# 

# Year 11 Semester One Examination, 2018

**Question/Answer Booklet**

**CHEMISTRY**

Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Teacher’s Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#### Time allowed for this paper

|  |  |
| --- | --- |
| **Section** | **Marks** |
| 1 | /20 |
| **/30** |
| 2 | **/55** |
| 3 | **/65** |
| total | **/150** |
| **%** |

Reading time before commencing work: ten minutes

Working time for paper: 2 ½ hours

**Materials required/recommended for this paper**

***To be provided by the supervisor***

This Question/Answer Booklet

Multiple-choice Question booklet

Chemistry Data Sheet

***To be provided by the candidate***

Standard items: pens (blue/black preferred), pencils, sharpener, correction tape/fluid, eraser, ruler, highlighters

Special items: up to three non-programmable calculators approved for use in the ATAR examinations

**Important note to candidates**

No other items may be taken into the examination room. It is your responsibility to ensure that you do not have any unauthorised notes or other items of a non‑personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor before reading any further.

**Structure of this paper**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Section | Number of questions available | Number of questions to be answered | Suggested working time  (minutes) | Marks available | Percentage of examination |
| Section One:  Multiple-choice | 20 | 20 | 30 | 30 | 1 |
| Section Two:  Short answer | 8 | 8 | 55 | 55 | 40 |
| Section Three:  Extended answer | 4 | 4 | 65 | 65 | 40 |
| **Total** | | | | | 100 |

**Instructions to candidates**

1. Answer the questions according to the following instructions.

Section One: Answer all questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Sections Two and Three: Write answers in this Question/Answer Booklet.

3. When calculating numerical answers, show your working or reasoning clearly. Express numerical answers to the appropriate number ofsignificant figures and include appropriate units where applicable

4. You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.

5. Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

 Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.

 Continuing an answer: If you need to use the space to continue an answer, **indicate in the original answer space where the answer is continued,** i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.

**Section One: Multiple-choice 17% (30 Marks)**

This section has **20** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question **shade the box** to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers.

**No marks will be given if more than one answer is completed for any question.**

Suggested working time: 30 minutes.

INSTRUCTIONS

For each question shade the box to indicate the answer.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. | a 🞏 | b ◼ | c 🞏 | d 🞏 |

Use only a blue or black pen to shade the boxes.

For example, if b is your answer

X

If you make a mistake, place a cross through that square, do not erase or use correction fluid.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. | a 🞏 | b ◼ | c 🞏 | d ◼ |

Shade your new answer.

For example, if b is a mistake and d is your correct answer:

In the event that you then change your mind back to your original answer, you then cross out the second selection and then circle the first choice.

X

X

For example, if b was the first choice and d your second, but you change your mind back and b is your answer:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. | a 🞏 | b ◼ | c 🞏 | d ◼ |

Marks will not be deducted for incorrect answers.   
No marks will be given if more than one answer is completed for any question.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 2. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
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| 4. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 5. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
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| 7. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 8. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 9. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 10. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |

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| 11. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 12. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 13. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 14. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 15. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 16. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 17. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 18. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 19. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |
| 20. | a 🞏 | b 🞏 | c 🞏 | d 🞏 |

**/20**

**Section Two: Short answer 37% (55 Marks)**

This section has **8** questions. Answer **all** questions. Write your answers in the spaces provided.

When calculating numerical answers, show your working or reasoning clearly. Express numerical answers to the appropriate number of significant figures and include appropriate units where applicable.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

 Planning: If you use the spare pages for planning, indicate this clearly at the top of the

page.

 Continuing an answer: If you need to use the space to continue an answer, **indicate**

**in the original answer space where the answer is continued,** i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 55 minutes.

