9th Grade Chemistry — Oxidation Quiz (45 minutes, 75 marks)

Instructions

- Time: 45 minutes. Total marks: 75.
- Materials: none (closed-book).
- Answer all questions. Questions are numbered 1–15. The total of the marks indicated for each question equals 75.
- Where rubrics or exemplars are included, use them when required. Some items ask you to plan collaborative roles or to choose between prompts; record your choices clearly.
- When asked to reference sources, cite the relevant part of the infographic, transcript, or question text (e.g., “Infographic — panel 2” or “Transcript — line 4”).
- Write legibly. Keep answers concise and focused.

Stimulus Materials (for use in Questions 6, 8, 10, and others)

Infographic (printable text description)

- Title: “Oxidation in Everyday Life”
- Panel 1 — Definition: “Oxidation is the loss of electrons by a substance. Reduction is the gain of electrons. Oxidizing agents accept electrons; reducing agents donate electrons.”
- Panel 2 — Examples:
  - Rusting of iron: 4 Fe + 3 O2 -> 2 Fe2O3 (visual: rusty bike)
  - Combustion of magnesium ribbon: 2 Mg + O2 -> 2 MgO (visual: bright flame)
  - Bleaching of stain: ClO– oxidizes colored molecules (visual: clothing)

- Panel 3 — Indicators: “An increase in oxidation number indicates oxidation; a decrease indicates reduction. Metals often lose electrons (oxidize).”
- Panel 4 — Safety & environmental note: “Some oxidizing agents can be hazardous. Controlling oxidation prevents material loss and pollution.”

Transcript (printable excerpt)

- Speaker (Ms. A): “When iron rusts it reacts with oxygen and water. People often describe rusting as ‘oxygen combining with iron,’ which works as shorthand; but chemically, iron loses electrons to oxygen atoms — iron atoms are oxidized. In some cases, water provides the medium and even participates as an electron acceptor in steps. Controlling rust is important for infrastructure costs and environmental impacts.”

Questions

1. (3 marks — multiple choice, auto-graded)
   Which statement best matches the definition of oxidation used in modern chemistry?
   A. Oxidation is the gain of oxygen only.
   B. Oxidation is the loss of electrons.
   C. Oxidation is the gain of electrons.
   D. Oxidation is any chemical change that produces heat.
   Answer: _____

2. (5 marks)
   Consider the reaction: Zn + 2 Ag+ -> Zn2+ + 2 Ag
   a) Identify which species is oxidized and which is reduced. (2 marks)
   b) Name the oxidizing agent and the reducing agent. (2 marks)
   c) How many electrons are transferred per Zn atom in this reaction? (1 mark)

3. (7 marks)
   Balance the following redox equation in acidic solution using half-reaction method, and show all steps. Then write the balanced equation.
   MnO4– + Fe2+ -> Mn2+ + Fe3+
   Scoring rubric: award up to 7 marks for correct half-reactions (3), correct electron balance (2), correct cancellation and final balanced equation (2).

4. (4 marks)
   Assign oxidation numbers to all atoms in the compound H2SO4. Using your oxidation numbers, identify which atom(s) are in their highest common oxidation state and justify why.

5. (6 marks)
   Magnesium ribbon is burned in oxygen to form magnesium oxide according to the reaction: 2 Mg + O2 -> 2 MgO.
   a) For 48.6 g of Mg, how many grams of MgO are produced? (Show work; Molar masses: Mg = 24.3 g·mol−1, O = 16.0 g·mol−1.) (4 marks)
   b) State whether Mg is oxidized or reduced in this reaction and identify the oxidizing agent. (2 marks)

6. (6 marks) — Multimedia annotation and synthesis (use Infographic and Transcript)
   Annotate the two provided stimuli by completing the table below (use the stimulus references). Then synthesize: state one claim about oxidation that appears in both the infographic and transcript, and cite the supporting lines/panels. Finally, identify any statement in either source that could be misleading without further context and explain what additional information is needed (maximum 2 sentences).

- Annotation table (3 marks total): list two distinct claims from the infographic (name panel) and two from the transcript (give line or phrase). (1 mark each for correct identification, max 2 marks).
- Synthesis (2 marks): single claim present in both sources plus citation. (1 mark for correct claim, 1 mark for correct citations).
- Clarification (1 mark): identify one potentially misleading statement and what context is

needed.

