

Nature of science
Standard level
Paper 1

Monday 1 May 2017 (afternoon)

1 hour 30 minutes

Candidate session number

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Instructions to candidates

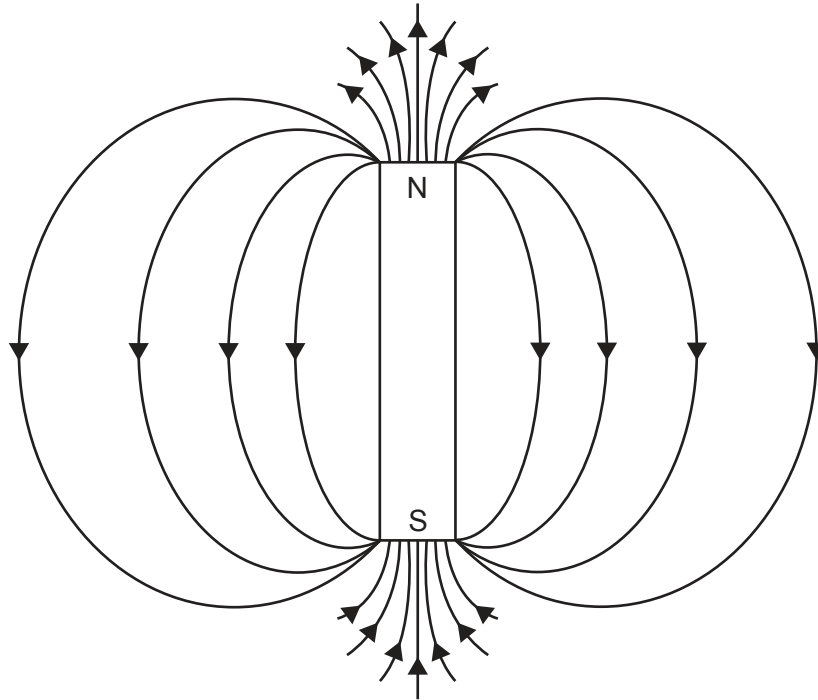
- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[60 marks]**.



Section A

Answer **all** questions. For each question (1 to 5), choose the answer you consider to be the best and indicate your choice in the box provided.

1. What does the visualization of the field pattern of a permanent bar magnet demonstrate?



- A. The transfer of energy
- B. The direction of electromagnetic radiation
- C. The energy contained in a magnet
- D. The magnetic field varies in strength and direction

2. What challenged the steady-state theory of the universe?

- A. The continuous creation of mass as the universe expands
- B. The discovery of the cosmic microwave background radiation
- C. The law of conservation of mass and energy
- D. The perfect cosmological principle



3. What defines both speed and velocity?

	Speed	Velocity	
A.	The change in displacement of an object	The change in direction of an object	<input type="checkbox"/>
B.	An object's capacity to gain momentum	An object's capacity to move faster in a given time	
C.	Distance travelled in a given time	Distance travelled in a given time in a specific direction	
D.	Vector quantity	Scalar quantity	

4. Why was *Homo neanderthalensis* recently reclassified as *Homo sapiens neanderthalensis*?

- A.** Absolute dating evidence showed modern and Neanderthal man existing at the same time
- B.** Recent fossil evidence showed more similarities between modern and Neanderthal man
- C.** Evidence of Neanderthal habitation was discovered in Europe
- D.** Both genomes provided evidence of interbreeding between modern and Neanderthal man

5. Why is the term organic food not used by the scientific community?

- A.** Organic is not a scientific term when used to describe food
- B.** More research on organic food is needed
- C.** There is a loss of nutrients during the processing of organic food
- D.** There is no clear international standard for organic food



For each question (6 to 8), answers must be written within the answer boxes provided.

- 6. The photograph shows a rocky area on the coast of the Hudson Bay in northern Canada, known as the Nuvvuagittuq greenstone belt. Analysed in 2001, these rocks are estimated to be 4.3×10^9 years old.



[Source: http://img.slate.com/features/badastronomy_archive/files/2008/09/oldestrocks.jpg]

- (a) State the age difference in years between Earth's formation 4.6×10^9 years ago and the Nuvvuagittuq greenstone belt rocks.

[1]

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- (b) Outline how rocks of this age can be dated.

[2]

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- (c) Explain why these early rocks are so rarely discovered.

[2]

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16EP04

7. Man's understanding of the elements and the structure of matter has changed from the early Greeks to the current time.

(a) Outline Dmitri Mendeleev's contribution to the periodic table of the elements. [2]

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(b) Compare and contrast early Greek and current understanding of the structure of matter. [3]

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16EP05

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16EP06

8. Golden Rice is a genetically modified variety of rice plant (*Oryza sativa*) that is able to synthesize beta-carotene, a precursor of vitamin A.

(a) (i) Suggest a reason for the importance of rice able to synthesize beta-carotene. [1]

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(ii) Discuss the use of scientific literacy in making an informed decision about the use of Golden Rice. [3]

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(b) Distinguish between nutrients and food additives. [1]

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Section B

Answer **all** questions. Write your answers in the boxes provided.

9. There are many species of land and marine iguanas on the Galapagos Islands. The pink land iguana (*Conolophus marthae*) is found only on Isabela Island in the Galapagos archipelago. The Galapagos Islands were the site of many of Charles Darwin's observations that led to the theory of evolution by natural selection.