**Question 21 (8 marks)**

(a) Write the formula of each of the following compounds. (4)

|  |  |
| --- | --- |
| **Name** | **Formula** |
| sodium sulfide |  |
| copper (II) sulfate |  |
| aluminium carbonate |  |
| nitrogen dioxide |  |

(b) Write the names of each of the following species. (4)

|  |  |
| --- | --- |
| **Formula** | **Name** |
| Zn(NO3)2 |  |
| NH4+ |  |
| SO3 |  |
| FeCℓ2 |  |

**Question 22 (11 marks)**

(a) **Draw** a full structural formula and **name** the straight chain isomer of a saturated hydrocarbon containing five carbon atoms. (3)

**Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(b) Give the **molecular** **formula** and **draw** a full structural formula for 1,2–dibromo-2-methylbutane. (3)

**Molecular Formula:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(c) **Draw** a full structural formula and **name** a branched chain isomer of C5H10 that could be used to create the compound in part (b). (3)

**Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(d) Name the type of chemical reaction and any chemical(s) required to carry out this conversion from chemical (c) to chemical (b). (2)

Name of reaction type: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
  
Chemical/s required: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Question 23 (6 marks)**

**Draw** and **name** the geometric isomers of but-2-ene and use them to explain this type of isomerism. (2)

**Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (2) **­­­­­**

**Explanation:** (2)

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**Question 24 (5 marks)**

(a) Draw a full structural formula of benzene. (2)

(b) Write a molecular equation and name the main organic product when benzene undergoes single substitution with chlorine gas (Cℓ2) in the presence of UV light.

Equation: (2)

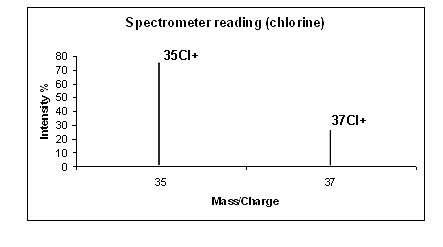
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Main organic product. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(1)

**Question 25 (7 marks)**

(a) What analytical technique was used to produce the graph below? (1)

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(b) Use the information in the graph above to calculate the approximate relative atomic mass of chlorine. (2)

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(c) Draw and label a diagram of a Cℓ-35 atom showing the location of the nucleus; the number and type of particles in the nucleus and the electron levels. (4)

**Question 26 (5 marks)**

Consider the information about some pure substances.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Substance | Melting point (oC) | Boiling point  (oC) | Electrical conductivity in solid state | Electrical conductivity in liquid state | Solubility in water |
| 1 | 1535 | 2750 | good | good | insoluble |
| 2 | 800 | 1410 | non | good | soluble |
| 3 | -259 | -253 | non | non | insoluble |
| 4 | 1710 | 2590 | non | non | insoluble |
| 5 | 50 | 265 | non | non | insoluble |

Choose **one** of the substances above that is most likely

(a) a **gas** at room temperature? (1)

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(b) to be a **covalent molecular solid**? (1)  
  
  
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(c) to be a **metal**? (1)  
  
  
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(d) a **covalent network** substance? (1)

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(e) an **ionic** substance? (1)

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**Question 27 (10 marks)**

Consider the following chemical reaction in which methane gas (CH4) reacts in excess oxygen gas.

CH4(g) + 2 O2(g) → CO2(g) + 2 H2O(g)

(a) How many **moles** of methane are in 10.0 g of methane gas? (1)

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(b) How many **moles** of oxygen gas are required to completely react with 1.85 mol of methane gas? (1)

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(c) What **mass** of carbon dioxide gas is produced from the complete combustion of

25.0 g of methane? (3)

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(d) What is the **mass** of 3.60 moles of methane? (1)

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**Question 27 contd.**

(e) What **mass** of water vapour is produced by complete combustion of 2.50 mol of methane? (2)

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(f) Determine the percentage composition of methane. (2)

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**Question 28 (3 marks)**

Balance the following equations.

(a) CuO + HNO3 → Cu(NO3)2 + H2O (1)

(b) Aℓ + HCℓ → AℓCℓ3 + H2 (1)

(c) C2H6 + O2 → CO2 + H2O (1)

**End of Section Two**

**Section Three: Extended answer 43% (65 Marks)**

This section contains **4** questions. You must answer **all** questions. Write your answers in the spaces provided.

