



International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

Nature of science

Standard level

Specimen papers 1 and 2

For first examinations in 2017

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**Nature of Science
Standard level
Paper 1**

SPECIMEN PAPER

Candidate session number

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1 hours 30 minutes

Instructions to candidates

- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: 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 **[40 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 is meant by work done?

- A. Work done is the transfer of energy
- B. Work done is the ability to lose energy
- C. Work done is given by force \times speed
- D. Work done is given by mass \times (speed of light)²

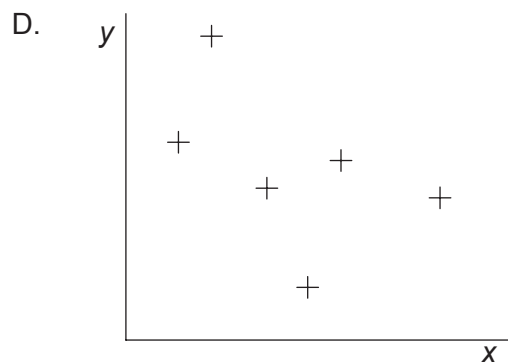
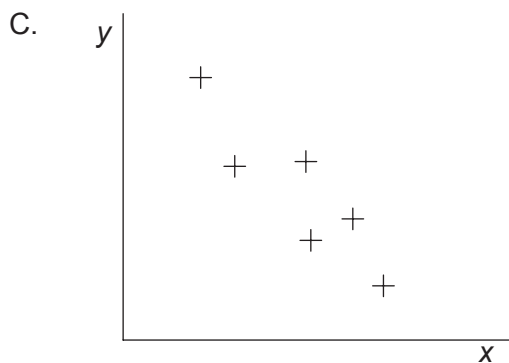
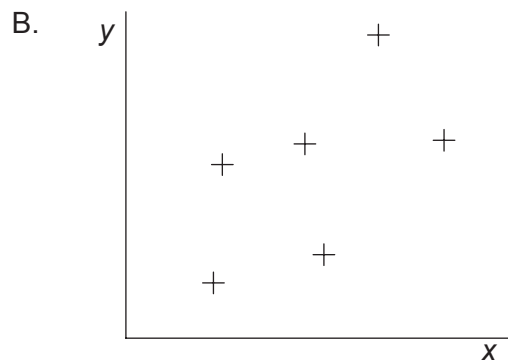
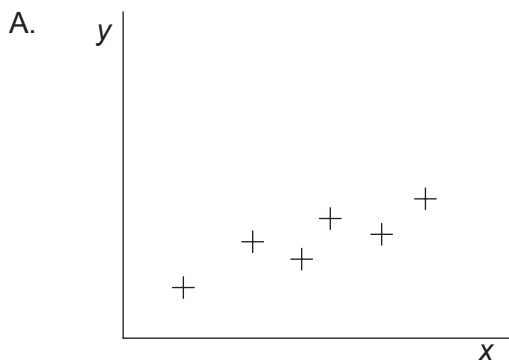
2. Paleomagnetism provided evidence for

- A. radioactivity.
- B. continental drift.
- C. natural selection.
- D. electromagnetic induction.

3. What is the relationship between kwashiorkor and iron?

- A. Causal
- B. Correlation
- C. Indirect
- D. None

4. Which graph shows a strong positive correlation between y and x ?



5. What characteristic of a star is classified by the Hertzsprung–Russell (H–R) diagram?
- A. Luminosity
 - B. Weight
 - C. Red-shift
 - D. Distance from the Sun

For questions 6 to 9, write your answers in the boxes provided.

6. Petrol (gasoline) and electrical energy are used as the fuels for a hybrid car. Discuss the possible effects that these fuels have on global warming when fuelling the car. [4]

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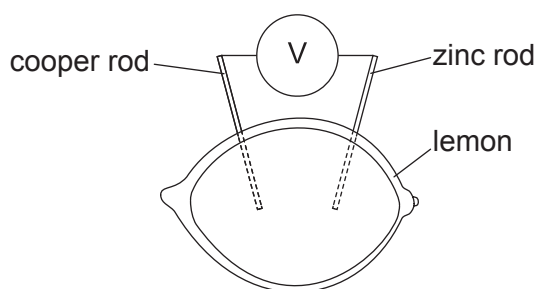
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7. A zinc rod and a copper rod are inserted into a lemon.



