96 | Cm | Curium |
| 68 | Er | Erbium | 97 | Bk | Berkelium |
| 69 | Tm | Thulium | 98 | Cf | Californium |
| 70 | Yb | Ytterbium | 99 | Es | Einsteinium |
| 71 | Lu | Lutetium | 100 | Fm | Fermium |
| 72 | Hf | Hafnium | 101 | Md | Mendelevium |
| 73 | Ta | Tantalum | 102 | No | Nobelium |
| 74 | W | Tungsten | 103 | Lr | Lawrencium |
| 75 | Re | Rhenium | 104 | Rf | Rutherfordium |
| 76 | Os | Osmium | 105 | Db | Dubnium |
| 77 | Ir | Iridium | 106 | Sg | Seaborgium |
| 78 | Pt | Platinum | 107 | Bh | Bohrium |
| 79 | Au | Gold | 108 | Hs | Hassium |
| 80 | Hg | Mercury | 109 | Mt | Meitnerium |
| 81 | Tl | Thallium | 110 | Ds | Darmstadtium |
| 82 | Pb | Lead | 111 | Rg | Roentgenium |
| 83 | Bi | Bismuth | 112 | Cn | Copernicium |
| 84 | Po | Polonium | 113 | Nh | Nihonium |
| 85 | At | Astatine | 114 | Fl | Flerovium |
| 86 | Rn | Radon | 115 | Mc | Moscovium |
| 87 | Fr | Francium | 116 | Lv | Livermorium |
| 88 | Ra | Radium | 117 | Ts | Tennesine |
| 89 | Ac | Actinium | 118 | Og | Oganesson |

[Turn over]

DATA SHEET**TABLE A****Infrared absorption data**

| Bond | Wavenumber /cm⁻¹ |
|---------------------------|--|
| N—H (amines) | 3300 – 3500 |
| O—H (alcohols) | 3230 – 3550 |
| C—H | 2850 – 3300 |
| O—H (acids) | 2500 – 3000 |
| C≡N | 2220 – 2260 |
| C=O | 1680 – 1750 |
| C=C | 1620 – 1680 |
| C—O | 1000 – 1300 |
| C—C | 750 – 1100 |

TABLE B


¹H NMR chemical shift data

| Type of proton | δ /ppm |
|---|---------------|
| ROH | 0.5 – 5.0 |
| RCH ₃ | 0.7 – 1.2 |
| RNH ₂ | 1.0 – 4.5 |
| R ₂ CH ₂ | 1.2 – 1.4 |
| R ₃ CH | 1.4 – 1.6 |
| $\begin{array}{c} \\ \text{R}-\text{C}-\text{C}- \\ \quad \\ \text{O} \quad \text{H} \end{array}$ | 2.1 – 2.6 |
| $\begin{array}{c} \\ \text{R}-\text{O}-\text{C}- \\ \\ \text{H} \end{array}$ | 3.1 – 3.9 |
| RCH ₂ Cl or Br | 3.1 – 4.2 |
| $\begin{array}{c} \\ \text{R}-\text{C}-\text{O}-\text{C}- \\ \quad \\ \text{O} \quad \text{H} \end{array}$ | 3.7 – 4.1 |
| $\begin{array}{c} \text{R} \quad \text{H} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \diagdown \end{array}$ | 4.5 – 6.0 |
| $\begin{array}{c} \text{O} \\ // \\ \text{R}-\text{C} \\ \backslash \\ \text{H} \end{array}$ | 9.0 – 10.0 |
| $\begin{array}{c} \text{O} \\ // \\ \text{R}-\text{C} \\ \backslash \\ \text{O}-\text{H} \end{array}$ | 10.0 – 12.0 |

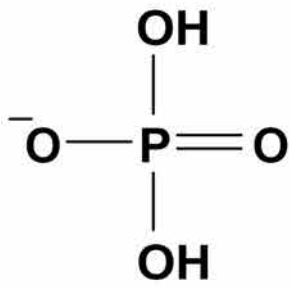
[Turn over]

