

CHEM1101 Example Multiple Choice Questions

The following multiple choice questions are provided to *illustrate* the type of questions used in this section of the paper and to provide you with extra practice.

It is *not* a sample quiz. The questions in the paper will be in the style of these questions but may well cover different topics.

In the exam, the answer should be indicated by clearly circling the letter next to the choice you make **and** by filling in the corresponding box on the computer-marked sheet provided. The marks for each correct answer are given beside each question.

Instructions for use of the computer sheet. Draw a **thick** line through the **centre** and crossing both edges of each box selected, as in this example.



Use a **dark** lead pencil so that you can use an eraser if you make an error. Errors made in ink cannot be corrected – you will need to ask the examination supervisor for another sheet. Boxes with faint or incomplete lines or not completed in the prescribed manner may not be read. Be sure to complete the SID and name sections of the sheet.

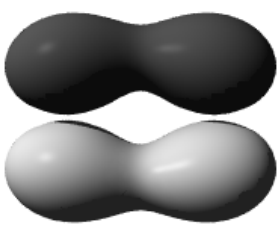
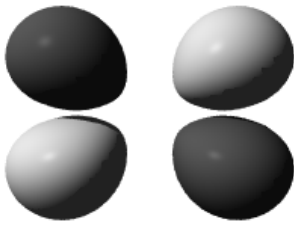
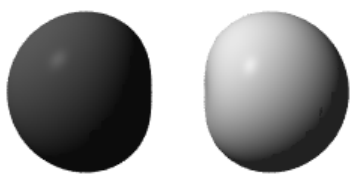
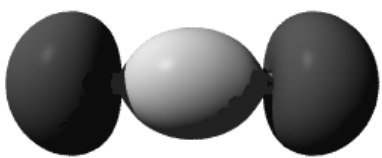
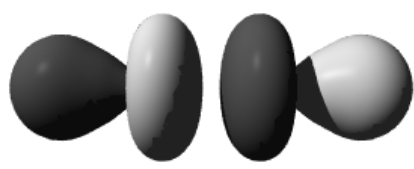
Your answer as recorded on the sheet will be used in the event of any ambiguity.

There is only one correct choice for each question.

Negative marks will not be awarded for any question.

1.	Which one of the following sets of quantum numbers is valid?	Marks 1																														
	<table><tr><td></td><td><i>n</i></td><td><i>l</i></td><td><i>m_l</i></td><td><i>m_s</i></td></tr><tr><td>A</td><td>4</td><td>3</td><td>4</td><td>−1/2</td></tr><tr><td>B</td><td>3</td><td>1</td><td>0</td><td>+1/2</td></tr><tr><td>C</td><td>1</td><td>−1</td><td>1</td><td>+1/2</td></tr><tr><td>D</td><td>2</td><td>1</td><td>2</td><td>−1/2</td></tr><tr><td>E</td><td>2</td><td>3</td><td>−3</td><td>+1/2</td></tr></table>		<i>n</i>	<i>l</i>	<i>m_l</i>	<i>m_s</i>	A	4	3	4	−1/2	B	3	1	0	+1/2	C	1	−1	1	+1/2	D	2	1	2	−1/2	E	2	3	−3	+1/2	
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E	2	3	−3	+1/2																												
2.	How many protons (p), neutrons (n) and electrons (e) are present in the barium isotope ¹²³ ₅₆ Ba ?	1																														
	<table><tr><td>A</td><td>56 p</td><td>67 n</td><td>56 e</td></tr><tr><td>B</td><td>56 p</td><td>123 n</td><td>67 e</td></tr><tr><td>C</td><td>123 p</td><td>56 n</td><td>56 e</td></tr><tr><td>D</td><td>67 p</td><td>56 n</td><td>67 e</td></tr><tr><td>E</td><td>67 p</td><td>123 n</td><td>56 e</td></tr></table>	A	56 p	67 n	56 e	B	56 p	123 n	67 e	C	123 p	56 n	56 e	D	67 p	56 n	67 e	E	67 p	123 n	56 e											
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3.	What is the ground state electronic configuration of the bromine atom?	1																														
	<table><tr><td>A</td><td>1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 4d¹⁵</td></tr><tr><td>B</td><td>1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 3d¹⁰ 4p⁵</td></tr><tr><td>C</td><td>1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 4d¹⁰ 4p⁶</td></tr><tr><td>D</td><td>1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 3d⁹ 4p⁶</td></tr><tr><td>E</td><td>1s² 2s² 2p⁶ 3s² 3p⁶ 4s² 4d¹⁰ 4p⁵</td></tr></table>	A	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹⁵	B	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 3d ¹⁰ 4p ⁵	C	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹⁰ 4p ⁶	D	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 3d ⁹ 4p ⁶	E	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹⁰ 4p ⁵																					
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4.	²²² Rn is unstable and decays by emits two alpha and two beta particles. What is the final decay product?	1																														
	<table><tr><td>A</td><td>²¹⁸Bi</td></tr><tr><td>B</td><td>²¹⁶Bi</td></tr><tr><td>C</td><td>²¹⁶Pb</td></tr><tr><td>D</td><td>²¹⁴Po</td></tr><tr><td>E</td><td>²¹²Tl</td></tr></table>	A	²¹⁸ Bi	B	²¹⁶ Bi	C	²¹⁶ Pb	D	²¹⁴ Po	E	²¹² Tl																					
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E	²¹² Tl																															