7. (5 marks) — Collaborative scenario planning + individual analysis
   Scenario: Your small study team will investigate whether vinegar slows the rusting of iron nails. Before performing individual written analysis, plan team roles and peer-feedback steps. Then submit your individual analysis based on hypothetical data given below.
   Hypothetical data: Two identical iron nails, Nail A stored in plain water for 7 days (heavy rust), Nail B stored in 5% acetic acid (vinegar) for 7 days (light rust).
   Part A — Team plan (2 marks): list three team roles (one sentence each) and two peer-feedback steps the team will use before submitting individual answers.
   Part B — Individual analysis (3 marks): Based on the hypothetical data, write a short explanation (max 5 sentences) using oxidation concepts to interpret the result and state one control variable the team should add in a follow-up experiment.

8. (6 marks) — Case study requiring stakeholder analysis and multi-source justification (use Infographic & Transcript)
   A small town has a historic iron bridge suffering from rust. Stakeholders include: town engineers (focus: safety), local business owners (focus: cost), environmental group (focus: pollution from coatings), and residents (focus: aesthetics and access). Provide:
   a) One concern for each stakeholder about methods to control oxidation of the bridge (4 brief bullet points; 1 mark each).
   b) Propose one equitable mitigation plan that balances the stakeholders' concerns and explicitly reference at least two items from the Stimulus Materials to justify why your plan addresses oxidation and environmental safety (2 marks).

9. (6 marks) — Performance task (podcast outline) with rubric
   Create a 1-page podcast episode outline (bullet format) titled "Oxidation Around Us." It must include: episode segments with approximate times (intro, 2 main segments, guest question, closing), two brief interview questions for a materials engineer, and two pieces of evidence you would cite (from Infographic or Transcript). Use the rubric below when producing your outline; the teacher will score using the rubric. Submit only the outline.
   Rubric (for scoring this question):

- Structure present with timings and 4 segments — 2 marks
- Two relevant interview questions — 1.5 marks
- Two evidence citations correctly referenced — 1.5 marks
  Total: 6 marks

10. (4 marks) — Multimedia language analysis (use Transcript)
    From the transcript excerpt, Ms. A says "people often describe rusting as 'oxygen combining with iron,' which works as shorthand." Annotate this phrase: explain (in 2–3 sentences) why the shorthand is chemically incomplete and give the correct electron-based description that includes the role of oxygen and water if applicable. (4 marks)

11. (4 marks) — Peer-review rubric application and improvement task
    You are given an exemplar short student answer to: "Explain, in terms of electrons and

oxidation states, why chlorine gas (Cl2) can bleach stains." Exemplar response: "Chlorine takes electrons from the stain molecules so it bleaches. Cl2 becomes Cl–." Use the peer-review rubric below to score the exemplar (provide scores for each criterion, total out of 4) and then write an improved one-sentence version of the answer that addresses the weaknesses you identified.
Peer-review rubric (use in scoring):

- Accuracy of electron transfer concept (0–2)
- Inclusion of species and charge change (0–1)
- Clarity and completeness (0–1)

12. (6 marks) — Choice board (pick ONE prompt and document rationale)
Document which prompt you choose (A or B) and one sentence rationale for choosing it (1 mark). Then answer the chosen prompt fully (5 marks).
Prompt A — Explain how oxidation numbers change for sulfur in the reaction: S + 4 HNO3 -> H2SO4 + 4 NO2 + H2O. Assign oxidation numbers for S and N before and after, and show how this indicates oxidation and reduction.
Prompt B — A farmer notices that copper tools stored in damp soil develop a green layer. Explain, using oxidation concepts, what causes the green layer, name the copper-containing product (common name acceptable), and suggest one practical step to slow formation of the layer.

13. (3 marks — multiple true/false, auto-graded)
Indicate True or False for each statement. (0.75 marks each)
a) An increase in oxidation number for an atom always means the atom has lost electrons.
b) All oxidation reactions require oxygen gas (O2) to occur.
c) The substance that is reduced is the oxidizing agent.

