

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
SCIENCE A**

A213/02

Unit 3: Modules B3 C3 P3 (Higher Tier)

Candidates answer on the question paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

**Wednesday 26 January 2011
Afternoon**

Duration: 40 minutes



Candidate
forename

Candidate
surname

Centre number

Candidate number

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- This document consists of **20** pages. Any blank pages are indicated.

2

Answer **all** the questions.

- 1 In many countries, electricity is generated by burning waste plant material, called **biomass**. One of the biggest renewable electrical power stations in the USA burns the waste from sugar plants.



- (a) Use **four** letters from the statements **A**, **B**, **C**, **D** and **E** below to complete the flow diagram showing how electricity is generated in this power station.

- A** This turns a turbine.
- B** Water is boiled into steam.
- C** This makes a generator spin.
- D** Heat is released from a nuclear reaction.
- E** A transformer changes the electrical voltage.



[2]

3

- (b) This power station produces carbon dioxide when the plant material burns. However, it is described as **carbon neutral**, because it does not add extra carbon dioxide to the atmosphere.

The statements below are all correct.

Put ticks (✓) in the boxes next to the **two** statements that explain why this power station is carbon neutral.

All the carbon in plants comes from the atmosphere.

☐

Coal, which contains carbon, comes from materials like the sugar plants.

☐

All the carbon dioxide given off by the power station comes from burning plants.

☐

Nuclear power does not involve burning any fuel so does not add carbon dioxide to the atmosphere.

☐

Sugar is a carbohydrate, so it contains carbon.

☐

[2]

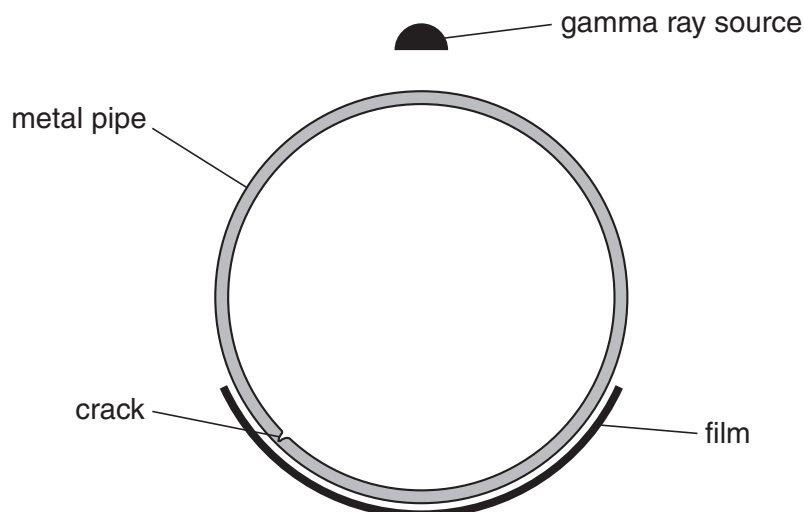
[Total: 4]

4

- 2 Metal pipes have joins in them. To test these joins, gamma rays can be used.

The gamma rays that get through the tube are picked up on film, just like an X-ray.

The film shows any cracks, just as an X-ray can show a crack in a broken bone.



- (a) The film is clear to start with. After it is developed, it looks darker where gamma rays have struck it.

Some gamma rays are absorbed by the metal pipe. This makes the radiation reaching the film weaker, so the film becomes less dark.

What will the developed film look like for the diagram above?

Put a tick (✓) in the box to complete the sentence.

Under the crack, the film will be dark grey.

Around the rest of the pipe, the film will be ...

... light grey. ☐

... dark grey. ☐

... black. ☐

[1]

5

(b) Here are four correct statements about beta radiation.

Which one explains why gamma radiation is suitable for testing pipes, but beta radiation is not?

Put a tick (✓) in the box next to the correct explanation.

Beta radiation is more penetrating than alpha radiation.

☐

Beta radiation is less penetrating than gamma radiation.

☐

Beta radiation is an ionising radiation.

☐

Beta radiation is given out by radioactive materials.