TABLE C

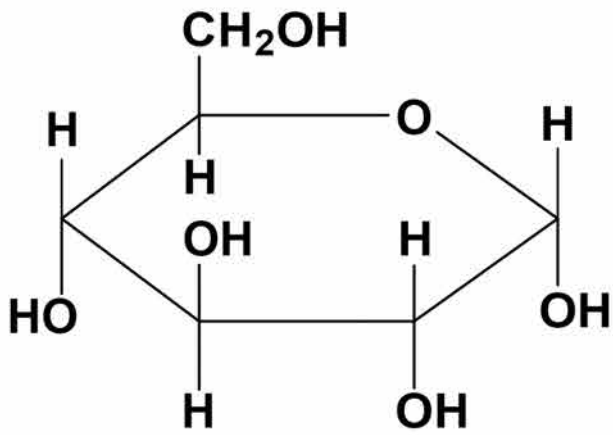
¹³C NMR chemical shift data

| Type of carbon | δ/ppm |
|--|----------------------------------|
| $\begin{array}{c} \quad \\ -\text{C}-\text{C}- \\ \quad \end{array}$ | 5 – 40 |
| $\begin{array}{c} \\ \text{R}-\text{C}-\text{Cl or Br} \\ \end{array}$ | 10 – 70 |
| $\begin{array}{c} \\ \text{R}-\text{C}-\text{C}- \\ \quad \\ \text{O} \end{array}$ | 20 – 50 |
| $\begin{array}{c} \\ \text{R}-\text{C}-\text{N} \\ \quad \diagup \quad \diagdown \end{array}$ | 25 – 60 |
| $\begin{array}{c} \\ -\text{C}-\text{O}- \\ \end{array}$ | alcohols, ethers or esters |
| $\begin{array}{c} \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \end{array}$ | 90 – 150 |
| $\text{R}-\text{C}\equiv\text{N}$ | 110 – 125 |
|  | 110 – 160 |
| $\begin{array}{c} \text{R}-\text{C}- \\ \\ \text{O} \end{array}$ | esters or acids |
| $\begin{array}{c} \text{R}-\text{C}- \\ \\ \text{O} \end{array}$ | aldehydes or ketones |

