Surname	
Other Names	
Candidate Signature	

AQA

General Certificate of Education
Advanced Level Examination
June 2015

Environmental Studies   ENVS4

Unit 4   Biological Resources and Sustainability

Thursday 18 June 2015   9.00 am to 11.00 am

You will need no other materials.
You may use a calculator.

Time allowed
* 2 hours

Instructions
* Use black ink or black ball-point pen.
* Fill in the boxes at the top of this page.
* Answer **all** questions.
* You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
* Do all rough work in this book. Cross through any work you do not want to be marked.

Information
* The marks for questions are shown in brackets.
* The maximum mark for this paper is 80.
  Two of these marks are for the Quality of Written Communication.
* You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.
* Question 7 should be answered in continuous prose.
  Quality of Written Communication will be assessed in this answer.

A

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ANSWER IN THE SPACES PROVIDED

Answer **all** questions in the spaces provided.

1 **Table 1** shows some terms and definitions connected with agriculture.

Complete **Table 1**.

[5 marks]

Table 1

Term	Definition
Bovine Somatotropin	A hormone which may be used to increase milk production in dairy cattle
	Yield per unit area
Integrated pest control	
Irrigation	The application of water to increase crop productivity
	A technique to maximise the number of offspring obtained from high quality female livestock
Extensive agriculture	
	A crop grown to conserve soil nutrients, rather than to produce food

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Turn over ▶

2 **Figure 1** shows information about Gross Domestic Product (GDP) per capita and deforestation rates in Brazil.

Figure 1

Key

— GDP $US per capita

---- Deforestation rate/ km^2 yr^{-1}
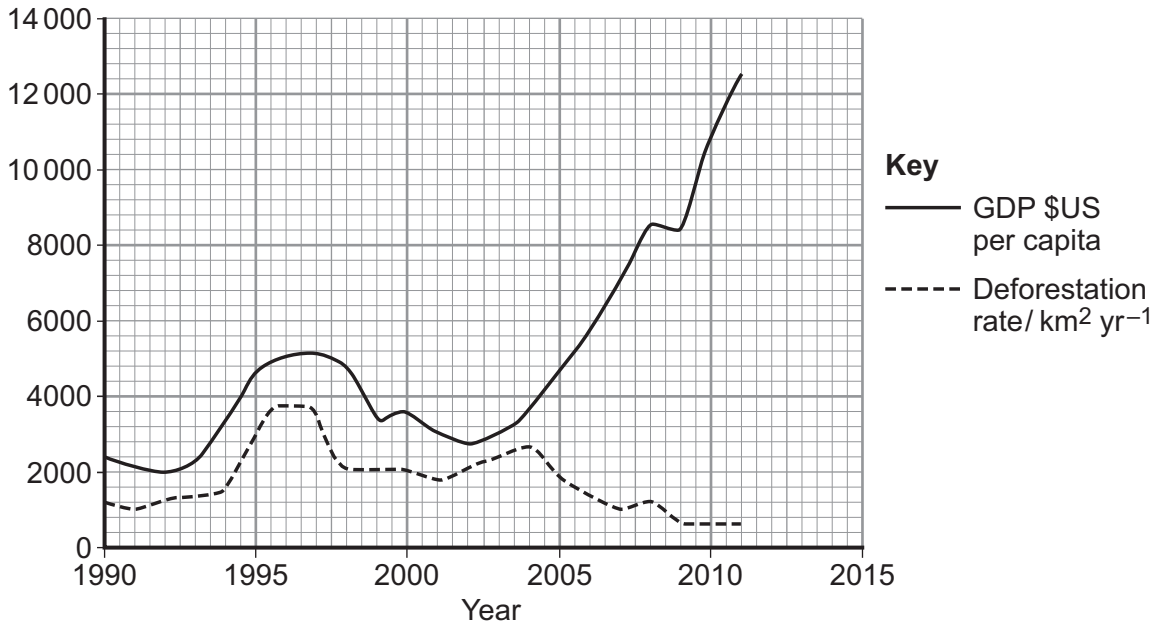
2 (a) Describe the relationship between GDP and the rate of deforestation before **and** after 2004.

[2 marks]

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2 (b) Explain how **deforestation** may help economic development.

[3 marks]

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2 (c)   Explain how **conserving forests** may help economic development.

[3 marks]

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2 (d)   Outline the role of the Forest Stewardship Council.

[2 marks]

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3 (a) **Figure 2** shows details of greenhouse gases released by the UK agricultural system.