5.	For which one of the following species is it possible to solve the wave equation analytically and obtain an equation for its electronic energy levels? A He B Li^{2+} C H_2 D H^- E He^-	Marks 1
6.	Which of the following atoms has the highest first ionisation energy? A Rb B Na C K D Cs E Si	1
7.	Which of the following quantities is proportional to the electron density at a point? A the wavefunction B the square of the wave function C the de Broglie wavelength D the reciprocal of the de Broglie wavelength E the Rydberg constant	1
8.	How many valence electrons are there in the P^{3-} ion? A 3 B 5 C 8 D 15 E 18	1
9.	The ^{14}C activity of a sample of wood is 0.250 of a modern standard. What is the radiocarbon age of the sample (to 3 significant figures)? A 2780 years B 5570 years C 11,100 years D 16,100 years E 22,300 years	1

<p>10. Which one of the following best describes a $3p$ orbital?</p> <p>A A function with 2 spherical nodes and 1 planar node. B A function with 1 spherical node and 0 planar nodes. C A function with 2 spherical nodes and 2 planar nodes. D A function with 1 spherical node and 1 planar node. E A function with 0 spherical nodes and 1 planar node.</p>	<p>Marks 1</p>
<p>11. Which one of the following is a lobe representation for a σ bonding molecular orbital?</p> <div><p>A</p><p>B</p><p>C</p><p>D</p><p>E</p></div>	<p>1</p>
<p>12. What is the shape of the XeF_4 molecule?</p> <p>A “see-saw” B tetrahedral C square pyramidal D trigonal bipyramidal E square planar</p>	<p>1</p>
<p>13. A certain molecule has a “see-saw” geometry. Which one of the following statements is true?</p> <p>A The central atom bears two lone pairs. B The external atoms must be fluorine. C The molecule could have the generic formula XY_4. D The shape is based on the octahedral electron pair arrangement. E All external atoms are in equivalent environments.</p>	<p>1</p>