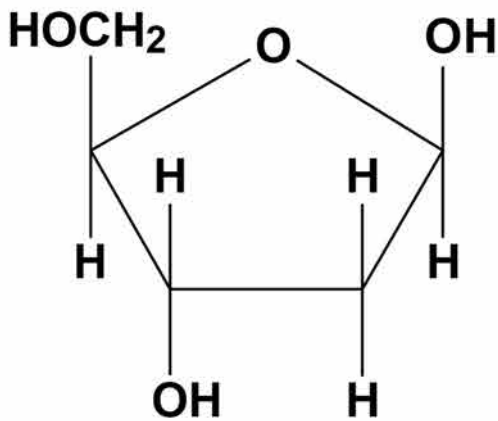
PHOSPHATE AND SUGARS



phosphate



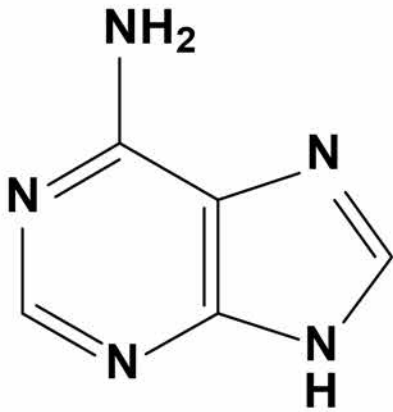
glucose



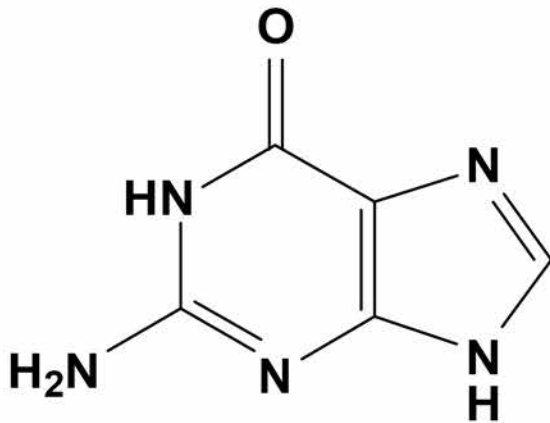
2-deoxyribose

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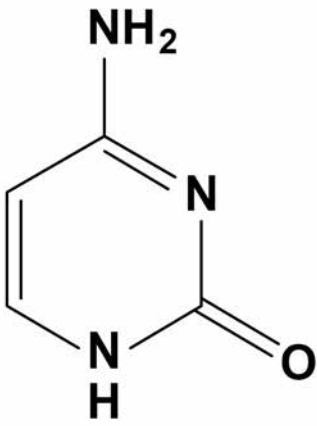
BASES



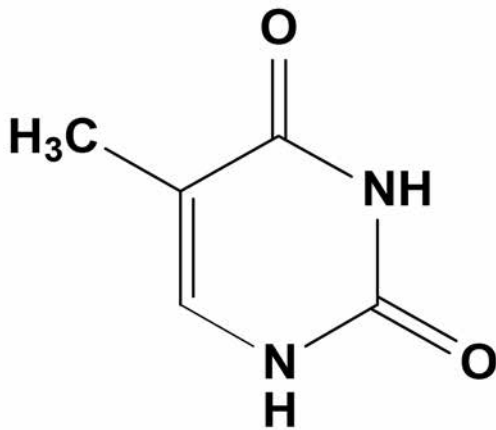
adenine



guanine



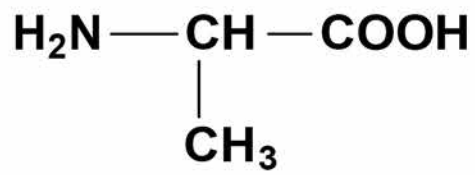
cytosine



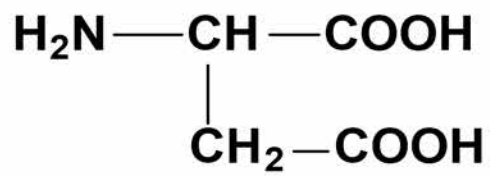
thymine

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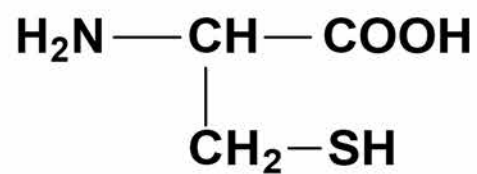
AMINO ACIDS



