

# **Cambridge Pre-U**

CANDIDATE NAME					
CENTRE NUMBER			CANDIDATE NUMBER		

BIOLOGY 9790/01

Paper 1 Structured

October/November 2020

2 hours 30 minutes

You must answer on the question paper.

No additional materials are needed.

#### **INSTRUCTIONS**

- Answer all questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do not write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

#### **INFORMATION**

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].

For Exam	iner's Use
Section A	
21	
22	
23	
24	
25	
Total	

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document has 32 pages. Blank pages are indicated.

#### Section A

#### Answer all the questions.

You are advised to spend no more than 30 minutes on this section.

- **1** A student set up a light microscope using:
  - an objective lens with a magnification of ×4
  - a stage micrometer
  - an eyepiece graticule placed in the ×10 eyepiece of the microscope.

The actual length of one division on both the graticule and on the micrometer is  $10 \,\mu m$ .

What happens when the objective lens magnification is increased to ×10?

- **A** The appearance of one eyepiece graticule division increases to 40 μm.
- **B** The appearance of one eyepiece graticule division increases to  $100 \, \mu m$ .
- **C** The image of one stage micrometer division increases to 0.4 mm.
- **D** The image of one stage micrometer division increases to 1 mm.

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aliowci	 	ı

2 A printed slide shows five patterns, each consisting of pairs of alternating black and white lines. Table 2.1 shows the number of line pairs per  $\mu m$  in each pattern.

Table 2.1

pattern	number of line pairs per μm
1	0.25
2	0.50
3	1.00
4	2.00
5	4.00

Microscope **P** distinguished between patterns 1 to 4. Microscope **Q** distinguished between patterns 1 to 5.

What describes the capability of microscope **Q** compared with microscope **P**?

- A decrease in magnification
- **B** decrease in resolution
- **C** increase in magnification
- **D** increase in resolution

answer ...... [1]

A student compared glucose solutions using a standardised Benedict's test. Soluble Cu<sup>2+</sup> ions were reduced to insoluble Cu<sup>+</sup> ions, forming solid precipitates. These precipitates were removed by filtering and the remaining solutions were placed in a colorimeter to measure their percentage light absorbance at a particular wavelength.

The data obtained is shown in Table 3.1.

Table 3.1

glucose concentration /mmoldm <sup>-3</sup>	percentage light absorbance by colorimeter
5	25
4	38
3	46
2	52
1	65

What explains the trends in glucose concentration and percentage light absorbance?

- A serial dilution of a 5 mmol dm<sup>-3</sup> glucose solution and a decrease in the mass of precipitate formed
- **B** serial dilution of a 5 mmol dm<sup>-3</sup> glucose solution and an increase in the mass of precipitate formed
- C proportional (simple) dilution of a 5 mmol dm<sup>-3</sup> glucose solution and a decrease in the mass of precipitate formed
- **D** proportional (simple) dilution of a 5 mmol dm<sup>-3</sup> glucose solution and an increase in the mass of precipitate formed

	- 4	
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answei	 	

4 Polar bears live in the Arctic and use sea ice as a base for hunting seals underwater.

Which properties of water make it a useful physical component of the polar bears' habitat?

- 1 the ability of liquid water to dissolve polar molecules
- 2 the high surface tension of liquid water
- 3 the lower density of solid water compared to liquid water
- A 1 and 2 only
- **B** 1, 2 and 3
- C 2 only
- **D** 3 only

5			nolecules must be present at the cell surface membrane of an <b>axon</b> for the repeated ition of action potentials?
		1	ATP
		2	channel proteins
		3	ligand-gated receptor proteins
	Α	2 a	nd 3 only
	В	1 a	nd 2 only
	С	1 a	nd 3 only
	D	1, 2	2 and 3
			answer [1]
6	ln w	vhat	stages of the cell cycle do centromeres perform their function?
		1	G <sub>1</sub> of interphase
		2	S of interphase
		3	mitosis
		4	cytokinesis
	Α	2 o	nly
	В	3 o	nly
	С	1, 2	2 and 3 only
	D	2, 3	3 and 4 only
			answer[1]

- 7 Which line of Table 7.1 explains the movement of water molecules:
  - into a plant, from the soil into a root hair cell
  - out of a plant, from leaf spongy mesophyll cell walls to the air?