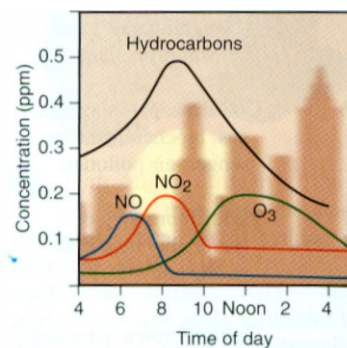
14. LiF and NaBr are ionic salts that both form a simple cubic lattice. The ionic radii of Li^+ , F^- , Na^+ and Br^- are 0.76, 1.33, 1.02 and 1.96 Å respectively. Which one of the following statements is <i>true</i> ?	Marks 1
<p>A The atomic radius of Na is smaller than 1.0 Å.</p> <p>B The atomic radius of F is larger than 1.4 Å.</p> <p>C Each Li^+ ion in LiF has 8 F^- ions as nearest neighbours.</p> <p>D The lattice energy of LiF is greater in magnitude than the lattice energy of NaBr.</p> <p>E The boiling point of NaBr is higher than the boiling point of LiF.</p>	
15. How would the concentration of $\text{Pb}^{2+}(\text{aq})$ ions in equilibrium with $\text{PbI}_2(\text{s})$ be affected if the concentration of $\text{I}^-(\text{aq})$ ions were doubled?	1
<p>A no change</p> <p>B increased by a factor of 2</p> <p>C decreased by a factor of 2</p> <p>D decreased by a factor of 4</p> <p>E decreased by a factor of 16</p>	
16. List the following "ideal" gases in order of increasing density at 25 °C and 1 atm. Cl_2 H_2 N_2 NO_2 O_2	1
<p>A $\text{H}_2 < \text{N}_2 < \text{O}_2 < \text{NO}_2 < \text{Cl}_2$</p> <p>B $\text{Cl}_2 < \text{NO}_2 < \text{O}_2 < \text{N}_2 < \text{H}_2$</p> <p>C $\text{H}_2 < \text{N}_2 < \text{O}_2 < \text{Cl}_2 < \text{NO}_2$</p> <p>D $\text{NO}_2 < \text{Cl}_2 < \text{O}_2 < \text{N}_2 < \text{H}_2$</p> <p>E All ideal gases have the same density</p>	
17. What is the oxidation number of the oxygen atoms in O_3 ?	1
<p>A -3</p> <p>B $-\frac{1}{3}$</p> <p>C 0</p> <p>D $+\frac{1}{3}$</p> <p>E +3</p>	

Marks
1

18. Which type of rocket fuel is chosen for a space engine that needs to be turned on and off frequently?

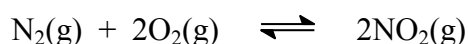
- A solid fuel
- B hypergolic fuel
- C petroleum fuel
- D cryogenic fuel
- E any of the above

19. Consider the idealised graph of various pollutants shown. Which one of the following statements concerning these species is *false*?

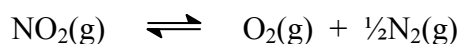
**1**

- A NO and hydrocarbons are primary pollutants.
- B NO₂ and O₃ are secondary pollutants.
- C NO₂ decomposes to form NO via: $\text{NO}_2 + h\nu \rightarrow \text{NO} + \text{O}$
- D When the concentrations of NO₂ and O₃ are very high, the nitrate radical, NO₃ can form, leading to acid rain.
- E The production of NO₂ and O₃ is considered to be bad for the atmosphere because they are both greenhouse gases.

20. Consider the following reaction, for which the equilibrium constant, $K_c = 100$.



What is K_c for the reaction below?