Metal	Standard electrode potential / V
magnesium	-2.37
zinc	-0.76
iron	-0.44
tin	-0.13
copper	0.34
silver	0.80

The voltmeter has a very high resistance.

(a) Estimate the potential difference between the zinc rod and the copper rod. [1]

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(b) List **three** factors required for an electrical cell to be sustainable and portable. [3]

1.
2.
3.

8. In telephone communication using optical technology the audio signal is transmitted along a glass fibre.

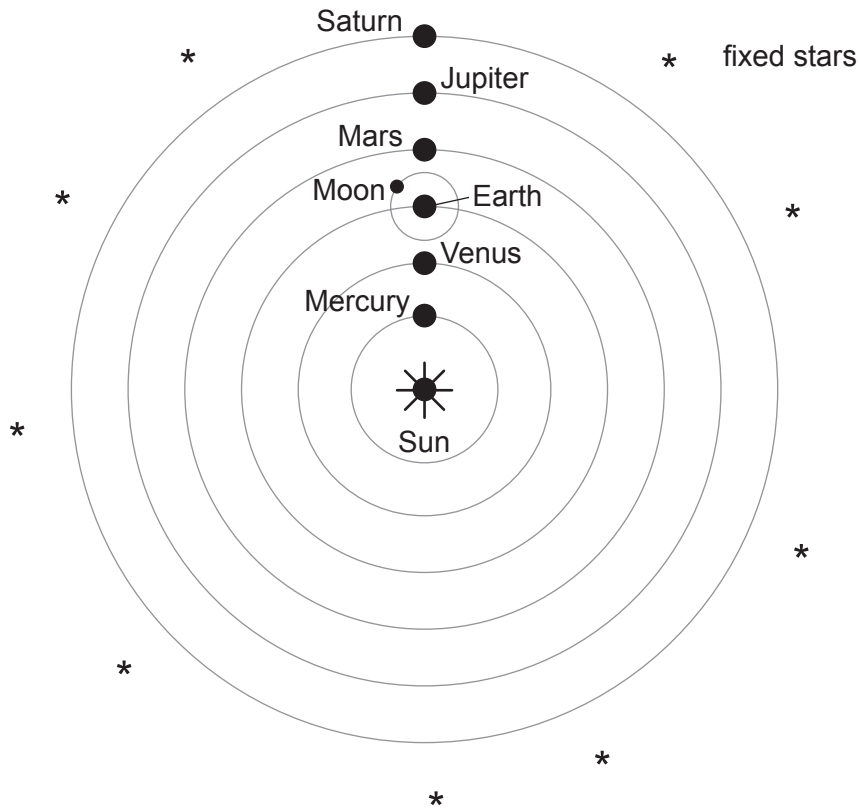
(a) Explain, with reference to bandwidth, why an optical fibre is better for the purposes of mass communication than a copper wire. [2]

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(b) Suggest **two** other benefits for society that would arise from a reduction in the amount of copper used in electrical wiring for communication purposes. [2]

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9. The diagram illustrates the understanding that Copernicus had of the solar system.



Our understanding underwent a paradigm shift from Ptolemy's understanding of the solar system as a result of the work of Copernicus and others.

(a) State what is meant by a paradigm shift in science. [1]

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(b) Describe how this model of the solar system differs from that of Ptolemy. [1]

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(c) State the technological advancement that helped to confirm the Copernicus model of the universe. [1]

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Please **do not** write on this page.

Answers written on this page
will not be marked.

Section B

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

$F = ma$	$E_p = mgh$	$E_k = \frac{1}{2}mv^2$
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10. An apple of mass 0.12 kg is attached to the branch of a tree.

