AP ENVIRONMENTAL SCIENCE • EXERCISE SHEET

5.13 Methods to Reduce Urban Runoff

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS permeable pavement 透水路面 • green roofs 绿色屋顶 • rain gardens 雨水花园 • impervious surfaces 不透水面

Objective

Build the skills to answer exam questions on **methods to reduce urban runoff**.

You must be able to:

- describe green infrastructure (**permeable pavement** 透水路面, **rain gardens** 雨水花园, green roofs)
- explain how each reduces runoff and pollution
- link solutions to the problem of impervious surfaces

1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

The problem

Cities' **impervious surfaces** cause heavy runoff that floods and carries pollutants to waterways. Solutions let water **soak in** instead.

Green infrastructure

- **Permeable pavement** — lets water pass through into the ground.
- **Rain gardens** — planted depressions that collect and absorb runoff.
- **Green roofs** — vegetation on roofs that absorbs rain and cools buildings.
- **Retention/detention ponds** — hold runoff and release it slowly.

How they help

They increase **infiltration**, reduce peak runoff (less flooding), and filter pollutants before water reaches rivers.

A worked link

A rain garden collects roof runoff, letting it soak into the soil where plants and soil filter out pollutants — reducing both flooding and water pollution.

2 Practice

Now apply the methods above.

2.1 How does permeable pavement reduce runoff? [1]

2.2 What is a rain garden? [1]

2.3 State one benefit of a green roof. [1]

3 Exam-style questions

3.1 Permeable pavement reduces flooding by allowing water to [1]

- **A** run off faster
- **B** soak into the ground
- **C** evaporate instantly
- **D** freeze

3.2 A city installs rain gardens and permeable pavement.

(a) Explain how these reduce runoff and pollution. [3]

(b) State the underlying problem they address. [1]

3.3 Explain how green roofs reduce both runoff and the urban heat island effect. [2]

Solutions

2.1 It lets water pass through into the ground instead of running off.

2.2 A planted depression that collects and absorbs runoff.

2.3 Any one: absorbs rain (less runoff), cools the building, reduces heat island.

3.1 B — soak into the ground.

3.2 (a) They increase infiltration so less water runs off (less flooding), and soil/plants filter pollutants before the water reaches rivers. (b) Impervious surfaces causing runoff.

3.3 The vegetation absorbs rainwater (reducing runoff) and cools the air through shade and transpiration, lowering the urban heat island effect.