14. (5 marks) — Predicting reactivity using the activity series (short answer)
Given the following metals: zinc (Zn), copper (Cu), and magnesium (Mg), and knowing Mg is more reactive than Zn and Zn is more reactive than Cu, answer:
a) If a piece of copper metal is placed in a solution containing Zn2+ ions, will a spontaneous redox reaction occur? Explain your reasoning in one sentence. (2 marks)
b) Predict which metal (Mg or Cu) will more readily oxidize when exposed to air and justify in terms of electron transfer (one sentence). (3 marks)

15. (6 marks) — Final reflection connecting to collaboration and digital creation expectations
Write a concise reflection (maximum 150 words) addressing: how collaborating with peers and using digital evidence (e.g., infographic and transcript) changed or strengthened your understanding of oxidation; and one digital-collaboration habit you will adopt for future group science products (e.g., podcast, shared slide deck). Award yourself a score out of 6 and briefly justify the self-score in one sentence (this self-assessment will be reviewed). (6 marks)

Answer Key (with detailed explanations and scoring guidance)

General scoring notes: award partial credit for correct reasoning even if the final numeric answer is slightly off when working is shown, except for multiple-choice and T/F which are exact.

1. (3 marks)
   Correct answer: B. Oxidation is the loss of electrons.
   Scoring: 3 marks for B; 0 otherwise.
   Explanation: Modern definition uses electron transfer; older oxygen-based definitions are incomplete.

2. (5 marks)
   a) Oxidized: Zn -> Zn2+ (Zn loses electrons). Reduced: Ag+ -> Ag (Ag+ gains electrons). (2 marks: 1 each)
   b) Oxidizing agent: Ag+ (it accepts electrons). Reducing agent: Zn (it donates electrons). (2 marks: 1 each)
   c) Electrons transferred per Zn atom: 2 electrons (Zn -> Zn2+). (1 mark)
   Explanation: Zn goes from 0 to +2, losing 2 e–; each Ag+ gains 1 e– so two Ag+ accept 2 e–.

3. (7 marks)
   Balanced in acidic solution: MnO4– + 5 Fe2+ + 8 H+ -> Mn2+ + 5 Fe3+ + 4 H2O
   Scoring breakdown:

- Half-reactions (3 marks):
  Oxidation: Fe2+ -> Fe3+ + e– (award 1.5 if correct)
  Reduction: MnO4– + 8 H+ + 5 e– -> Mn2+ + 4 H2O (award 1.5 if correct)
- Electron balance (2 marks): Multiply oxidation half by 5 so electrons cancel (2 marks for correct 5 e– matching).
- Final balanced equation (2 marks): MnO4– + 5 Fe2+ + 8 H+ -> Mn2+ + 5 Fe3+ + 4 H2O (2 marks)
  Explanation: Permits full credit if half-reactions and cancellation shown clearly.

4. (4 marks)
   Assign oxidation numbers in H2SO4: H = +1 (each), O = –2 (each), let S = x. Equation: 2(+1) + x + 4(–2) = 0 -> 2 + x – 8 = 0 -> x = +6.
   Highest common oxidation state: Sulfur is in +6, which is a high oxidation state for S (1 mark for calculation, 1 mark for stating S = +6). The S is near its maximum common oxidation state (justify: typical S oxidation states range from –2 to +6 in common compounds). (2 marks for justification)
   Scoring: 1 for correct numbers for H and O, 1 for correct S value, 2 for justification.

5. (6 marks)
   a) 48.6 g Mg -> moles Mg = 48.6 / 24.3 = 2.000 mol. Stoichiometry 2 Mg -> 2 MgO means 1 mol Mg -> 1 mol MgO; so moles MgO = 2.000 mol. Molar mass MgO = 24.3 + 16.0 = 40.3 g·mol–1. Mass = 2.000 × 40.3 = 80.6 g. (4 marks: 2 for correct mol calculation, 2 for correct mass)

b) Magnesium is oxidized (Mg -> Mg2+, loses electrons). The oxidizing agent is oxygen (O2), which gains electrons (reduced to O2– in MgO). (2 marks: 1 for stating oxidized, 1 for naming oxidizing agent)
Explanation: Oxidation is electron loss; Mg goes from 0 to +2.