- (a) (i) Estimate the force the branch exerts on the apple where $g = 9.8 \text{ m s}^{-2}$. [1]

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- (ii) Suggest why your answer to (a)(i) is an estimate. [1]

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- (b) (i) The apple falls to the ground from rest. The branch is 2.7 m above the ground. Determine the speed of the apple when it hits the ground. [3]

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- (ii) State **one** assumption you made when calculating your answer to (b)(i). [1]

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(This question continues on the following page)

(Question 10 continued)

(iii) Explain why scientists often make assumptions when developing a scientific model.

[2]

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(c) The calculations in (a) and (b) involved Newton's second law of motion and the law of conservation of energy.

(i) Outline what is meant by a scientific law.

[2]

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(ii) Newton's second law of motion is now known to be invalid for objects that travel at very high speed. Justify that it should retain its status as a law.

[2]

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11. (a) Miller and Urey were able to synthesize organic compounds from materials that were thought to be present in the early Earth environment.



[Source: <http://assets.coolhunting.com>]

- (i) Identify the hypothesis that Miller and Urey were testing. [1]

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- (ii) Outline why the evidence provided by Miller and Urey is not sufficient to establish a causal relationship. [2]

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(This question continues on the following page)

(Question 11 continued)

(b) Meteorites discovered on Earth are assumed to have been formed at the same time as the rest of the solar system.

(i) Describe the origin and composition of a meteorite. [2]

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(ii) State the evidence for the origin of life on Earth as provided by meteorites. [1]

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(This question continues on the following page)

(Question 11 continued)

- (c) A meteorite contains two lead isotopes lead-207 (Pb-207) and lead-208 (Pb-208). These are products from the radioactive decay of two uranium isotopes uranium-238 (U-238) and uranium-235 (U-235). The table gives other data for the decays. Both lead isotopes are stable once formed.

Decay	Approximate half-life / $\times 10^9$ year
U-235 \rightarrow Pb-207	0.70
U-238 \rightarrow Pb-208	4.5

- (i) Outline what is meant by radioactive decay. [2]

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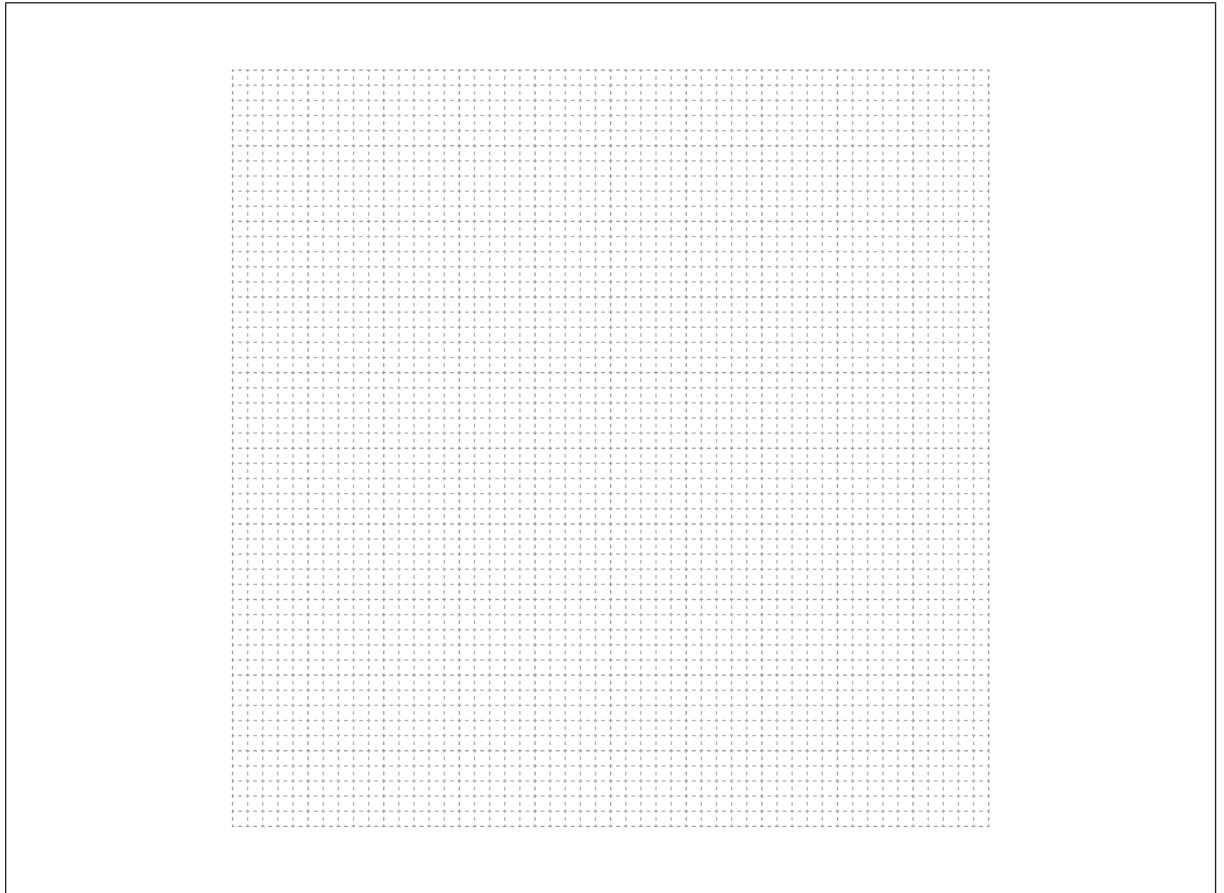
- (ii) Describe the difference between the nucleus of Pb-207 and the nucleus Pb-208. [1]