Table 7.1

	soil → root hair cell	spongy mesophyll cell walls $ ightarrow$ air
Α	simple diffusion	facilitated diffusion
В	simple diffusion	osmosis
С	osmosis	simple diffusion
D	osmosis	osmosis

answer	[1	1	•	
--------	----	---	---	--

**8** Components of blood plasma leave the capillaries of the glomerulus to form the glomerular filtrate in kidney nephrons.

Which aspects of the blood vessels in the kidney will influence the rate of formation of this glomerular filtrate?

- 1 renal arterial blood pressure
- 2 glomerular capillary permeability
- 3 diameter of the afferent arteriole
- 4 diameter of the efferent arteriole
- A 1 and 2 only
- **B** 3 and 4 only
- **C** 1, 2 and 4 only
- **D** 1, 2, 3 and 4

answer	[1	١٦
anovvoi	 	

9 Mouse monoclonal antibodies may be introduced into patients to target a particular antigen on a pathogen or on a cancer cell. After a while the patient's immune system recognises the monoclonal antibodies as non-self and destroys them.

What parts of a monoclonal antibody could be redesigned to increase the length of time that the antibody lasts in a patient's body?

- A heavy and light constant regions
- B heavy and light variable regions
- **C** hinge region
- **D** light variable region

ancwar	[1]	ſ
answer	 	

**10** Fig. 10.1 shows a small-scale apparatus for processing milk.

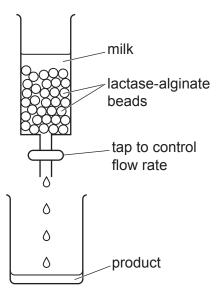


Fig. 10.1

Which statements are true of this apparatus?

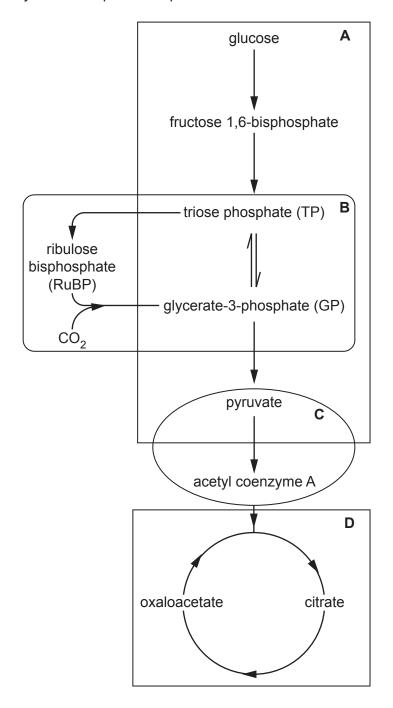
- 1 It is a model of a commercial application of biotechnology.
- 2 An enzyme is immobilised to improve efficiency.
- 3 The product contains more lactose than the original milk.
- A 2 only
- **B** 3 only
- C 1 and 2 only
- **D** 1, 2 and 3

answer ...... [1]

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# **Questions 11, 12, 13 and 14**

Some metabolic pathways that take place in a plant cell are shown below.



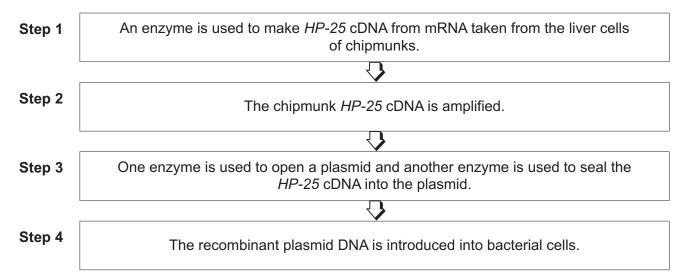
State the letter or letters indicating the section or sections of the pathway that:

11	occur in animal cells	answer	[1]
12	involve decarboxylation	answer	[1]
13	generate ATP	answer	[1]
14	make an overall net use of ATP.	answer	[1]

#### **Questions 15, 16, 17 and 18**

Chipmunks are small rodents that hibernate (spend the winter in a dormant state). Researchers were interested in the role of the chipmunk hibernation-specific gene, *HP-25*, and its protein product.