Where questions require an explanation and/or description, marks are awarded for the relevant chemical content and also for coherence and clarity of expression. Lists or dot points are unlikely to gain full marks.

Final answers to calculations should be expressed to the appropriate number ofsignificant figures.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

 Planning: If you use the spare pages for planning, indicate this clearly at the top of the

page.

 Continuing an answer: If you need to use the space to continue an answer, **indicate in the original answer space where the answer is continued**, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time: 65 minutes.

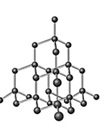
**Question 29 (16 marks)**

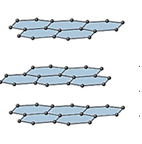
Diamond and graphite are two allotropes of carbon with distinctly different covalent network structures and physical properties. Compare them in terms of the following points.

(a) Covalent network structure.

(i) Label the following **once** on the appropriate diagram. (4)

*Diamond Graphite covalent bond carbon atom*





*Source:* [*http://scienceline.ucsb.edu/getkey.php?key=4545*](http://scienceline.ucsb.edu/getkey.php?key=4545)

**Question 29 contd.**

(ii) Compare the covalent network structures of both diamond and graphite. (4)

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(b) Electrical conductivity.

(i) Explain why diamond does not conduct electricity. (2)

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(ii) Explain why graphite does conduct electricity. (2)

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(c) Hardness of the solid.

(i) Give two reasons why diamond is so hard. (2)

Reason 1:   
  
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Reason 2:   
  
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(ii) Give two reasons why graphite is soft. (2)

Reason 1   
  
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Reason 2   
  
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**Question 30 (16 marks)**

(a) What was Neils Bohr’s contribution to the understanding of atomic structure? (2)  
  
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(b) How does his contribution explain analytical techniques such as Flame tests and Atomic Absorption Spectroscopy? (3)

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**Question 30 contd.**

(c) A drinking water sample was thought to be contaminated with lead (II) ions. The absorbance readings, on an Atomic Absorption Spectrometer, of some **known** samples of lead (II) ions are shown below. Draw a **graph** showing the relationship between lead (II) ion concentration and the absorbance level. (5)

|  |  |
| --- | --- |
| **Concentration of lead (II) ion (mg L-1)** | **Absorbance** |
| 0.0010 | 10 |
| 0.0030 | 35 |
| 0.0070 | 70 |
| 0.010 | 95 |
| 0.013 | 125 |
| 0.016 | 160 |
| 0.020 | 195 |

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*Note: A spare grid is provided at the end of the examination if required*

**Question 30 contd.**

(d) The suspect drinking water sample was then tested on the same Atomic Absorption Spectrometer and the absorbance measured at 105. Determine if the water is safe to drink and give your reasoning in the space below.

(The maximum acceptable level of lead in drinking water has been established by the National Health and Medical Research Centre at 0.01 mg L-1)(2)

*Source:* [*https://www.nhmrc.gov.au/guidelines-publications/eh52*](https://www.nhmrc.gov.au/guidelines-publications/eh52)

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(e) The water sample was retested using a different atomic absorption spectrometer and the lead (II) ions level was found to be below the guideline (below 0.01 mg L-1). Describe an error that could account for this difference in results. (2)

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(f) Describe how the scientist/s conducting this test could improve the reliability of their results. (2)

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**Question 31 (15 marks)**

Refer to the properties of elements A,B and C in the same period of the Periodic Table to answer the following questions.

|  |  |  |  |
| --- | --- | --- | --- |
| Element | Relative atomic radius | Relative electronegativity | Number of valence electrons |
| A | small | medium | 4 |
| B | medium | low | 2 |
| C | large | low | 1 |

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(a) Explain the trend in atomic radius and number of valence electrons. (3)  
  
  
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(b) Explain the trend in the number of valence electrons and electronegativity. (3)

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**Question 31 contd.**

Sodium and chlorine are reactive elements with distinctly different physical and chemical properties. The chemically stable compound formed from these two elements has completely different properties to either element. The reactivity or stability of these three substances is related to their valence electrons.