☐

[1]

(c) Pipes can be tested with X-rays instead of gamma rays. Gamma ray sources are small and portable. X-ray sources need large, powerful electrical supplies.

Using X-rays is less risky than using gamma rays, but there are situations where the use of gamma rays is necessary.

Explain why

- using X-rays is less risky than using gamma rays
- there are situations where the use of gamma rays is necessary.

.....

.....

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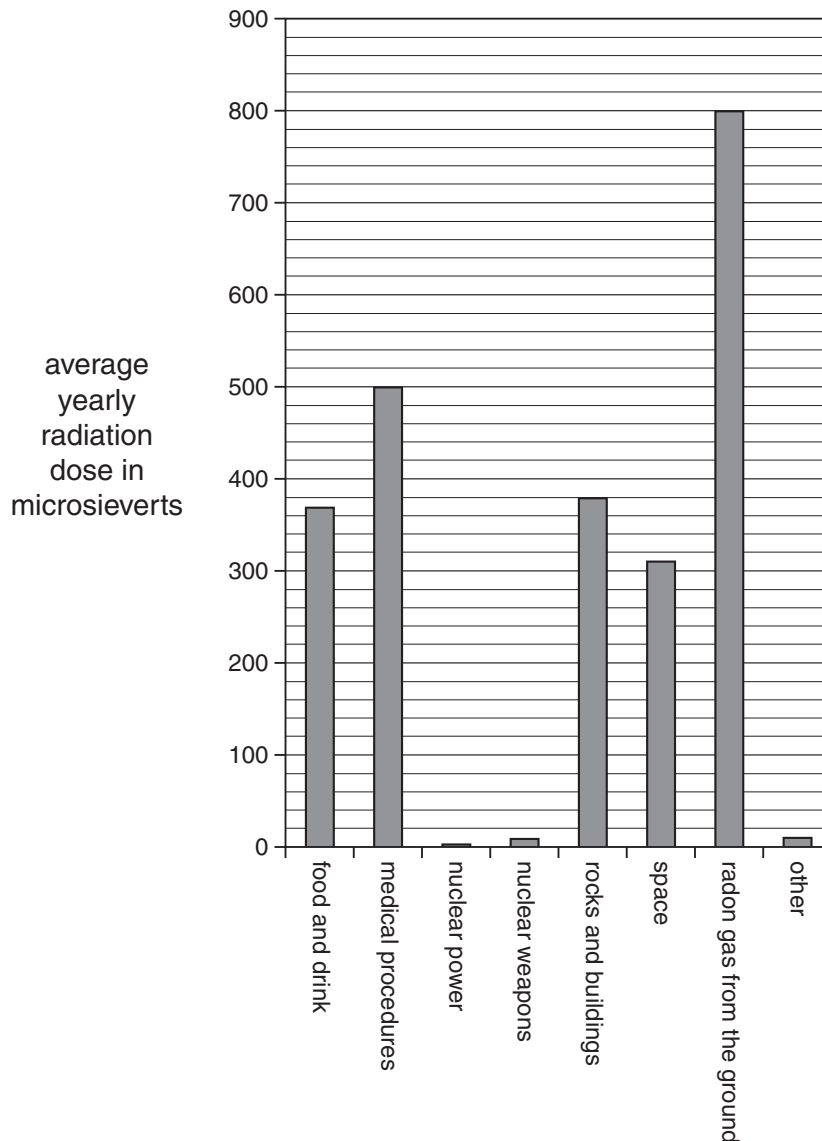
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..... [3]

[Total: 5]

6

- 3 The bar chart below shows the average radiation dose from all sources for people living in Europe.



- (a) Use the data in the chart to show that the average yearly **total** radiation dose received by people living in Europe is between 2300 and 2400 microsieverts.

Show your working clearly in this space.