Four steps that can be used to obtain a supply of bacteria that express the HP-25 protein are outlined below.



Some enzymes and techniques are listed as A-J.

Α	DNA fingerprinting
В	DNA ligase
С	gel electrophoresis
D	gene therapy
E	polymerase chain reaction
F	RNA polymerase
G	restriction endonuclease
Н	reverse transcriptase
I	Taq polymerase
J	transformation

15	Which letter identifies the enzyme used in <b>Step 1</b> ?	answer	[1]
16	Which letter identifies the enzyme used in <b>Step 2</b> ?	answer	[1]
17	Which letters identify the enzymes used in <b>Step 3</b> ?	answer	[1]
18	Which letter identifies the technique used in <b>Step 4</b> ?	answer	[1]

### Questions 19 and 20

A-(	<b>G</b> list	names given to types of animal behaviour.
	Α	classical conditioning
	В	habituation
	С	innate
	D	kinesis
	Е	learned
	F	operant conditioning
	G	taxis
Sta	te <b>all</b>	the letters that apply to these examples of behaviour.
19	Bur	nblebees on their first day of foraging move towards flowers that are yellow or blue.
		answer[1]
20		er four weeks, bumblebees who have been taking nectar and pollen from mainly white flowers we towards white flowers when presented with a choice of white, yellow and blue flowers.
		answer[1]

# Section B

# Answer all the questions.

21 Fig. 21.1 shows some organelles and storage molecules in a mammalian liver cell.



Fig. 21.1

**A** is a storage polysaccharide.

(a)	(i)	Name the storage polysaccharide A	[1]
	(ii)	Outline how <b>enzymes</b> are involved in regulating the quantity of <b>A</b> in the cell.	
			[2]

(b) (i)	Name organelle <b>B</b> .	
(ii)	Name the type of microscope that produced the image in Fig. 21.1.	1]
(iii)	B and C are both the same type of organelle.	1]
	Suggest why <b>B</b> and <b>C</b> appear to have different shapes.	
	[	
(iv)	The mean diameter of organelle <b>B</b> in Fig. 21.1 is 34 mm.	
	The magnification of Fig. 21.1 is ×20000.	
	Calculate the actual mean diameter of organelle <b>B</b> . Give your answer in micrometres.	
	You must show your working.	
	μ [:	m 2]

(c)	<b>D</b> is	a ribosome attached to a membrane. <b>A</b> is not attached to a membrane.
	(i)	Use Fig. 21.1 to identify one <b>other</b> way in which <b>D</b> can be distinguished from <b>A</b> .
		[1]
	(ii)	Suggest how the composition of the inner membrane of ${\bf C}$ may differ from the membrane attached to ${\bf D}$ .
		[2]
		[Total: 12

22	(a)	Plant growth substances like auxins and gibberellins control growth and reproduction in plants, while hormones control growth and reproduction in mammals.
		Outline <b>two</b> similarities and <b>two</b> differences between plant growth substances and mammalian hormones.
		similarities
		differences
		[4]

(b)	Rapid-cycling brassicas are plants that have been selectively bred to complete their life cycle
	in less than 40 days. Normal rapid-cycling brassicas have leaves spaced out on a tall stem.

A mutation in a rapid-cycling brassica resulted in a plant with leaves clustered together at a similar height close to the ground. The leaves were arranged like this because the internode gaps between the leaves had failed to expand.

(i)	State the name given to the growth form shown by the mutant plant.	
		[1]

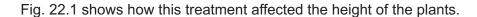
Table 22.1 summarises some differences in the rate of growth and development of the normal and mutant plants.

**Table 22.1** 

growth stage	time after planting seed/days		
growth stage	normal	mutant	
emergence of seedling	2	5	
flower buds visible	12–15	22–28	
flowers open	20–23	>40	
seed pods present	26–28	>40	

(ii)	The process of mutation produces genetic variation that may enable organisms with mutant alleles to survive better and reproduce more.
	Comment on this statement with reference to Table 22.1.
	[2]

(c) Gibberellins were applied to the leaves of mutant plants 12 days after planting.