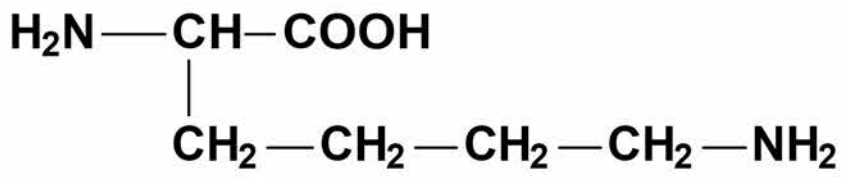
alanine



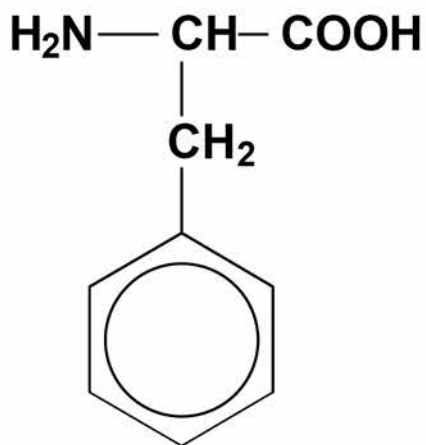
aspartic acid



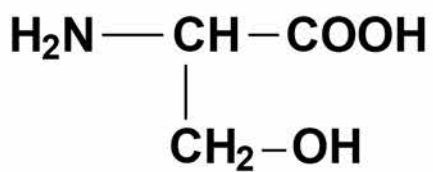
cysteine



lysine



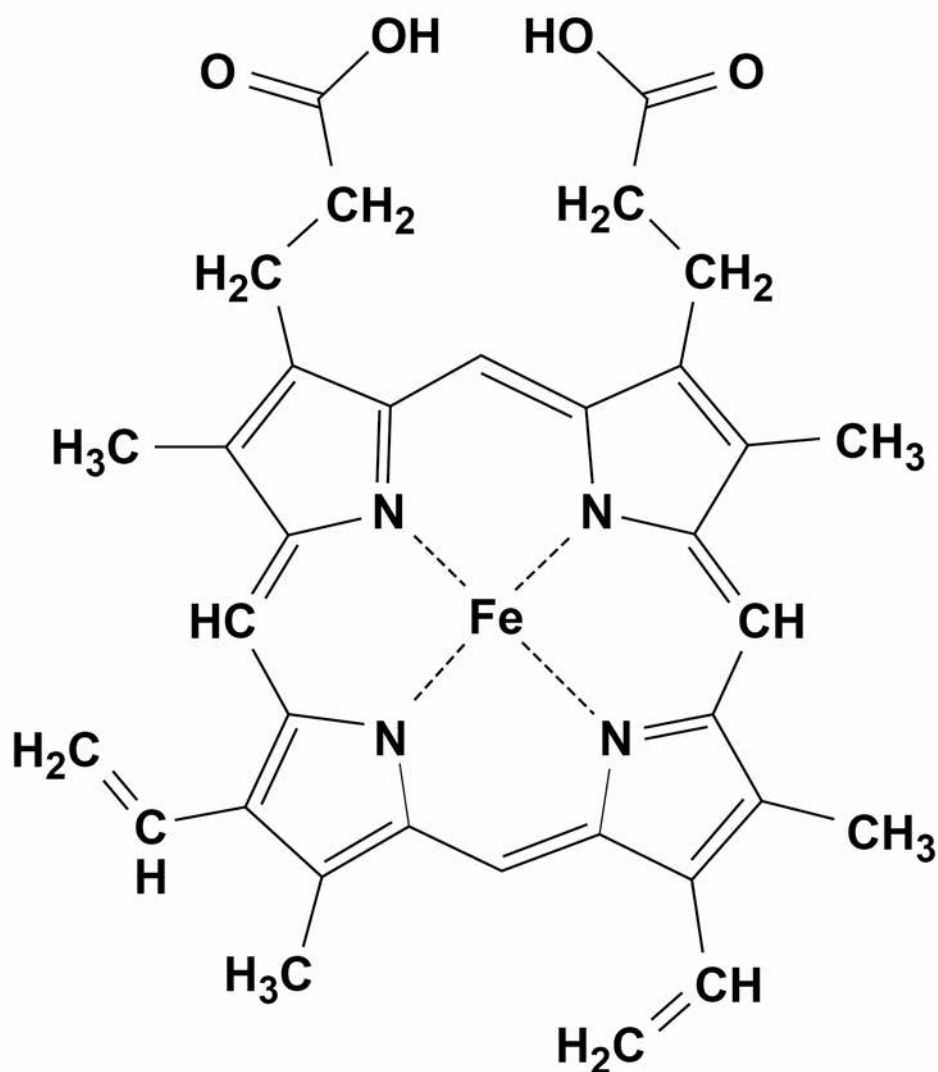
phenylalanine



serine

[Turn over]

HAEM B

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