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(This question continues on the following page)

(Question 11 continued)

(iii) Sketch a graph to show the variation of the number of Pb-207 nuclei with time. [3]



(iv) Suggest why the ratio

$$\frac{\text{number of Pb-207 nuclei}}{\text{number of Pb-208 nuclei}}$$

in a sample of a meteorite changes with time. [2]

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(Question 11 continued)

- (d) This question has dealt with the work of Miller and Urey, meteorite research, and radioactive dating. Discuss the funding issues for this type of fundamental research. [2]

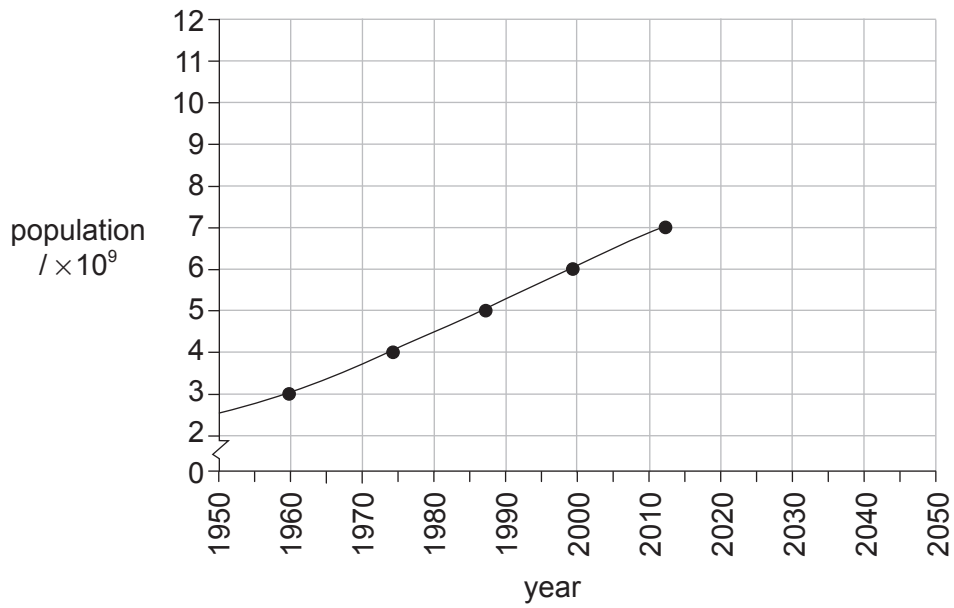
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12. The graph shows the variation in world population from 1950 to present.