[1]

7

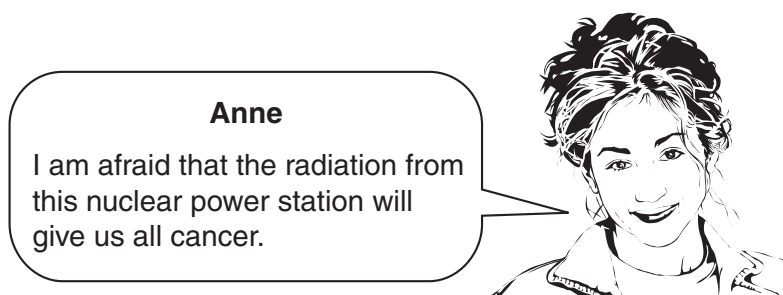
- (b) Calculate the percentage of their radiation dose that an average person gets from food and drink.

In this part, you can assume the average total yearly radiation dose is 2400 microsieverts.

Show your working clearly.

answer = % [2]

- (c) Anne is very worried about plans to build a new nuclear power station near her house.



Which of the following statements correctly describes the risk?

Put ticks (✓) in the boxes next to the **two** correct statements.

Anne is trying to use the ALARA principle.

☐

The perceived risk is much greater than the actual risk.

☐

There is no radiation risk at all from nuclear power stations.

☐

The precautionary principle only applies to artificial sources of radiation.

☐

Even though the chance of a problem is small, the consequences would be very serious.

☐

[2]

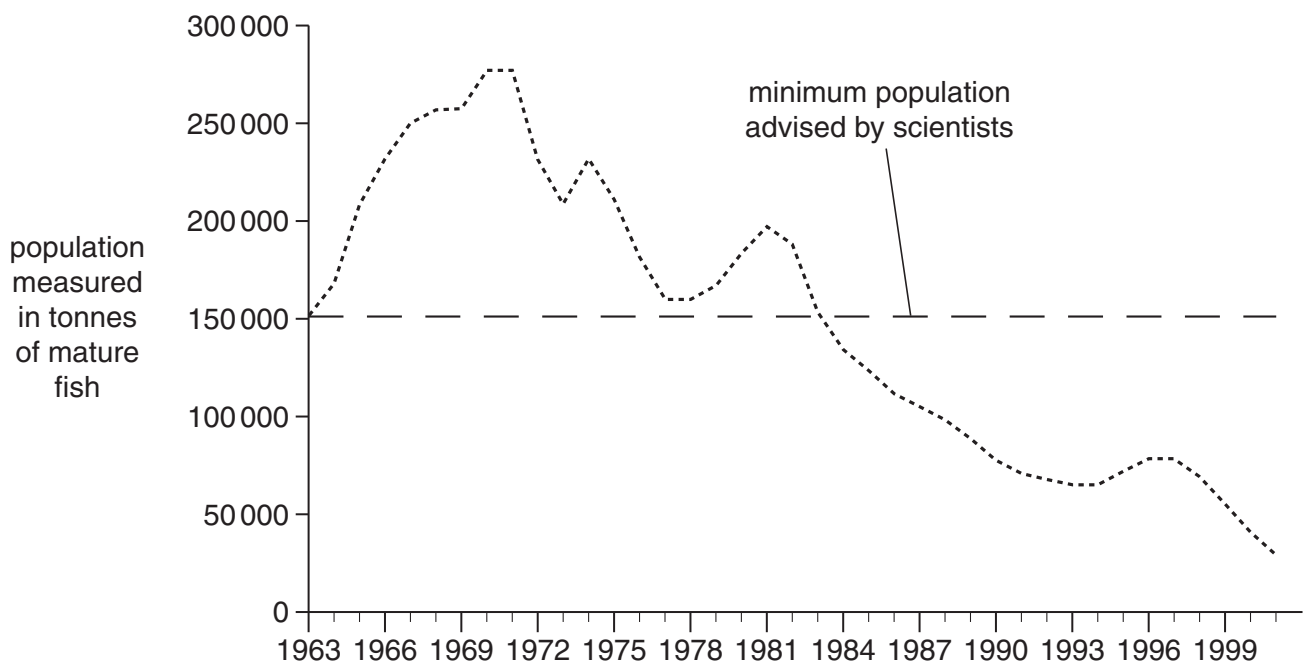
[Total: 5]

- 4 Fish are an important part of the human diet.



- (a) Look at the graph.

It shows the estimated population of mature North Sea cod between 1963 and 2001.