6. (6 marks) — Multimedia annotation and synthesis
Annotation table (3 marks) — Expected answers (examples):

- Infographic claim 1: “Oxidation is the loss of electrons” (Infographic — Panel 1).
- Infographic claim 2: “Rusting of iron is a common example” (Infographic — Panel 2).
- Transcript claim 1: “iron loses electrons to oxygen atoms — iron atoms are oxidized” (Transcript — Ms. A).
- Transcript claim 2: “water provides the medium and even participates as an electron acceptor” (Transcript — Ms. A).
Scoring: 1 mark each for correctly identifying two infographic claims (max 2) and 1 mark each for two transcript claims (max 2) but total capped at 3 marks as indicated. Award partial credit for near-equivalent phrasing.

Synthesis (2 marks):
Sample correct synthesis: “Both sources state that oxidation involves loss of electrons by iron during rusting” — cite Infographic Panel 1 and Transcript line “iron loses electrons” (1 mark for the claim, 1 mark for citations).

Clarification (1 mark):
A defensible answer: “Infographic Panel 2 shows the overall reaction 4 Fe + 3 O2 -> 2 Fe2O3; this can be misleading because it omits electron transfer steps and the role of water — need half-reaction detail or mention of electron transfer and H2O involvement (Transcript line).” Award 1 mark if student names a plausible missing context and what is needed.

7. (5 marks) — Collaborative scenario + individual analysis
Part A — Team plan (2 marks):
Acceptable roles (examples): Team leader (protocol coordination); Data recorder (logs observations); Safety officer (ensures safe handling); Materials preparer (sets up nails and solutions); Analyst (coordinates interpretation). Two peer-feedback steps (examples): 1) Each member provides written comments on another member’s draft answer using a provided checklist; 2) Group meets to discuss and incorporate feedback before finalizing. (Award 0.5 mark per reasonable role up to 3 roles; 1 mark for two clear feedback steps.)

Part B — Individual analysis (3 marks): Sample correct analysis (key points): Vinegar (acetic acid) creates acidic environment that can change corrosion pathways; acid may inhibit formation of typical iron oxide layers or produce different corrosion products leading to lighter rust; iron in Nail A lost electrons more readily than in Nail B under the conditions; control variable: oxygen exposure (e.g., ensure equal aeration) or temperature. Scoring: 2 marks for correct oxidation-based interpretation, 1 mark for a sensible control variable.

8. (6 marks) — Case study with stakeholders and multi-source justification

a) One concern each (4 marks total, 1 each):

- Town engineers: Concern about structural integrity and effectiveness of anti-corrosion method.
- Local business owners: Concern about cost and disruption during repair.
- Environmental group: Concern about toxic runoff from certain anti-corrosion coatings.
- Residents: Concern about aesthetics and access during repairs.
  (1 mark each for plausible stakeholder concern)

b) Equitable mitigation plan (2 marks): Sample plan: “Apply targeted, low-toxicity protective coatings to the most critical structural elements, combined with phased repairs to minimize disruption; include environmental monitoring and community notification.” Justification referencing stimuli: cite Infographic Panel 4 (need to control hazardous oxidizing agents; environmental safety) and Transcript (Ms. A on importance for infrastructure costs). Award 1 mark for an appropriate plan and 1 mark for referencing at least two stimulus items.

9. (6 marks) — Podcast outline performance task
   Teacher scoring via rubric:

- Structure with timings and 4 segments — 2 marks (e.g., Intro 0:00–1:00; Segment 1: examples 1:00–6:00; Segment 2: science explanation 6:00–12:00; Guest Q&A 12:00–15:00; Closing 15:00–16:00 — acceptable).
- Two relevant interview questions — 1.5 marks (acceptable examples: “How do engineers choose coatings to prevent oxidation?” and “Can you explain the electron transfer steps during rusting?”).
- Two evidence citations — 1.5 marks (must reference Infographic Panel and/or Transcript line, e.g., “Infographic Panel 2: rusting reaction; Transcript Ms. A on electron loss”).
  Full credit requires all components; award partial credit for near-complete outlines.

10. (4 marks) — Transcript language analysis
    Expected answer (2–3 sentences): The shorthand “oxygen combining with iron” omits the electron transfer details; chemically, iron atoms are oxidized (Fe -> Fe2+), losing electrons that are accepted by oxygen (O2 is reduced, often forming O2− and combining with H+ from water to form OH− in steps). Water often participates as a medium and source of H+/OH− that influence the redox steps. (Award up to 4 marks: 2 for explaining why shorthand is incomplete, 2 for correct electron-based description including oxygen and water roles.)