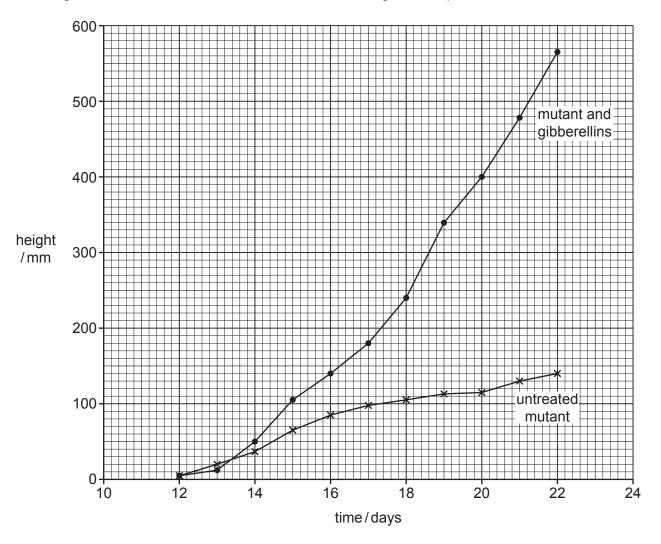


Fig. 22.1

Describe and explain the effect of gibberellins on the height of the treated plants.
[4]

(d) Fig. 22.2 shows the drumstick primula, *Primula denticulata*. Stems bearing flower buds push up from a cluster of leaves close to the ground.

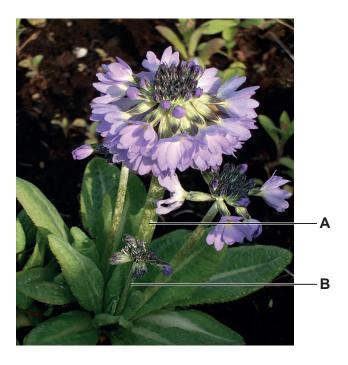


Fig. 22.2

Explain how the action of auxin in the more developed stem, ${\bf A}$ , has changed its appearance compared with the less developed stem, ${\bf B}$ .
[4]

(e)	Experiments show that gibberellins can be moved through plant phloem by translocation.		
	(i)	Explain what is meant by translocation in the phloem.	
		[2]	
	(ii)	Describe how loading occurs at a source, such as a photosynthesising leaf.	
		[2]	
		[Total: 19]	

23	Cancer is caused by mutations that disrupt the control of the cell cycle.			
	(a)	(i)	Describe the stages of the cell cycle <b>and</b> explain how it is controlled.	
		(ii)	Proteasomes help to coordinate the cell cycle.	
			Explain how proteasomes help to coordinate the cell cycle.	
				[2

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**(b)** Tobacco smoke contains many carcinogenic compounds, including benzopyrene. A large number of research studies conducted over many years have established a link between smoking tobacco and developing lung cancer.

In 1978 Doll and Peto published epidemiological data which showed the relationship between tobacco smoking and lung cancer in men. This is shown in Fig. 23.1.

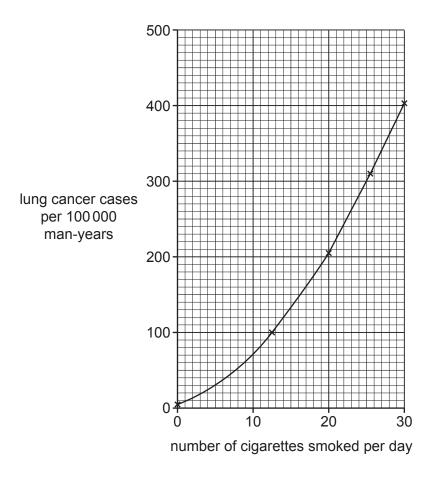


Fig. 23.1

In 1996 the effect of benzopyrene on cells and DNA was investigated *in vitro*. Researchers identified three sites where benzopyrene binds to the tumour suppressor *p53* gene, at codons 157, 248 and 273. When benzopyrene bound to guanine bases at these three sites, substitution mutations to thymine occurred.