Describe the changes in the cod population between 1963 and 2001.

.....

.....

..... [2]

9

- (b) The possible extinction of North Sea cod due to over fishing is an example of using the environment in an unsustainable way.

Explain why it is important to use the environment in a sustainable way.

Use these ideas in your answer

- biodiversity
- food webs
- possible resources.

.....

.....

.....

.....

.....

..... [3]

(c) Read this information.

Cod can live for approximately 40 years.

Now, due to over fishing, 90 % of the cod in the North Sea are only one or two years old.

This has changed the structure of the population. Natural selection has led to a population of fish that mature at a younger age.

The long-term effects of this selection pressure are unknown.

(i) Four friends are discussing how natural selection results in a population of fish that matures at a younger age.



Sunil

Fishing nets catch the bigger fish so it is an advantage to be small as you are less likely to be caught.



Alan

Younger fish are smaller so it is an advantage to be young as you are less likely to be caught.



Charles

Cod which can breed when only one or two years old are most likely to breed and so maturing earlier becomes more common.



Helen

Bigger, older fish have less chance to breed as they are more likely to be caught.

Write down the name of the friend who has **best** understood this example of natural selection.

answer [1]

(ii) Natural selection depends on variation.

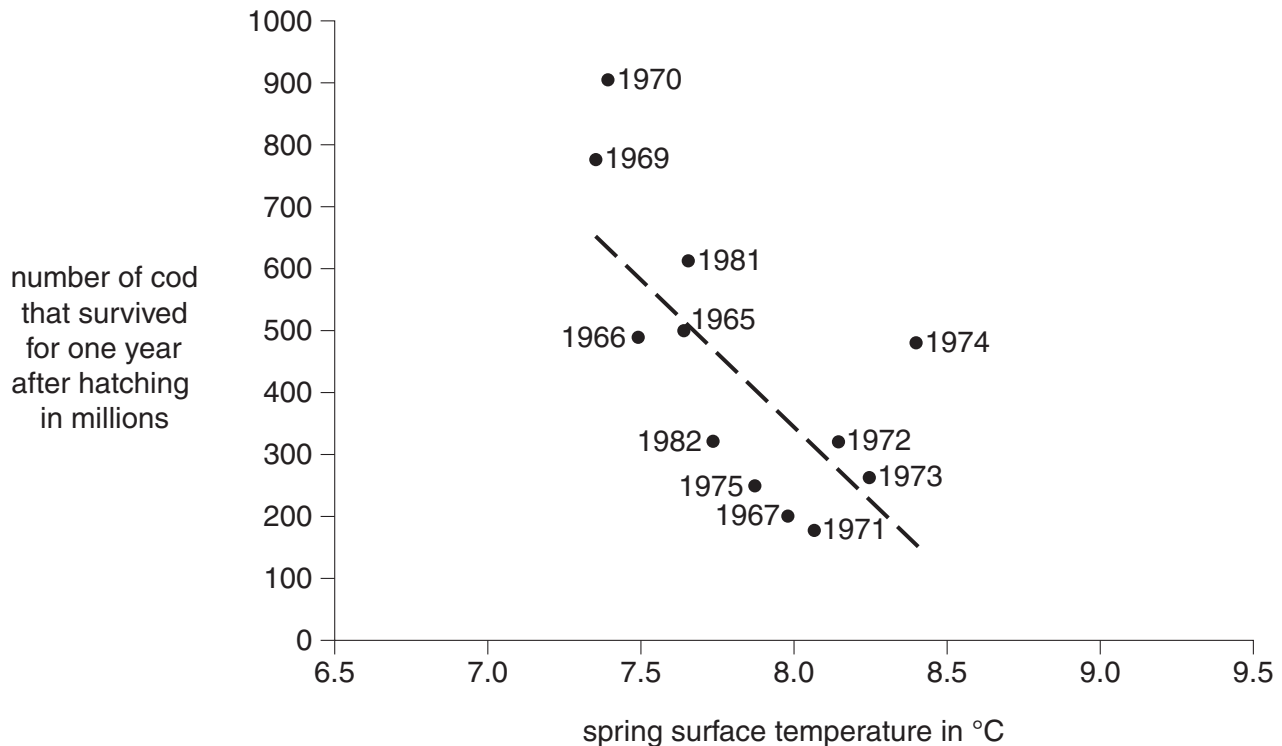
Complete these sentences about variation.