11. (4 marks) — Peer-review rubric & improvement
    Scoring exemplar with rubric: Typical scoring of exemplar:

- Accuracy of electron transfer concept (0–2): Exemplar says “Chlorine takes electrons from the stain molecules so it bleaches.” This is accurate but incomplete — award 1.5/2.
- Inclusion of species and charge change (0–1): Exemplar mentions Cl2 becomes Cl− — award 1/1.
- Clarity and completeness (0–1): Exemplar is short and misses oxidation-number language and

mention of oxidizing agent mechanism — award 0.5/1.
Total exemplar score example: 3.0/4 (teacher may accept small variations; student must show computed scores totaling ≤4). (2 marks expected for correct scoring rationale; allow partial credit.)
Improved one-sentence answer (write): “Chlorine (Cl2) oxidizes stain molecules by accepting electrons and being reduced to chloride ions (Cl–), which breaks the chromophore bonds and decolorizes the stain.” (2 marks: 1 for improved accuracy, 1 for clarity/inclusion of species and charges)

Scoring guidance: award 2 marks for correctly applying rubric (scores summing to ≤4 and brief justification), and 2 marks for the improved sentence addressing weaknesses.

12. (6 marks) — Choice board
    Student picks A or B and provides 1-sentence rationale (1 mark). Provide full answer to chosen prompt (5 marks).

Prompt A expected answer highlights (5 marks): Assign oxidation numbers: elemental S = 0. In HNO3: N in HNO3 is +5 (common for nitric acid). Products: in H2SO4, S = +6; in NO2, N = +4. Show sulfur increases 0 -> +6 (oxidation, loss of electrons), nitrogen decreases +5 -> +4 (reduction, gain of electrons). Show balanced electron transfer per appropriate stoichiometry explanation. Award points for correct oxidation number assignments (3 marks) and correct identification of oxidation vs reduction with reasoning (2 marks).

Prompt B expected answer highlights (5 marks): The green layer is patina (copper carbonate/hydroxide compounds, e.g., basic copper carbonate or verdigris). Moist, oxygen-rich or acidic soils cause copper to oxidize and react with carbonate or sulfate to form green products. Copper is oxidized (Cu -> Cu2+), electrons are accepted by oxygen or other acceptors. Practical step: keep tools dry, apply protective oil or paint, or store in a dry container — award marks for correct identification of product (2 marks), correct oxidation concept (2 marks), and practical step (1 mark).

13. (3 marks) — True/False (0.75 each)
    a) True. An increase in oxidation number corresponds to loss of electrons (0.75).
    b) False. Not all oxidation reactions require oxygen gas (e.g., oxidation by halogens, acidified oxidants). (0.75)
    c) True. The substance that is reduced is the oxidizing agent (it accepts electrons). (0.75)
    Scoring: exact answers as above.

14. (5 marks) — Activity series reasoning
    a) If copper metal is placed in Zn2+ solution, will spontaneous reaction occur? No. Explanation: Zn is more reactive than Cu; Zn metal would tend to oxidize to Zn2+, not copper oxidizing. Because Cu is less reactive, Cu cannot reduce Zn2+ to Zn metal; the reaction Cu + Zn2+ -> Cu2+ + Zn will not be spontaneous. (2 marks for correct No and correct reasoning.)
    b) Which metal more readily oxidizes in air: Mg or Cu? Magnesium (Mg) will more readily oxidize because it is higher in the activity series and more easily loses electrons (Mg -> Mg2+), forming oxide layers quickly; copper is less reactive. (3 marks: 2 for correct metal and 1 for brief electron-transfer justification.)

15. (6 marks) — Final reflection and self-assessment
    Scoring guidance (teacher-reviewed):

- Content: 0–4 marks for reflection quality (insight about how collaboration and digital evidence strengthened understanding; clarity and connection to oxidation concepts).
- Self-assessment: 0–2 marks for a justified self-score out of 6 (score aligns reasonably with reflection, concise justification).
  Example strong response (full 6 marks): Reflection describing how peer explanations and the infographic clarified electron-transfer concept and gave real-world examples; self-score e.g., “5/6 — strong evidence and links to sources, but could add richer stakeholder perspective” with brief justification. Award marks according to quality.

End of answer key.