[Source: https://upload.wikimedia.org/wikipedia/commons/f/f2/Iggy_pink.jpg]

- (a) Outline how the colour of the pink land iguana could have evolved by natural selection. [4]

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- (b) Identify the evidence for evolution used by Darwin. [2]

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16EP08

(Question 9 continued)

(c) Discuss the initial opposition to Darwin’s theory and the scientific arguments that gradually overcame this resistance.

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(d) Identify additional evidence that can be provided by modern scientific techniques showing the genetic relationship between Galapagos iguana species.

[1]

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(e) The eruption of Wolf Volcano on Isabela Island in 2015 has threatened the survival of the pink land iguana. Suggest what issues could be involved in the proposal to relocate pink land iguanas to another island.

[4]

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16EP09

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16EP10

10. The table shows the production cost of different energy sources used to produce electricity in 2009. The efficiency factor is the ratio of electrical energy produced, to the total energy used in the extraction, transportation, construction, production, distribution, use, maintenance and environmental regeneration associated with each energy source over its lifetime.

Source/form of energy	Production cost \$ MWh ⁻¹	Efficiency factor
Natural gas	66	0.38
Coal	95	0.29
Geothermal	102	5.14
Wind	97	11.64
Nuclear	114	2.90
Solar	211	2.07

[Adapted from: <http://blogs.wsj.com/numbers/what-is-the-most-efficient-source-of-electricity-1754/>]

(a) (i) State the efficiency factor of the energy source that has the lowest production cost.

[1]

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(ii) Coal and wind have similar production costs. Using data from the table, justify the use of one energy source over the other.

[1]

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(iii) List **two** possible stages in the production of geothermal energy that need to be considered in the calculation of its energy efficiency factor.

[2]

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16EP11

Turn over

(Question 10 continued)

(b) Outline the advantages and disadvantages of natural gas in producing electricity. [4]

Advantages:

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Disadvantages:

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(c) (i) State the isotope used as a nuclear fission reactor fuel. [1]

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(ii) Discuss the environmental and ethical issues in the use of nuclear energy. [4]

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(Question 10 continued)

- (d) Internal combustion engines rely mostly on fossil fuels. Suggest **two** developments that could promote the use of hybrid or electric cars.

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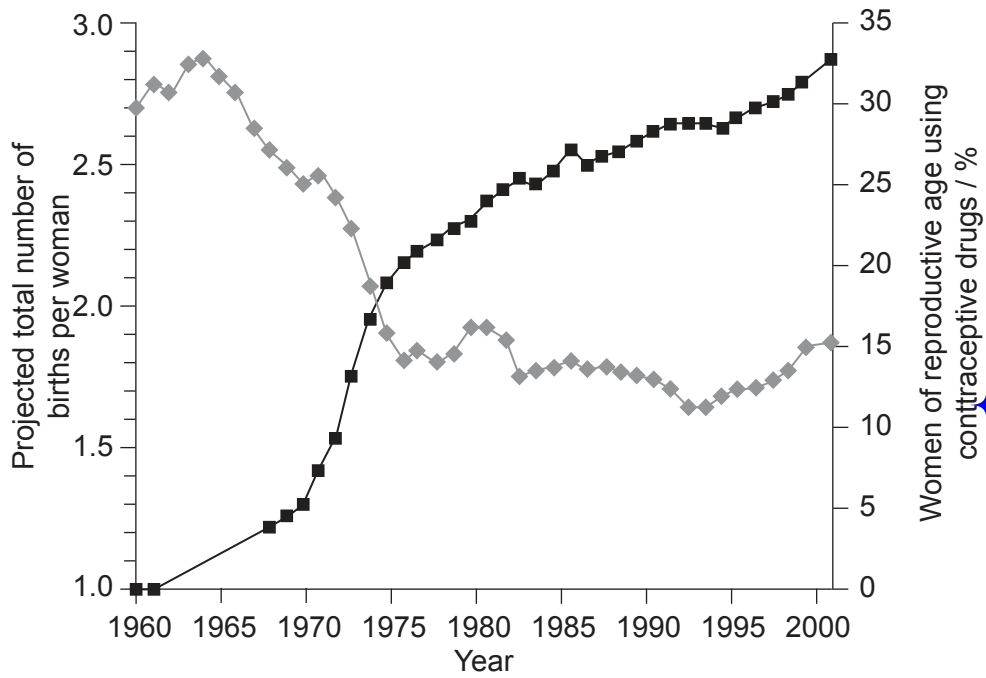
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16EP13

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11. The graph shows the percentage of French women of reproductive age using contraceptive drugs from 1960 to 2001 and the projected total number of births per woman.



Key:

- ◆ Projected total number of births per woman
- Use of contraceptive drugs

[Source: Henri Leridon 2006 Human Reproduction Update Vol 12 (5) p603–616]

- (a) (i) Describe the trend in the percentage of women of reproductive age using contraceptive drugs from 1960 to 2001.

[2]

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- (ii) Describe the trend in the projected total number of births per woman from 1960 to 2001.

[2]

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16EP14

(Question 11 continued)

- (b) Using the data, evaluate the hypothesis that the total number of births per woman decreases as contraceptive drug use increases. [2]

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- (c) Discuss the claim that there is a causal connection between total number of births per woman and contraceptive drug use. [2]

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- (d) Explain the process a female contraceptive drug should go through before it is available to the public. [3]

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16EP16