The researchers then identified the p53 mutations present in the lung cancer cells of people who smoked tobacco.

Fig. 23.2 shows the number of mutations occurring at different locations of the p53 gene in the lung cancer cells of these people.

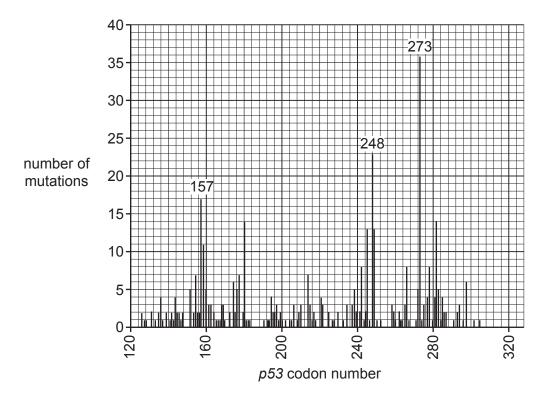


Fig. 23.2

(i)	Suggest how mutation in the <i>p53</i> gene can contribute to the development of cancer.
	[2]
(ii)	Explain how the 1996 findings, including Fig. 23.2, represent an advance upon the 1978 data in Fig. 23.1 in providing evidence for the link between tobacco smoking and lung cancer.
	[4]

**(c)** Some types of cancer are inherited. Most cancers, however, arise due to the lifetime accumulation of mutations in genes such as *p53* and proto-oncogenes.

There are different alleles of genes that code for enzymes that detoxify carcinogens. An individual's genotype for these alleles affects their chance of suffering DNA damage that might lead to cancer.

Fig. 23.3 compares the frequency in the population of two alleles for hereditary cancer (shaded blue) and two alleles for less effective detoxification enzymes (shaded pink), and the increased risk of cancer each represents.

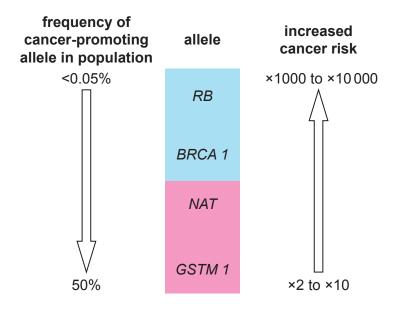


Fig. 23.3

Research funds are limited. Calculations that multiply the frequency of a cancer-promoting allele by the increased cancer risk may be used to estimate the possible impact of the allele on society.

Use the data in Fig. 23.3 to discuss which alleles should be prioritised for the allocation of

search funds.
[4]

[Total: 17]

24 Coral reefs cover 0.1% of the ocean floor but support nearly 25% of marine species. Rising ocean temperatures, pollution and destructive fishing methods damage corals.

Fig. 24.1 shows part of a coral reef ecosystem.



Fig. 24.1

(a)	Coral reefs are described as biodiversity hotspots.
	Suggest why coral reefs are described as biodiversity hotspots.
	[1]

**(b)** Each coral consists of a colony of animals called polyps that form by asexual budding. The polyps secrete the calcareous skeleton on which they rest.

Each coral polyp has the following structure.

- It consists of two layers of epithelial cells that enclose a central gut cavity.
- The two layers of epithelial cells are separated by a non-cellular gelatinous layer.
- Symbiotic bacteria form a thin layer over the polyp's outer epithelial cells.

Single-celled photosynthetic eukaryotes called zooxanthellae live within the polyp's inner epithelial cells. The zooxanthellae and the polyp have an endosymbiotic relationship.

Fig. 24.2 shows a transverse section through a polyp.