Figure 2

**Agriculture emissions by gas (2009)/
proportion of total greenhouse effect caused by agriculture**

CO_2 8%

CH_4 37%

N_2O 55%
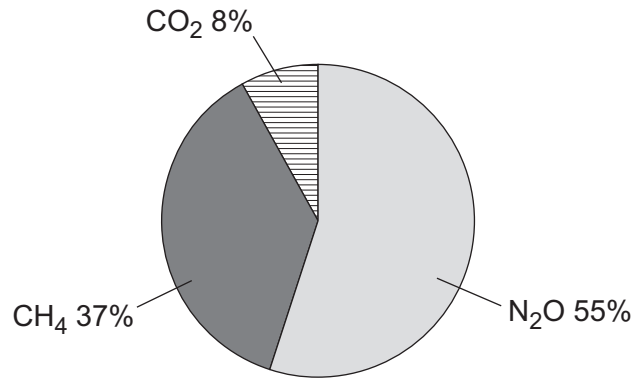
Outline **two** ways in which farming practices cause the release of greenhouse gases from soil.

[2 marks]

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3 (b) **Figure 3** is a graph showing the relationship between meat consumption and income in a range of countries.

Figure 3

The relationship between meat consumption and income
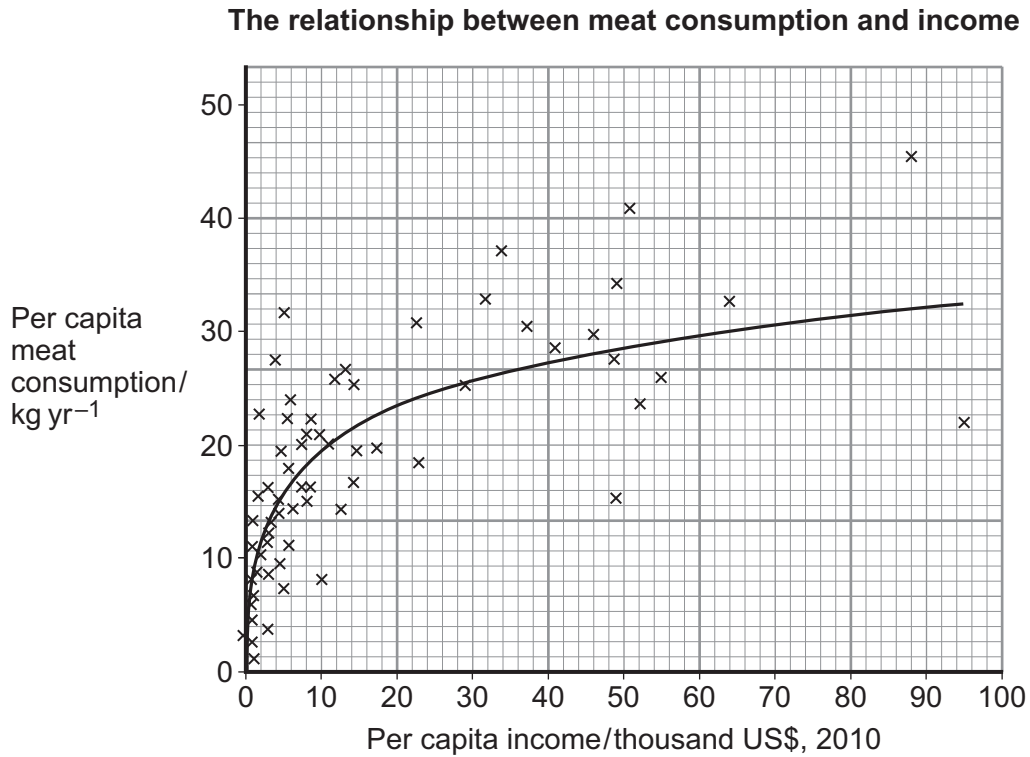
Each point on the graph represents the mean value of per capita meat consumption and income for one country.

What information must have been known about the mean values to be able to draw an accurate line of best fit?

[1 mark]

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Question 3 continues on the next page

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3 (c) Outline why a diet which includes intensively produced meat may be considered to be less sustainable than a vegetarian diet in terms of:

3 (c) (i) energy subsidies

[2 marks]

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3 (c) (ii) food chain efficiency.

[2 marks]

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3 (d) Outline situations in which livestock production is more practical than growing plant foods for human consumption.

