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NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Scholarship 2008
Science

9.30 am Friday 21 November 2008
Time allowed: Three hours
Total marks: 48

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

Each question is worth 8 marks.

Write all your answers in this booklet.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–18 in the correct order and that none of these pages is blank.

You are advised to spend approximately 30 minutes on each question.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

You have three hours to complete this examination.

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QUESTION ONE: RADIOACTIVE WASTE

Any activity that produces or uses radioactive materials generates radioactive waste. The main types of waste are:

- low-level waste, which is typically generated from hospitals, laboratories and industry. It includes items such as paper, rags, tools, clothing, and filters. These contain small amounts of radioactivity with short half-lives.
- high-level waste, which includes sources such as waste fuel from nuclear reactors and material from decommissioned weapons. It contains higher amounts of radioactivity with long half-lives, and generates a lot of heat.

Radioactive waste can be managed by a range of methods which can be summarised as:

- containing and burying
- diluting and dispersing
- delaying and decaying.

Discuss fully the disposal of both low-level and high-level radioactive waste considering:

- the need to dispose of radioactive waste effectively
- the particular method of disposal.

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QUESTION TWO: WATER TURBIDITY

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The Secchi disc is widely used to determine the depth of light penetration in lakes. The disc is fastened to a rope marked in metres, which is lowered into the water, and the depth at which the disc is lost to sight is recorded. This gives a measure of water clarity, by indicating the amount of suspended solids (turbidity) in the water. Very little light penetrates beyond 150 metres, even when the water is very clear.

Secchi disc readings do not provide an exact measure of transparency, but are an inexpensive and straightforward method of measuring water clarity. Because of the potential for variation between different users and different times of use, there needs to be rigorous control of variables when using a Secchi disc.

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http://www.scn.org/savelake/NL.Spr.Sum.2006/NL.Spr.Sum.2006_files/Secchi_disk.jpg

A group of students has decided to measure water turbidity in a typical lake over a period of time.

Discuss how variables will be rigorously controlled to ensure the results collected are valid and reliable.

Justify your answer by discussing:

- how suspended solids, time of day, and weather would affect light penetration
- relevant properties of light, such as reflection and refraction.

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QUESTION THREE: SOUNDS IN SPACE

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Very few recordings have been made of the sounds on moons or planets in the Solar System, other than Earth, mainly because acoustic instruments have not often been included on space probes. However, such instruments have the potential to provide a wealth of information. Space is not completely empty and sensitive instruments will detect sounds.

The Moon

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ttp://www.spacetoday.org/images/Moon/Moon1969nasaReddish.jpg

Io

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http://upload.wikimedia.org/wikipedia/commons/thumb/7/7b/Io_highest_resolution_true_color.jpg/600px-Io_highest_resolution_true_color.jpg

Europa

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http://www.wwu.edu/depts/skywise/planets/europa.jpg

Three moons in the Solar System – the Moon, Io and Europa – are similar in size and have thin atmospheres. None of these appears to have a molten core.

The Moon is influenced by the Earth's gravitational field and has a dry, rigid crust, which has many moonquakes. The Moon takes 27.3 days to orbit the Earth.

Io and Europa are both influenced by Jupiter's gravitational field. Io has active volcanoes caused by huge tidal bulges in its solid crust. The bulges move as Io orbits Jupiter, once every 1.8 days. Europa has an icy surface, about three kilometres deep, with cracks that form and then disappear. Europa may have liquid water below the ice. Europa takes 3.5 days to orbit Jupiter.

Justify the use of acoustic instruments to gain information about planets and moons in our Solar System. Include in your answer consideration of:

- the main processes that would cause sounds on each moon
- how the different crusts of these moons might affect the transmission of sound
- how the transmission of sound might be determined with acoustic instruments.

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QUESTION FOUR: THE KERMADEC AREA

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The Kermadec area consists of three main parts:

- the Kermadec Trench, which drops to more than 10 000 metres below the ocean's surface
- the Kermadec Ridge, which rises up to 1 000 metres below the ocean's surface
- a line of mainly submerged volcanic cones parallel to the ridge.

The ocean floor is covered with sediment made up of mud, sand and gravel which has come from land, air and sea.

Discuss fully how the Kermadec Trench, Ridge and line of volcanoes may have formed. Consider in your answer:

- the relative densities of the Australian and Pacific plates, and the angle of subduction
- the reason for the great depth of the trench and the height of the ridge
- why the Kermadec volcanoes run parallel to the ridge and trench
- the role and influence of sediment.

Diagrams may assist your answer.

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http://fieldgeology.massey.ac.nz/images/NIWA-bathymetry-low.jpg

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QUESTION FIVE: GOLDEN RICE

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One use of genetic engineering is to produce food that addresses nutritional needs. For example, rice is a staple food for much of the world's population, but is highly deficient in Vitamin A, a deficiency which can lead to blindness in children.

Golden rice is a variety of rice that has been modified by genetic engineering to produce beta-carotene in rice grains. The human body converts beta-carotene to Vitamin A. A typical serving of rice could provide at least half of the daily requirement for a child. The rice is yellowish in colour and has two genes, one from maize and one from bacteria, added to the rice genome.

At the moment this rice is not grown commercially. There will be no fee for its humanitarian use and farmers will be permitted to keep and replant seed. However, the use of golden rice is controversial.

Discuss fully the scientific and ethical issues involved in the production and use of golden rice. Consider in your answer investigations that would need to be carried out to determine if this product would be safe and effective.

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QUESTION SIX: POLYTHENE

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Polythene is a plastic made from polymer chains of thousands of ethene monomers. By controlling the length and amount of branching of the polymer chains, plastics with different properties can be made. There are two common types of polythene:

- High density polythene (HDPE), which has long straight polymer chains with minimal branching. HDPE is relatively strong and dense, and is used to make plastic toys and rubbish bins.
- Low density polythene (LDPE) has branched polymer chains. LDPE is lighter and more flexible, and is used to make plastic bags, plastic wrap, and squeeze bottles. LDPE has a lower melting point than HDPE.

(a) Compare the relative density, strength and flexibility of HDPE and LDPE with reference to the length and branching of the polymer chains. Diagrams may assist your answer.

(b) Products such as artificial ice for skating rinks, replacement joints, and bullet-proof vests, can be made from a high grade HDPE that has particularly long polymer chains.

For at least one of these products, discuss how the length of the polymer chains gives properties essential to the product's use.

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Question Six continues on the following page.

(c) Another type of polythene, called PEX, contains covalently bonded cross links between the polymer chains, which gives this polythene elastic properties and a higher melting point than HDPE or LDPE. PEX is commonly used in plumbing and can withstand high water temperatures.

Discuss how cross links between the polymer chains give this polythene elastic properties and a high melting point.

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Extra paper for continuation of answers if required.
Clearly number the question.

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Question number	

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Question Number	Marks
ONE	(8)
TWO	(8)
THREE	(8)
FOUR	(8)
FIVE	(8)
SIX	(8)
TOTAL	(48)