Variation can be caused by mutations in and by the environment.

Variation due to the environment cannot be [1]

11

- (d) Other scientists have studied the effect of surface sea temperature on the number of cod that survive for one year after hatching. The graph shows their findings. Each data point is marked with the year it was obtained.



Which conclusions can be made from the data in this graph?

Put ticks (✓) in the boxes next to the two **best** answers.

The data disprove the explanation that over fishing has caused a fall in the population of North Sea cod.

☐

The data support the explanation that over fishing has caused a fall in the population of North Sea cod.

☐

The data prove the North Sea cod population is more affected by surface sea temperature than fishing.

☐

The data reduces confidence in the explanation that only over fishing has caused a fall in the population of North Sea cod.

☐

The data is insufficient to give up the accepted explanation that over fishing is the major cause of the falling North Sea cod population.

☐

[2]

[Total: 9]

5 Scientists place humans in the hominid family.

The table gives details of some hominid species that have been discovered.

species	when they first lived (millions of years ago)	where they lived	brain volume in cm ³	number of fossils found
<i>H. habilis</i>	2.20	Africa	660	many
<i>H. erectus</i>	1.40	Africa, Europe and Asia	1100	many
<i>H. neanderthalensis</i>	0.35	Europe, W. Asia	1700	many
<i>H. sapiens</i>	0.20	worldwide	1850	many
<i>H. floresiensis</i>	0.10	Indonesia	400	7 individuals

(a) Where are hominids most likely to have originated?

Use the information in the table.

answer [1]

(b) Most scientists think that as hominids evolved their brains became larger.

H. floresiensis does not fit this pattern.

However, the scientists are reluctant to give up the accepted view that brain size has increased during hominid evolution.

What information from the table explains this reluctance?

..... [1]

(c) Complete the sentences about hominid evolution.

Scientists think that all hominids shared a

All the species of hominids except *H. sapiens* are

If conditions on Earth had been different then the hominid species that evolved

could have been [3]

[Total: 5]

6 Some students are discussing different types of farming.

Look at what they say.

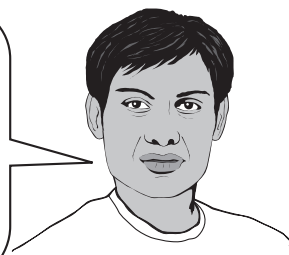


Barry

Some farmers use animal waste to fertilise the soil.

Anwar

Some farmers do not spray their crops with chemicals. No one knows what harm the chemicals may do.



Donna

Intensive farmers put pesticides and fertilisers on their fields even though they know it harms the environment. This is because it increases their crop yield.

Clare

Pesticides often kill insects that are food for other animals.



Flora

I only buy organic food. You never know what effect pesticides on crops may have on your body.



Ed

I do not think it matters whether you buy food from organic or intensive farms. Just buy the food that you like.

(a) Who is talking about using renewable resources?

answer [1]

(b) Who suggests that the benefits of intensive farming outweigh the risks?