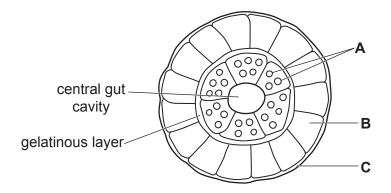


Fig. 24.2

(i)	State <b>one</b> difference in cell structure between a cell of type <b>A</b> and cell <b>B</b> .	
		[1]
(ii)	State <b>two</b> differences in cell structure between cell <b>B</b> and a cell in layer <b>C</b> .	
		[2]

(c)	zoo whe	ng ocean temperatures harm corals, causing them to expel their endosymbiotic xanthellae. These zooxanthellae contain pigments like chlorophyll and xanthophylls and en the zooxanthellae have been expelled the coral is said to be bleached. Bleached corals the benefit of having endosymbiotic zooxanthellae and usually die.
	Sug	gest why bleached corals may die.
		[2]
(d)		ensive coral bleaching, tropical storms and predation by starfish have caused the area of an floor covered by coral to halve since 1990.
	(i)	Outline the social and economic reasons for trying to conserve coral reefs.
		[2]
	(ii)	Outline the implications of the species-area concept for coral reef ecosystem conservation.
		[2]

Explain why individual coral species have low genetic diversity <b>and</b> how the chances of survival in response to environmental change from global warming	
Colombiato intercepted in companying corel worfe have identified these groups of	
Scientists interested in conserving coral reefs have identified these research g	joais:
<ul> <li>increase genetic diversity within each species of coral</li> <li>selectively breed corals to have improved tolerance to high temperatures</li> <li>selectively breed or genetically engineer symbiotic zooxanthellae to tolerance to high temperatures.</li> </ul>	
Discuss the potential problems of achieving these research goals.	
	[3]

**25** (a) In the mammalian immune system, different cells interact to perform the actions of the non-specific immune system and the specific immune system.

Complete Table 25.1 to name or describe the actions performed by some of the cells involved in each part of the mammalian immune system.

**Table 25.1** 

	cell name	action
non-specific immune	macrophage	
system		presents fragments of pathogens to T lymphocytes
specific immune system		activates cytotoxic T cells and B lymphocytes
Specific infinitine system	B memory cell	

(b)	Explain the meaning of the term <i>autoimmune disease</i> with reference to myasthenia gravis.
	IN]

[4]

(c) Multiple sclerosis is an autoimmune disease that involves loss of myelin from nerve cells in the brain and spinal cord. Repeated loss and repair of myelin results in scar lesions forming in nerve tissue.

Fig. 25.1 shows a transverse section of a lower region of the spinal cord.

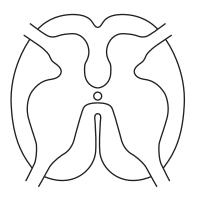


Fig. 25.1

(i) Add **one** label to Fig. 25.1 to show and name the area of tissue in the spinal cord where scarring is most likely to occur in a multiple sclerosis patient. [1]

A number of factors combine to cause multiple sclerosis. The variation seen in the chance of developing the disease appears to have both genetic and environmental causes.

Fig. 25.2 shows the number of people per 100 000 people who are affected by the disease in different areas of the world.

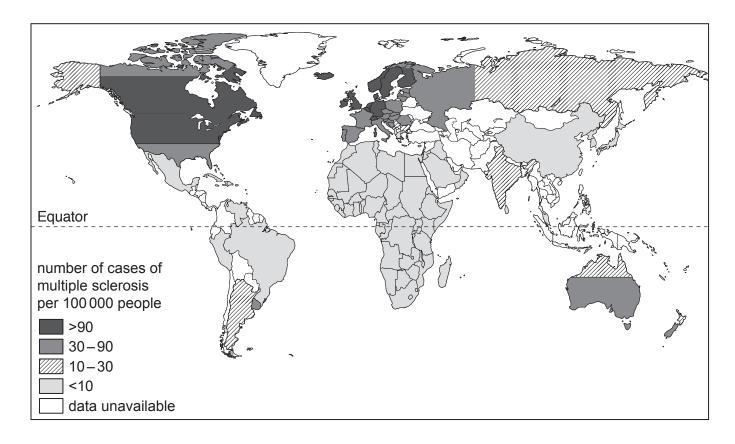


Fig. 25.2

- (ii) Some factors that have been suggested to increase the chance of developing multiple sclerosis include:
  - inheriting a DRB1\*1501 allele at a locus important in histocompatability
  - insufficient exposure to sunlight
  - exposure to organophosphate compounds used to kill insects.

Discuss the extent to which Fig. 25.2 supports the suggestion that these factors have a role in the development of multiple sclerosis.
[5]

[Total: 14]

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