1.3 Sustainability: natural capital and footprints

Name: _____ Class: _____ Date: _____ **Total: 18 marks**

KEY WORDS sustainability • natural capital • natural income • sustainable yield • ecological footprint • biocapacity • planetary boundaries

Objective

Build the skills to answer exam questions on **sustainability** : **natural capital** and income, sustainable yield, **ecological footprints** , planetary boundaries and doughnut economics.

You must be able to:

- explain natural capital and natural income, and calculate a sustainable yield
- calculate and compare ecological footprints with biocapacity
- explain the planetary boundaries and doughnut models
- evaluate ways to measure and improve sustainability

1 Key knowledge and worked examples

■ Sustainability

Sustainability means using resources at a rate that lets them be replaced, so future generations can meet their needs too.

Natural capital is a stock in nature that gives goods and services (a forest, a fish stock, soil). **Natural income** is the yearly flow from it (new timber, new fish). Living on the income keeps the capital.

Sustainable yield = the amount that can be taken each year without reducing the stock:

$$\text{sustainable yield} = \text{stock}_{t+1} - \text{stock}_t \text{ (growth with no harvest)}$$

exercises.lol exercises.com.cn

Ecological footprint (EF): the area of land and water needed to supply a population's resources and absorb its wastes, in global hectares (gha). **Biocapacity**: the area actually available. If EF > biocapacity, the population is in **ecological deficit** and is using up natural capital.

model	idea
planetary boundaries	nine Earth processes (e.g. climate change, biosphere integrity, nitrogen and phosphorus flows) each with a safe limit; several are already crossed
doughnut economics	between a **social foundation** (food, health, education for all) and an **ecological ceiling** (the planetary boundaries) lies a safe and just space
circular economy	design out waste: reuse, repair, recycle, so materials stay in use

Worked example. A forest holds 500 t of timber and grows to 530 t in a year with no felling: sustainable yield = **30** t a year.

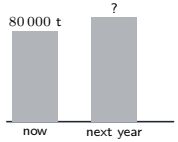
Answer shapes: in calculations, write the formula, the numbers with units, then compare with the right reference (stock, biocapacity, boundary).

2 Practice

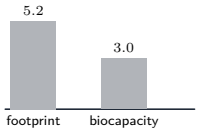
2.1 Distinguish between natural capital and natural income, using a fish stock as the example. [2]



2.2 A fish stock is 80 000 t. With no fishing it would be 92 000 t a year later. (i) Calculate the sustainable yield. (ii) The fleet catches 15 000 t a year. Describe what happens to the stock. [3]



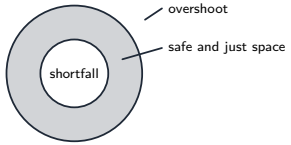
2.3 Country X has an ecological footprint of 5.2 gha per person and a biocapacity of 3.0 gha per person. Calculate the ecological deficit per person, and state **two** ways the country could reduce it. [3]



3 Exam-style questions

3.1 The doughnut model shows a safe and just space for humanity.

(a) Describe what the inner and outer rings of the doughnut represent. [2]



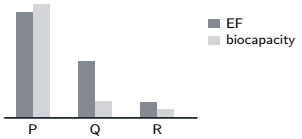
(b) Suggest why a rich country and a poor country might be in different parts of the model. [2]

3.2 The table shows the ecological footprint (EF) and biocapacity of three countries, in gha per person.

country	EF	biocapacity
P	7.5	8.0
Q	4.0	1.2
R	1.1	0.6

(a) Identify the country with an ecological reserve, and the country with the largest deficit per person. [2]

(b) Evaluate the ecological footprint as a measure of sustainability. [4]



exercises.lol exercises.com.cn

Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

natural capital: the stock of fish in the sea; natural income: the new fish added each year by growth and reproduction, which can be caught sustainably

2.2

(i) $92\,000 - 80\,000 =$ **12 000** t a year; (ii) the catch is larger than the yield, so the stock falls by about 3 000 t a year: the natural capital is being used up

2.3

$5.2 - 3.0 =$ **2.2** gha per person; any two: renewable energy instead of fossil fuels; less meat in diets; less waste and more recycling; public transport

3.1

(a) inner ring: the social foundation, the minimum everyone needs (food, water, health, education); outer ring: the ecological ceiling, the planetary limits that must not be crossed

(b) a rich country often meets the social foundation but overshoots the ceiling through high consumption; a poor country may stay inside the ceiling but fall short of the social foundation

3.2

(a) reserve: P (EF below biocapacity); largest deficit: Q, 2.8 gha per person

(b) award up to [4]: strengths: one simple number, easy to compare countries and over time; links consumption to land and sea area; limitations: leaves out some impacts (e.g. pollution, water use, biodiversity loss); depends on assumptions in converting to global hectares; a country can import goods and "move" its footprint elsewhere; conclusion: useful for awareness and comparison, best used with other indicators

exercises.lol exercises.com.cn