- A 0.0100
- B 0.100
- C 1.00
- D 10.0
- E 100

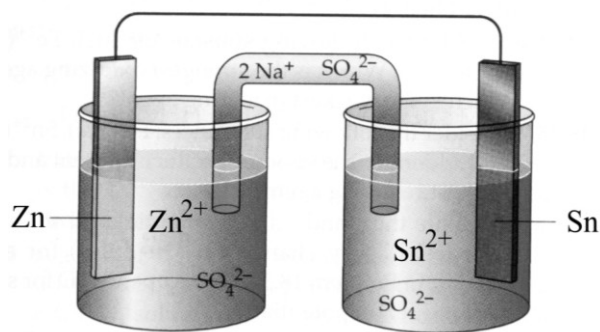
1

<p>21. Which intermolecular force is most important in allowing Xe gas to liquefy?</p> <p>A dipole-dipole B hydrogen-bonding C ionic D instantaneous dipole-induced dipole E ion-dipole</p>	<p>Marks 1</p>
<p>22. Which type of rocket fuel provides the best efficiency in terms of energy per mass of reactants.</p> <p>A solid fuel B hypergolic fuel C petroleum fuel D cryogenic fuel</p>	<p>1</p>
<p>23. The reaction below has reached equilibrium.</p> $\text{Ag}^+(\text{aq}) + \text{Fe}^{2+}(\text{aq}) \rightleftharpoons \text{Ag}(\text{s}) + \text{Fe}^{3+}(\text{aq}) \quad \Delta H < 0$ <p>Which one of the following would cause precipitation of more silver?</p> <p>A warming B removing some of the solid silver C increasing the concentration of $\text{Fe}^{2+}(\text{aq})$ ions D increasing the concentration of $\text{Fe}^{3+}(\text{aq})$ ions E decreasing the concentration of $\text{Fe}^{2+}(\text{aq})$ ions</p>	<p>1</p>
<p>24. Consider the following information:</p> $\text{A} + \text{B} \rightarrow \text{C} + \text{D} \quad \Delta H^\circ = -10.0 \text{ kJ}$ $\text{C} + \text{D} \rightarrow \text{E} \quad \Delta H^\circ = 15.0 \text{ kJ}$ <p>Which one of the following reactions would have $\Delta H^\circ = -10 \text{ kJ}$?</p> <p>A $\text{C} + \text{D} \rightarrow \text{A} + \text{B}$ B $2\text{C} + 2\text{D} \rightarrow 2\text{A} + 2\text{B}$ C $\text{A} + \text{B} \rightarrow \text{E}$ D $\frac{1}{2}\text{E} \rightarrow \frac{1}{2}\text{C} + \frac{1}{2}\text{D}$ E $2\text{E} \rightarrow 2\text{A} + 2\text{B}$</p>	<p>1</p>

<p>25. The enthalpy change for which of the following processes represents the standard enthalpy of formation of AgCl?</p> <p>A $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$</p> <p>B $\text{Ag}(\text{s}) + \text{Cl}(\text{g}) \rightarrow \text{AgCl}(\text{s})$</p> <p>C $\text{AgCl}(\text{s}) \rightarrow \text{Ag}(\text{s}) + \frac{1}{2}\text{Cl}_2(\text{g})$</p> <p>D $\text{Ag}(\text{s}) + \text{AuCl}(\text{s}) \rightarrow \text{Au}(\text{s}) + \text{AgCl}(\text{s})$</p> <p>E $\text{Ag}(\text{s}) + \frac{1}{2}\text{Cl}_2(\text{g}) \rightarrow \text{AgCl}(\text{s})$</p>	Marks 1
<p>26. Consider the following reaction and its equilibrium constant.</p> $\text{A} + 3\text{B} \rightleftharpoons 2\text{C} \qquad K = \frac{1}{[\text{A}][\text{B}]^3}$ <p>What reaction conditions could give rise to the observed equilibrium expression?</p> <p>A A, B and C are in aqueous solution.</p> <p>B A, B and C are liquids.</p> <p>C A and B are liquids, C is a gas.</p> <p>D C is a gas, A and B are solids.</p> <p>E C is a solid, A and B are in aqueous solution.</p>	1
<p>Questions 27 and 28 relate to the smelting of iron from iron oxide. The overall reaction for this process is:</p> $\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightleftharpoons 2\text{Fe}(\text{l}) + 3\text{CO}_2(\text{g})$	
<p>27. What is the role of the CO(g) in this reaction?</p> <p>A A catalyst</p> <p>B An oxidant</p> <p>C A reductant</p> <p>D A fuel</p> <p>E A solvent</p>	1
<p>28. What would happen to the equilibrium position if the total pressure were increased?</p> <p>A The reaction would move to the left.</p> <p>B The reaction would move to the right.</p> <p>C The equilibrium would not change.</p> <p>D Not sufficient information to decide.</p>	1

29. The figure below shows a $\text{Zn}^{2+}|\text{Zn}$ and $\text{Sn}^{2+}|\text{Sn}$ voltaic cell. Relevant electrode potentials are on the separate data sheet.

Marks
2



Which one of the following best describes the chemical operation of the cell?

- A** The Zn electrode is the cathode; Zn is being oxidised; electrons travel from right to left.
- B** The Zn electrode is the anode; Zn is being oxidised; electrons travel from left to right.
- C** The Sn electrode is the anode; Zn^{2+} is being reduced; electrons travel from left to right.
- D** The Sn electrode is the cathode; Sn is being oxidised; electrons travel from right to left.
- E** The Zn electrode is the anode; Sn^{2+} is being reduced; electrons travel from right to left.

