Unit 15 · Ecological Imbalances

ANSWER KEY · FOR TEACHERS

Full marks 39

Give the marks for the points in the marking scheme; an answer in other words that says the same is right.

1 Key words

1. greenhouse effect → **f.** greenhouse gases trapping the infrared given out by the Earth's surface
2. global warming → **a.** the warming of the Earth by an enhanced greenhouse effect
3. ozone layer → **j.** the ozone of the stratosphere that absorbs most of the Sun's UV
4. CFCs → **b.** chemicals once used in refrigerators and aerosol sprays that destroy ozone
5. Montreal Protocol → **i.** the 1987 treaty that phased out ozone-depleting substances
6. liming → **d.** adding powdered limestone to an acidified lake to neutralize it
7. carbon sequestration → **c.** forests taking carbon dioxide from the air and storing it
8. invasive alien species → **e.** an exotic species that spreads on its own and causes harm

Each carries 0.5 mark. **K · 4**

2 Label the diagram

1. sunlight passes through
2. greenhouse gases
3. infrared (heat)
4. the ground warms and gives out infrared
5. some escapes
6. sent back down

Each carries 0.5 mark. **K · 3**

3 Multiple choice

i. **c.** water vapor **K · 1**

Water vapor is the most abundant. But human activities change it only indirectly; carbon dioxide, methane and nitrous oxide are the ones human activities add directly.

ii. **a.** sulphur dioxide and oxides of nitrogen **K · 1**

SO_2 and **NO_x**, from burning coal and oil, are oxidized in the air and dissolve in cloud water as **sulphuric** and **nitric acid**. Carbon dioxide only makes clean rain slightly acidic (pH about 5.6); methane, ozone and CFCs don't make rain acidic.

iii. **b.** it is a catalyst: it is set free again at the end of each cycle and attacks another ozone molecule **U · 1**

In the chain reaction, $Cl + O_3 \rightarrow ClO + O_2$ and then $ClO + O \rightarrow Cl + O_2$: the chlorine atom is **regenerated**. Like any catalyst, it is not used up, so it keeps going until it is finally locked away in a stable compound.

iv. **b.** it dissolves carbon dioxide from the air, forming weak carbonic acid **U · 1**

CO_2 dissolves in rainwater to form a little **carbonic acid** (H_2CO_3), giving clean rain a pH of about **5.6**. Only rain more acidic than that is called acid rain.

v. **b.** an exotic species, but not invasive **A · 1**

It was brought from elsewhere, so it is **exotic** (alien); but it doesn't spread on its own or harm native ecosystems, so it is **not invasive**. Only exotic species that spread and cause harm, like *Mikania* or *Parthenium*, are invasive.

4 Very short answers

a. **K · 1**

MARKING SCHEME

✓ About −18 °C.

b. **K · 1**

MARKING SCHEME

✓ Any two of Mikania, Chromolaena, Lantana, water hyacinth.

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c. MARKING SCHEME U · 1

✓ It releases bromine, which destroys ozone faster than chlorine.

5 Short answers

a. MARKING SCHEME U · 2

✓ Sunlight passes through the greenhouse gases.

✓ They absorb the infrared given out by the warm Earth and send part back.

b. MARKING SCHEME U · 2

✓ Venus's thick CO_2 atmosphere traps its heat: a huge greenhouse effect.

✓ Mercury has almost no atmosphere, so heat escapes.

c. MARKING SCHEME A · 2

✓ Acid rain's acids react with the calcium carbonate of the stone and dissolve it.

✓ The equation.

d. MARKING SCHEME U · 3

✓ A first feature.

✓ A second feature.

✓ A third feature.

6 Numerical problems

ANSWER A · 4

i. $427 - 316 = $ **111 ppm**.

ii. $111 \div 316 \times 100 \approx$ **35 %**.

iii. $2025 - 1959 = 66$ years; $111 \div 66 \approx$ **1.7 ppm a year**.

iv. $5.6 - 4.6 = 1$, so **10 times** as acidic.

MARKING SCHEME

✓ 111 ppm.

✓ About 35 %.

✓ About 1.7 ppm a year.

✓ 10 times.

7 Long answers

a. ANSWER U · 4

Ozone layer depletion is the thinning of the ozone layer in the stratosphere, when ozone is destroyed faster than it is made.

CFCs are very stable, so they drift up unchanged to the stratosphere; there strong **UV breaks them apart**, freeing **chlorine atoms**.

Each chlorine atom acts as a **catalyst**: $Cl + O_3 \rightarrow ClO + O_2$; $ClO + O \rightarrow Cl + O_2$. The chlorine comes out unchanged, so one atom can destroy over **100,000** ozone molecules.

Under the **Montreal Protocol (1987)** every country agreed to phase out CFCs, halons and other ODS; stratospheric chlorine is falling and the layer is expected to recover by about 2040–2066.

MARKING SCHEME

✓ Definition of ozone layer depletion.

✓ CFCs reach the stratosphere and UV frees chlorine atoms.

✓ The two equations; chlorine is a catalyst, freed again each cycle.

✓ The Montreal Protocol, 1987, phasing out ODS.

b. ANSWER

It **grows very fast**, climbs over shrubs and young trees, and **has few natural enemies** in Nepal (almost nothing eats it), having left them behind in Central and South America; disturbed forest edges are easily invaded.

Harm: it **blocks light** from the plants it covers and smothers them, so the rhinos' and deer's **food declines**, native species are crowded out, and **biodiversity** falls.

Management: **prevention** and **early detection** of new patches; **mechanical** control, cutting and

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uprooting before it seeds; careful **chemical** control; **biological** control with a natural enemy from its home, tested so it attacks nothing else; **awareness**, and replanting native species. A · 4

MARKING SCHEME

- ✓ Spreads by fast growth, few natural enemies, disturbed land.
- ✓ Smothers native plants, blocking light.
- ✓ Less food for rhinos and deer; loss of biodiversity.
- ✓ Any two management methods (prevention, mechanical, chemical, biological, awareness).

8 Think

ANSWER HA · 3

Any two: **Himalayan glaciers are shrinking** and new **glacial lakes** formed behind walls of loose rock could burst (Imja Lake was lowered by about 3.4 m in 2016); **dengue mosquitoes** now breed in the hills and Kathmandu; more extreme weather, floods and droughts.
Nepal makes **almost all its electricity from water** (hydroelectricity), so an electric bus or an induction stove runs on **clean energy**, replacing diesel or LPG; in countries whose electricity comes from burning coal, the saving is much smaller.

MARKING SCHEME

- ✓ One effect on Nepal.
- ✓ A second effect on Nepal.
- ✓ Nepal's electricity is hydroelectric, so electric use replaces fossil fuel with clean energy.

9 Activity: Invasive plants near you

(not marked)

WHAT STUDENTS SHOULD FIND

Roadsides and disturbed ground are where invasive plants are commonest: *Ageratina* and *Lantana* in thick patches on hill roadsides and forest edges, *Parthenium* on roadsides and in fields of the Tarai and valleys, water hyacinth covering ponds. Where they grow thickly, few native plants grow beneath them: they grow fast, shade the ground and compete for light, water and nutrients, and few animals eat them.

Marks by level	Knowledge	Understanding	Application	Higher ability	Total
Marks	11	14	11	3	**39**

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