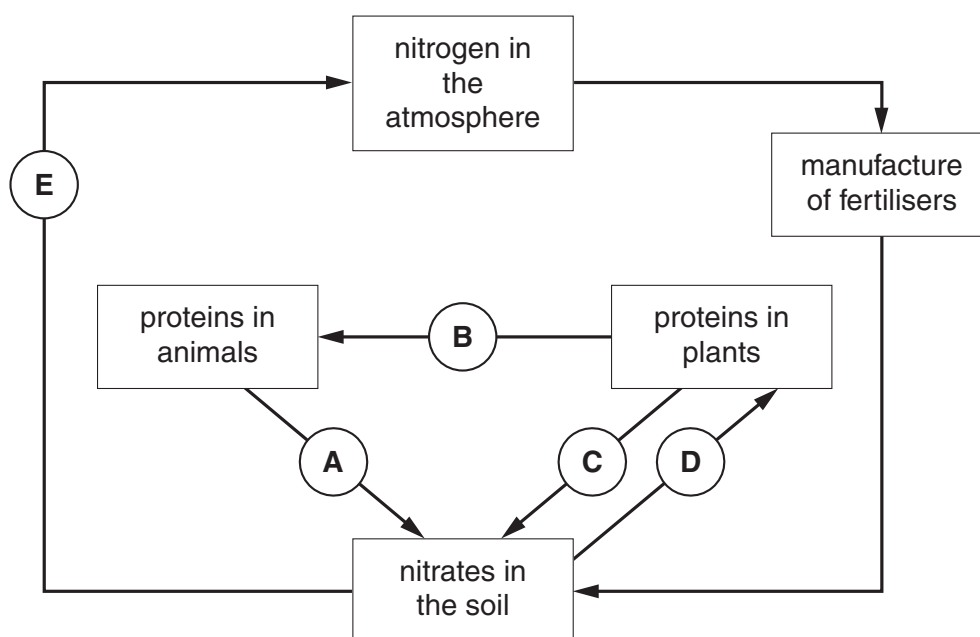
answer [1]

(c) Who is using the precautionary principle?

answer [1]

[Total: 3]

7 The diagram shows the continual cycling of nitrogen.



(a) (i) Which arrow, **A**, **B**, **C**, **D** or **E**, shows plants making proteins?

arrow [1]

(ii) Which **two** arrows from **A**, **B**, **C**, **D** and **E** show decay?

arrows and [1]

(iii) What type of micro-organism found in the soil is needed for process **E**?

Put a (ring) around the correct answer.

bacteria

fungi

nitrates

proteins

viruses

[1]

(iv) Which change, **not** shown on the diagram, involves lightning in thunderstorms?

Put a tick (✓) in the box next to the correct answer.

nitrogen in the air → proteins in animals

☐

nitrogen in the air → nitrates in soil

☐

nitrogen in the air → proteins in plants

☐

nitrates in the soil → nitrogen in the air

☐

[1]

15

- (b) When too much fertiliser is put on the land some of it can run off into waterways.

Explain how this damages the environment.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 7]

8 Read this newspaper article.

Rise in type 2 diabetes

The number of people in the UK with type 2 diabetes has risen to nearly 2.5 million.

Part of the rise can be explained by improvements in diagnosis, but the main factor is the increase in obesity in the UK.

A doctor said “We need to do all we can to raise awareness of the seriousness of the risk of type 2 diabetes.”

- (a) The doctor says that people need to be aware of the risk of type 2 diabetes.

What information would an overweight or obese person need to assess their risk?

Put ticks (✓) in the boxes next to the two **best** answers.

how to reduce the risk of type 2 diabetes

☐

the chance of diabetes happening if people are overweight or obese

☐

the percentage of people with type 2 diabetes

☐

the percentage of people who are overweight or obese

☐

how much more likely people are to develop life threatening diseases if they have type 2 diabetes

☐

[1]

- (b) There are two types of diabetes.

These are type 1 and type 2 diabetes.

They are controlled in different ways.

Give **one** method used to control type 1 diabetes and a **different** method used to control type 2 diabetes.

.....

.....

.....

.....

..... [2]

17

- (c) When a person has diabetes and it is not treated, their bodies have problems processing sugary foods.

Draw lines to complete a sentence that explains why untreated diabetes causes problems.

Draw **one** line from list **A** to list **B**.

Draw **one** line from list **B** to list **C**.

A

Sugar in foods is quickly absorbed into the bloodstream ...

or

Sugar in foods is not absorbed into the bloodstream ...

or

Sugar in foods is slowly absorbed into the bloodstream ...

or

Proteins are not absorbed into the bloodstream ...

B

... causing a drop in blood sugar level ...

or

... causing a rapid rise in blood sugar level ...

or

... causing a slow rise in blood sugar level ...

or

... causing the blood sugar level to stay the same ...

C

... which returns to normal very quickly.

or

... which returns to normal very slowly.

[1]

[Total: 4]

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