[3 marks]

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4 Read the passage below.

The North-east Atlantic Mackerel fishery

The Atlantic Mackerel, *Scomber scombrus*, is a marine pelagic fish species, which forms large shoals near the sea surface. The shoals migrate between the fishing zones around Iceland, the Faroe Islands, Norway and the EU countries of north-west Europe.

For many years, the commercial catch of mackerel was small. Most consumers preferred to buy demersal species living near the seabed, such as cod and haddock, which live in mixed species shoals. More recently, mackerel has become more popular, partly because it is high in omega-3 oils, which are believed to have benefits for human health. Mackerel has also been promoted by supermarkets and celebrity chefs as a more sustainable alternative to species such as cod. The cod population had been reduced by overfishing.

The majority of mackerel are caught by purse seining, with some pair trawls and small numbers of hand-line fishermen operating close to the coast. The larger fishing boats have sonar equipment, which allows fishermen to identify single-species shoals of mackerel.

Catches around Iceland and the Faroe Islands increased rapidly from a few hundred tonnes in 2005 to 300 000 tonnes in 2012. Spokesmen from these two countries have said that mackerel have moved northwards as a result of increasing sea temperatures, which they say entitles them to an increased quota. They also argue that, as mackerel move into these more northerly areas, they pose a threat to populations of other fish.

Catch quotas, catchable size limits, no-take zones and fishing season restrictions are all used in some areas in an attempt to reduce overfishing.

Fisheries scientists believe that the total biomass of mackerel in the north-east Atlantic is approximately 3 million tonnes and that the Maximum Sustainable Yield (MSY) is 542 000 tonnes per year. In 2012, the actual total catch was 900 000 tonnes. In January 2012, the Marine Conservation Society (MCS) removed Atlantic Mackerel from its list of sustainable fisheries.

Line numbers: 5, 10, 15, 20, 25

Use information in the passage and your own knowledge to answer the questions that follow.

4 (a) Suggest why mackerel may pose a threat to other fish species if their range extends northwards (lines 20–21).

[2 marks]

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4 (b) Suggest why fishing for mackerel is likely to have a smaller environmental impact than fishing for cod.

[2 marks]

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4 (c) Explain why the methods used to catch mackerel may reduce overfishing (lines 12–15 and lines 22–23).

[6 marks]

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5 **Figure 4** shows features associated with a buffer strip. The buffer strip reduces the amounts of eroded soil reaching a river from nearby farmland.

Figure 4
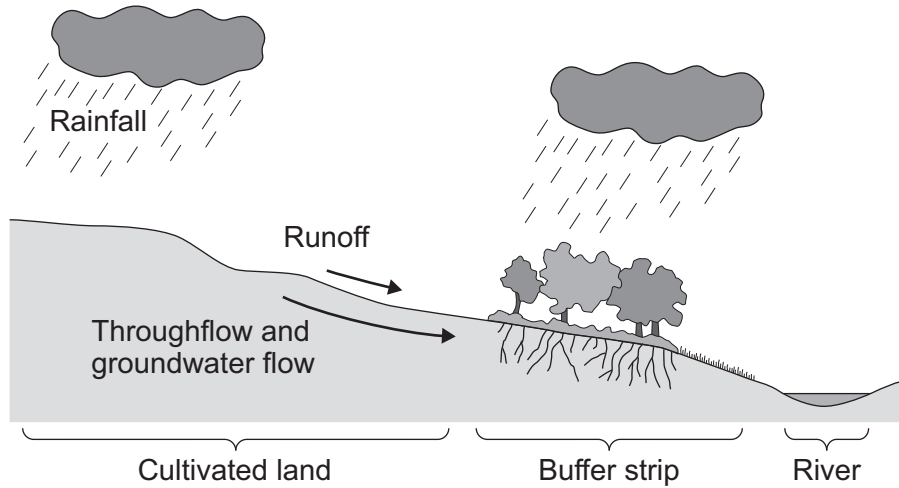
5 (a) (i) Explain how the buffer strip may reduce the amount of eroded soil reaching the river.

[2 marks]

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5 (a) (ii) Explain why subsidy payments may be needed to encourage farmers to use buffer strips.

[2 marks]

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5 (b) **Table 2** shows the results of an investigation into the amounts of eroded soil entering rivers flowing through farmland. Three areas of farmland were studied, with different slope angles and buffer strips of different widths.