[Source: adapted from US Census Bureau, International Data Base, (2011)]

(a) Calculate the percentage change in population between 1950 and 2000. [1]

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(b) (i) Predict the world population in 2050. [1]

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(ii) Suggest **two** possible reasons for uncertainty in this prediction. [2]

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(This question continues on the following page)

(Question 12 continued)

- (c) Increased resources are needed for a growing global population. Outline **three** challenges in providing sufficient food for this population. [3]

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- (d) State and discuss the use of **one** technology that can lead to an increase in food production. [3]

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- (e) Discuss the advantages of a Food Miles programme. [2]

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**Nature of Science
Standard level
Paper 2**

SPECIMEN PAPER

Candidate session number

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1 hour

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
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- The maximum mark for this examination paper is **[30 marks]**.

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

1. The males of species of *Dynastinae* (Rhinoceros beetle) use the long projections on their heads to fight other male beetles. Computer modelling of the mechanics showed that the projections are more effective against members of their own species than against other species of Rhinoceros beetle.



[Source: www.thaiguide-to-thailand.com]

- (a) Describe how computer modelling can help scientists to study beetle behaviour.

[3]

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(This question continues on the following page)

(Question 1 continued)

- (b) One hypothesis states that fighting strategies led to the varied head projections of Rhinoceros beetles. Discuss this hypothesis with reference to the theory of natural selection. [3]

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- (c) Computer modelling is also used in weather forecasting. Explain how computers have improved weather forecasts. [3]

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2. Outbreaks of influenza can quickly spread around the world.

(a) (i) State the role of epidemiologists. [1]

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(ii) Describe how social media can be used to study a pandemic. [2]

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(b) Discuss how viral diseases can become pandemics. [3]

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(This question continues on the following page)

(Question 2 continued)

(c) In treating viral outbreaks, experimental drugs that have not been tested on humans are sometimes available.

(i) Discuss the ethical issues of using experimental drugs with infected patients. [2]

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(ii) Outline the problems of using experimental drugs with infected patients. [3]

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3. Some areas in a field where cows graze contain plants that are larger than plants in other areas of this field. Scientists suggest that the cow's urine influences plant growth. Urine is converted to nitrates by soil bacteria.

(a) (i) State a possible hypothesis based on this suggestion. [1]

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(ii) Suggest a prediction based on this hypothesis. [1]

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(b) For your hypothesis state

(i) an independent variable. [1]

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(ii) a dependent variable. [1]

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(This question continues on the following page)

(Question 3 continued)

- (c) State **two** controlled variables that may affect the growth rate of the plants. [2]

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- (d) An investigation was carried out to see the effect of cow's urine on plant growth. Describe how *post hoc ergo propter hoc* biases could affect the interpretation of the investigation. [2]

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- (e) One of the scientists states without further evidence that horse urine would have the same effect on plant growth. Explain which type of bias this statement represents. [2]

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4. A survey claimed that wearing a bracelet that applies pressure to the inner wrist prevents motion sickness during a rollercoaster ride. The table shows data collected from 15 participants.



[Source: www.patchofpuddles.co.uk]

Participants	Degree of nausea on the scale of 1 to 5 (1 is low — 5 is severe)
1	1
2	2
3	1
4	3
5	4
6	1
7	1
8	3
9	5
10	2
11	3
12	1
13	1
14	2
15	2

(This question continues on the following page)

(Question 4 continued)

- (a) (i) Calculate the mean degree of nausea. [1]

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- (ii) Justify the number of significant figures to which you expressed your answer. [1]

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- (b) State the type of data shown in the table. [1]

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(This question continues on the following page)

(Question 4 continued)

(c) A report on this survey was rejected by a peer-reviewed scientific journal.

(i) Outline what is meant by peer review. [2]

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(ii) Justify the decision of the journal to reject the report. [4]

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(d) (i) Outline the protocol for a double blind test. [2]

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(ii) Identify a reason why this survey cannot be a double blind test. [1]

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(This question continues on the following page)

(Question 4 continued)

- (e) The survey was funded by a company that manufactures the motion sickness bracelet. Comment on the validity of the results of the survey.

[1]

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- (f) The survey was improved and a strong correlation between wearing the bracelet and motion sickness was established. Discuss the validity of the claim that wearing the bracelet prevents motion sickness.

[2]

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will not be marked.