(c) Explain these statements, **in terms of their valence electrons**, by completing the following table. (9)

|  |  |  |  |
| --- | --- | --- | --- |
| **Statement** | **Explanation** | **Electron dot diagram (Lewis structure)** | **Marks** |
| Sodium is a reactive element |  | **Sodium atom** | 3 |
| Chlorine is a reactive element |  | **Chlorine gas** | 3 |
| The chemically stable compound formed from these elements has completely different properties to either element |  | **Sodium chloride** | 3 |

**Question 32 (18 marks)**

Three groups of chemistry students (A, B and C) were investigating endothermic and exothermic reactions. Each group was given one reaction to study, as shown in the table below.

|  |  |
| --- | --- |
| **Group A** | HCl(aq) + NaHCO3(aq) → NaCl(aq) + CO2(g) + H2O(l) |
| **Group B** | CuSO4(aq) + Mg(s) → MgSO4(aq) + Cu(s) |
| **Group C** | Ba(OH)2(s) + 2 NH4SCN(s) → Ba(SCN)2(aq) + 2 H2O(l) + 2 NH3(g) |

Each group planned their experiment, with the aim to investigate whether their reaction was endothermic or exothermic. They mixed their reagents together in test tubes and recorded the initial temperature of the system, as well as the final temperature once the reaction was finished.

The incomplete results of each group are shown in the tables below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Group A** | **Trial 1** | **Trial 2** | **Trial 3** |
| Initial temp (°C) | 20.5 | 20.0 | 21.5 |
| Final temp (°C) | 17.0 | 16.0 | 18.0 |
| Temperature change (°C) | - 3.5 |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Group B** | **Trial 1** | **Trial 2** | **Trial 3** |
| Initial temp (°C) | 22.5 | 21.5 | 23.0 |
| Final temp (°C) | 25.0 | 26.5 | 26.5 |
| Temperature change (°C) | + 2.5 |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Group C** | **Trial 1** | **Trial 2** | **Trial 3** |
| Initial temp (°C) | 18.5 | 19.0 | 19.5 |
| Final temp (°C) | 4.0 | 5.5 |  |
| Temperature change (°C) | -14.5 |  |  |

The final temperature reading of group C is shown on the thermometer to the right.

15

10

5

0

-5

-10

-15

(a) Complete the tables on the previous page, by reading the final result for group C and recording it in the correct table. Then fill in any other values that are missing, by calculating the change in temperature (i.e. final – initial). (4 marks)

The following diagrams represent the energy changes that can occur during a reaction, as well as illustrate whether a reaction is endothermic or exothermic.

**Diagram X Diagram Y**

Reactants

Products

H

Progress of reaction

Reactants

Products

H

Progress of reaction

Choose **one** of the reactions investigated (A, B or C) that corresponds to Diagram X.

(b) State the reaction (A, B or C) and explain what information this diagram provides in terms of the bond breaking and bond making that has occurred in your chosen reaction. (3 marks)

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Choose **one** of the reactions investigated (A, B or C) that corresponds to Diagram Y.

(c) State the reaction (A, B or C) and explain why this diagram represents your chosen reaction. Include a description of how the Law of Conservation of Energy relates to this diagram. (4 marks)

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(d) Explain why the groups would have chosen to carry out three trials. (2 marks)

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(e) Which group had the most **precise** results (best minimised random errors)? Justify your answer. (2 marks)

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Group B realised that they had forgotten to ‘tare’ (reset to zero) the balance they used to weigh out the magnesium metal. This resulted in them using **less** Mg(s) than intended in each trial.

(f) Is this a random or systematic error? Justify your choice and state the likely effect that this error would have had on the final temperatures that group B measured (i.e. higher, lower or unchanged)? (3 marks)

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**End of questions**

**Additional Working Space**

**Question Number:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Spare grid for Question 30**

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