Table 2

Field slope angle in farm area	Mass of eroded soil reaching river / 10^3 t yr^{-1}				
	Width of buffer strip / m				
	No buffer strip	10	20	30	40
Farm area A Slope angle 5°	82.5	63.5	55.0	48.3	45.2
Farm area B Slope angle 3°	61.5	50.0	45.0	39.8	35.5
Farm area C Slope angle 1°	8.5	5.5	5.1	2.9	2.6

Use information from **Table 2** to describe the trends shown.

[3 marks]

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Question 5 continues on the next page

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5 (c) Outline the environmental impacts of eroded soil that is washed into a river.

[3 marks]

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5 (d) Describe **one** method that may be used to investigate the effect of slope angle on the rate of soil erosion.

[5 marks]

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6 (a) A group of students investigated the effects of different methods of pest control on the populations of non-target insects.

The students:
- chose fields of similar size in which the same crop was grown
- visited each field six times throughout one year
- recorded the insect species that they collected in each field
- used the Chi-squared test to assess the significance of their results.

Figure 5 gives details of how to calculate and interpret the Chi-squared statistic for this type of investigation.

Figure 5

$$x^2 = \Sigma \frac{(O - E)^2}{E}$$

where:
Σ = the sum of
O = the observed value
E = the expected value

df (degrees of freedom) = k – 1
where k = the number of categories to which the data have been allocated

Critical values for the Chi-squared (x^2) Test

Degrees of freedom (df)	Level of significance (p)				
	0.05	0.025	0.01	0.005	0.001
1	3.84	5.02	6.63	7.88	10.83
2	5.99	7.38	9.21	10.60	13.81
3	7.81	9.35	11.34	12.84	16.27
4	9.49	11.14	13.28	14.86	18.47
5	11.07	12.83	15.09	16.75	20.52
6	12.59	14.45	16.81	18.55	22.46
7	14.07	16.01	18.48	20.28	24.32
8	15.51	17.53	20.09	21.96	26.13
9	16.92	19.02	21.67	23.59	27.88
10	18.31	20.48	23.21	25.19	29.59
11	19.68	21.92	24.73	26.76	31.26
12	21.03	23.34	26.22	28.30	32.91
13	22.36	24.74	27.69	29.82	34.53
14	23.68	26.12	29.14	31.32	36.12

Four fields were studied, **W**, **X**, **Y** and **Z**. **Table 3** shows the observed and expected values for this investigation and the calculated values of $\dfrac{(O - E)^2}{E}$.

Table 3

	Method of pest and weed control			
	Field W Chemical methods only	**Field X** Non-chemical methods only	**Field Y** Chemical and non-chemical methods	**Field Z** No pest or weed control methods used
Total number of species seen (the observed values)	12	19	8	
Theoretically expected number of species (the expected values)	15	15	15	15
$\dfrac{(O - E)^2}{E}$	0.60	1.07	3.27	2.40

6 (a) (i) Use information from **Table 3** to calculate the number of species observed in **Field Z**.

Write your answer in the space provided in **Table 3**.

[1 mark]

6 (a) (ii) Calculate the value of x^2 for the data in **Table 3**.

[1 mark]

$x^2 =$ ....

6 (a) (iii) In a similar study, the students calculated a value for x^2 of 12.02.

Use **Figure 5** to select the level of significance that can be accepted for this critical value.

[1 mark]

Tick (✓) **one** box.

p = 0.001 ☐

p = 0.005 ☐

p = 0.01 ☐

p = 0.025 ☐

Turn over ▶

6 (a) (iv) If the level of significance (p) is 0.025, what is the percentage probability that the results were produced by chance?

[1 mark]

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6 (b) Describe how animal pests may be controlled without using chemical pesticides.

[6 marks]

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7 Write an essay on **one** of the following topics.

Credit will be given for your understanding of the relationship between different areas of the subject, also for the organisation and presentation of the essay and for grammar, punctuation and spelling.
You should answer this question in continuous prose.

Either

7 (a) Describe how changes in transport systems may reduce damage to the environment **and** increase the sustainability of affluent societies.

[20 marks]

or

7 (b) Describe the ways in which abiotic factors are controlled in agroecosystems to increase productivity.

[20 marks]

or

7 (c) Explain how the methods used to control the gene pool of food species may create advantages as well as problems.

[20 marks]

Which question have you chosen?

Tick (✓) **one** box.

7 (a)

7 (b)

7 (c)

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Extra space for Question 7 ....

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END OF QUESTIONS

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