30. Consider the following reaction.



Which one of the following is the correct expression for the Nernst equation for this reaction?

- A** $E = E^\circ - \frac{RT}{2F} \times 2.303 \log \frac{[\text{Fe}^{2+}]^2 [\text{Sn}^{4+}]}{[\text{Fe}^{3+}]^2 [\text{Sn}^{2+}]}$
- B** $E = E^\circ - \frac{RT}{2F} \times 2.303 \log \frac{[\text{Fe}^{3+}]^2 [\text{Sn}^{2+}]}{[\text{Fe}^{2+}]^2 [\text{Sn}^{4+}]}$
- C** $E = E^\circ - \frac{RT}{F} \times 2.303 \log \frac{[\text{Fe}^{2+}]^2 [\text{Sn}^{4+}]}{[\text{Fe}^{3+}]^2 [\text{Sn}^{2+}]}$
- D** $E = E^\circ - \frac{RT}{F} \times 2.303 \log \frac{[\text{Fe}^{3+}]^2 [\text{Sn}^{2+}]}{[\text{Fe}^{2+}]^2 [\text{Sn}^{4+}]}$
- E** $E = E^\circ - \frac{RT}{F} \times 2.303 \log \frac{[\text{Fe}^{2+}] [\text{Sn}^{4+}]}{[\text{Fe}^{3+}] [\text{Sn}^{2+}]}$

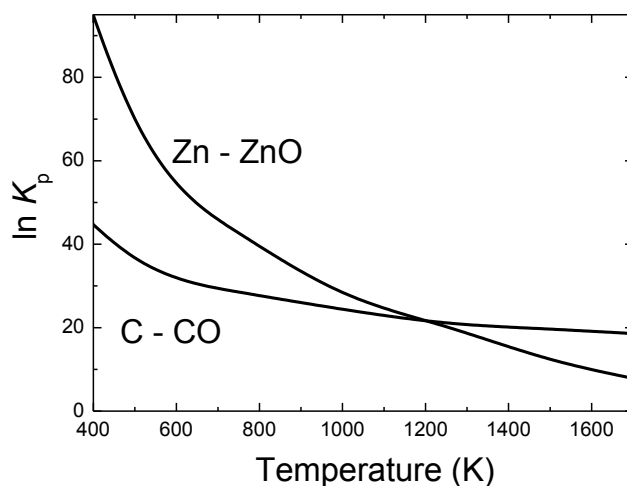
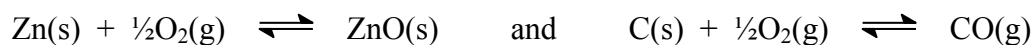
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31. Why do lead-acid batteries maintain an approximately constant voltage?	Marks 1
<p>A They never run down.</p> <p>B No aqueous species appear in the equation for the overall cell reaction.</p> <p>C Their E° values are very high.</p> <p>D They are primary batteries.</p> <p>E The concentrations of reagents in the half cell reactions remain approximately constant.</p>	
32. Which one of the following statements is correct?	1
<p>A In anodic inhibition, corrosion of a metal is minimised by forming an impermeable barrier at its surface.</p> <p>B In cathodic protection, corrosion of a metal is minimised by forming a contact to another metal with a higher reduction potential.</p> <p>C In fuel cells oxidation and reduction occur at the same electrode.</p> <p>D Iron corrodes in oxygen-free water.</p> <p>E Iron corrodes more rapidly in salty water because the electrochemical potential is higher.</p>	
33. Why do mercury batteries and silver batteries maintain a constant voltage?	1
<p>A They never run down.</p> <p>B No aqueous species appear in the equation for the overall cell reaction.</p> <p>C Their E° values are very high.</p> <p>D They are primary batteries.</p> <p>E The concentrations of reagents in the half cell reactions remain approximately constant.</p>	
34. Using the relevant half cell reduction potentials calculate the standard electrode potential for the hydrogen fuel cell.	1
<p>A 0.83 V</p> <p>B 1.77 V</p> <p>C 0.68 V</p> <p>D 2.07 V</p> <p>E 1.23 V</p>	

Questions 35 and 36 refer to the following reaction. $2\text{CO(g)} + \text{O}_2\text{(g)} \rightleftharpoons 2\text{CO}_2\text{(g)}$	Marks
<p>35. What is the equilibrium constant expression, K_c, for this reaction?</p> <p>A $K_c = k[\text{CO}]^2[\text{O}_2]$</p> <p>B $K_c = \frac{[\text{CO}]^2[\text{O}_2]}{[\text{CO}_2]}$</p> <p>C $K_c = \frac{[\text{CO}_2]}{[\text{CO}][\text{O}_2]}$</p> <p>D $K_c = \frac{[\text{CO}_2]^2}{[\text{CO}]^2[\text{O}_2]}$</p> <p>E $K_c = \frac{[\text{CO}]^2[\text{O}_2]}{[\text{CO}_2]^2}$</p>	1
<p>36. Suppose the equation is rewritten as $\text{CO(g)} + \frac{1}{2}\text{O}_2\text{(g)} \rightleftharpoons \text{CO}_2\text{(g)}$ with an equilibrium constant K_c'. What is the relationship between K_c and K_c'?</p> <p>A $K_c' = K_c$ (<i>i.e.</i> no change)</p> <p>B $K_c' = (K_c)^{1/2}$</p> <p>C $K_c' = \frac{1}{2}(K_c)$</p> <p>D $K_c' = (K_c)^2$</p> <p>E $K_c' = (K_c)^{-1}$</p>	1
<p>37. The following reaction is at equilibrium.</p> $\text{CF}_2\text{Br}_2\text{(g)} \rightleftharpoons \text{CF}_2\text{(g)} + 2\text{Br(g)} \quad \Delta H = 424 \text{ kJ mol}^{-1}$ <p>How will the system respond if the temperature is decreased?</p> <p>A The reaction will shift to the left.</p> <p>B The reaction will shift to the right.</p> <p>C There will be no change to the equilibrium position.</p>	1
<p>38. The following reaction is at equilibrium.</p> $\text{Cl}_2\text{(g)} + 3\text{F}_2\text{(g)} \rightleftharpoons 2\text{ClF}_3\text{(g)}$ <p>How will the system respond if the volume is increased at constant temperature?</p> <p>A The reaction will shift to the left.</p> <p>B The reaction will shift to the right.</p> <p>C There will be no change to the equilibrium position.</p>	1

Marks
1

39. Consider the following Ellingham diagram, representing the temperature dependence of the following reactions.



Which one of the following statements is FALSE?

- A** At $T > 1200$ K, carbon will reduce ZnO(s) to Zn(s).
B At $T < 1200$ K, the reaction $\text{ZnO(s)} + \text{C(s)} \rightleftharpoons \text{Zn(s)} + \text{CO(g)}$ favours the reactants.
C At $T < 1200$ K, the reaction $\text{C(s)} + \frac{1}{2}\text{O}_2(\text{g}) \rightleftharpoons \text{CO(g)}$ favours the reactants.
D The reaction $\text{Zn(s)} + \frac{1}{2}\text{O}_2(\text{g}) \rightleftharpoons \text{ZnO(s)}$ favours the products at all temperatures shown.
E The reaction $\text{C(s)} + \frac{1}{2}\text{O}_2(\text{g}) \rightleftharpoons \text{CO(g)}$ favours the products at all temperatures shown.

40. Which one of the following processes is endothermic?

- A** When concentrated sulfuric acid is added to water, the water gets hot.
B Natural gas (CH_4) is burned in a Bunsen burner.
C Water is frozen in a freezer.
D Glucose is metabolised to warm the body.
E Water is boiled in a kettle.

1

Answers

Question	1	2	3	4	5	6	7	8	9	10
Answer	B	A	B	D	B	E	B	C	C	D

Question	11	12	13	14	15	16	17	18	19	20
Answer	D	E	C	D	D	A	C	B	E	B

Question	21	22	23	24	25	26	27	28	29	30
Answer	D	D	C	E	E	E	C	C	B	A

Question	31	32	33	34	35	36	37	38	39	40
Answer	E	A	B	E	D	B	A	A	C	E