NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Scholarship, 2004

Science (93104)

National Statistics

Assessment Report

Assessment Schedule

Science, Scholarship, 2004

General Comments

This was the first year that this exam had been offered. Candidates needed to make sure that they understood what was required by careful reading of the standard. Candidates needed to have a thorough grounding in all the skills and knowledge required by the explanatory notes of the standard. An outstanding knowledge of content was needed to tackle challenging integrated contexts. The ability to critically analyse data as well as passages was required, and should have been shown in the answers.

Good literacy skills were also required. Candidates at this level need to expect passages at a 17–18 year old reading level. They need to take time to read passages carefully, noting key points, and to realise that passages are very carefully worded so that everything within them is important. They also need to be able to pace themselves so that the last question gets as much attention as the first.

Successful candidates were able to write clear paragraphs that developed and articulated ideas. They were able to make deductions, and apply, integrate and synthesise knowledge. They showed evidence of critical thinking and at times integrated knowledge that was relevant and enhanced the answer, even though it was not asked for by the question.

Science Scholarship 93104

National Statistics

Number of Results	Percentage		
	Not Achieved	Scholarship	Outstanding
41	90.2%	9.8%	0.0%

Assessment Report

Candidates awarded Scholarship showed that they had an excellent grounding in the subject across the curriculum, and that they had studied all the parts of the curriculum as indicated by the explanatory notes in the standard. They exhibited an understanding of the skills required in effective experimentation, and in analysing scientific controversies.

These candidates also showed an ability to read and understand the contexts of the questions and were able to effectively express themselves in their answers. Their answers showed analysis and evaluation as required by the question. Successful candidates demonstrated these skills, while less successful candidates often just re-stated the passages in their own words.

Successful candidates were also able to interpret data presented in challenging ways, such as the graph in Question Two (b) and the tables in Question Four. They could also integrate knowledge from wider reading or studying to enhance answers.

The geology questions, Question Three (b) and (c), were not well done. It seemed to indicate that many candidates had not prepared well for this topic. Successful candidates had outstanding understanding of all the content required by the explanatory notes of the standard.

Question Four was not well done overall, but candidates doing well in this question compared and analysed the data and integrated this into their answer.

Assessment Schedule

Scholarship Science (93104)

Evidence Statement

Question	Scholarship Critically analyse integrated contexts using the knowledge and methodology of Science.	Outstanding scholarship Scholarship plus consistently demonstrate perception in the critical analysis of integrated contexts.
1(a)	Be-10 and C-14 have very different half-lives, so there will be a difference in ranges. C-14 is used for the shorter cycles as it has a shorter half life and is only useful for up to 10 000 years. Be-10 has a very long half-life so can be used to determine the longer cycles of sunspot activity. Easier to get tree rings than ice cores and tree rings have a greater geographical coverage. However, tree rings do not go back very far in age. Must get a good range and number of samples of both. Ice cores to any great depth only can be got in the higher latitudes. The results need to be cross checked with each other where possible, and with other samples.	Scholarship plus: The levels of Be-10 and C-14 are related to sunspot activity as when the Sun is magnetically active, less of these isotopes are produced as more cosmic rays are deflected. Be-10 levels in ice cores and C-14 levels in tree rings can be used to cross check each other and to compare with sunspot levels. Tree rings can be found in many different geographical places so that C-14 results can be checked against other tree ring samples. Tree rings and ice cores offer a resolution of 1 year and can give absolute results. Cross checking is necessary for scientific rigour. C-14 easily cross correlated with sunspot observations and Be-10 measurements. Then by studying the Be-10 measurements back assumptions can be made about sunspot levels. Evidence of critical thinking, eg Be-10 in terrestrial minerals can affect results, samples must taken from areas undisturbed by tectonic plate activity, melting of ice in warm periods produces inaccuracies.
1(b)	• Accurate correlation between increased sunspot activity and increased temperature. • Comment on climate, possibly incorporating general knowledge about climate change, eg increased temperature is causing global warming, sea level rises, ice caps melting, loss of communities such as Pacific islands.	• Accurate correlation between increased sunspot activity, increased temperature, decreased C-14/Be-10 levels and reduced mean average cloud cover. Must show use of data from the graph. • As sunspot numbers increase, mean temperatures increase. This could enhance already increased temperature from global warming/CO_2 levels. • The general magnetic activity of the Sun appears to be increasing which may mean that the Earth is in a warm long term cycle. • Further implications for climate change, eg ice melting, sea level rises, ecological changes.

Question	Scholarship Critically analyse integrated contexts using the knowledge and methodology of Science.	Outstanding scholarship Scholarship plus consistently demonstrate perception in the critical analysis of integrated contexts.
2(a)	Discussion of detergent/oil polarities, hydrophilic (polar) and hydrophobic (non-polar) ends of detergents, non-polar property of oil. The oil becomes broken into small droplets called micelles, which become suspended below the surface of the water. Must use detergents that effectively work in sea water. Must show a good understanding of the formation of a micelle.	Gives a reasoned argument as to the type of detergent, probably non-ionic. Non-ionic doesn't produce a lather, anionic will react with metal ions in the sea water. Biodegradable detergents should be used. Weak intermolecular forces between the oil (hydrocarbon) chains are broken which aid in dispersal.
2(b)	Factors identified include the need for: • enough data to be collected for validity, reliability and sufficiency • determination of the factors that must be controlled such as added nutrients, temperature, incubation conditions, water composition • test one type of bacteria at a time • measure the time taken for the crude oil to be broken down or the amount broken down.	Scholarship plus mention of the need to separate out the different bacteria to use by using seawater from a crude oil polluted marine source, refining of sample to get a single species eg with antibiotics, temperature, nutrients. Toxicity of end products needs to be determined.
2(c)	• GE bacteria could contain genes to specifically target toxins. • Could have a bank of such bacteria storing bacteria specific for certain toxins. • The GE bacteria and naturally occurring bacteria could be mass produced and seeded on environmental waste. • Naturally occurring bacteria already there, with the necessary genes and enzymes. • Transgene could be passed onto naturally occurring bacteria, • The risk is always there that the GE bacteria may be in competition with naturally occurring bacteria. • GE bacteria may upset a finely tuned balance, this balance already upset by the oil, so need to get it cleaned up as quickly as possible.	• GE bacteria could widen the range of areas/ toxins covered. • Some environmental toxins esp artificially made ones may not have naturally occurring bacteria that can break them down. • Oil spills may select for naturally occurring bacteria with the necessary genes. • GE bacteria potentially covered by patents, natural ones not. • Environment is used to breakdown products of natural bacteria, GE ones may produce an unfavourable breakdown product. • An ethical consideration is whether the damage from the oil spill far outweighs any potential damage from the GE bacteria. A conclusion with a valid justified stand that must show understanding of all four bullet points. Eg the candidate may conclude that genetically-engineered bacteria are justified if laboratory trials or sampling show that there are no naturally-occurring bacteria in the environment breaking down the pollutant(s) or are only breaking down the pollutant(s) very slowly. The use would have to be justified by thorough lab trialling and risk management, which would involve ongoing monitoring. The breakdown product(s) would need to be predetermined and judged safe in the environment. If this technology proved successful, consideration should be given to **not** preventing use by restrictive patents.

Question	Scholarship Critically analyse integrated contexts using the knowledge and methodology of Science.	Outstanding scholarship Scholarship plus consistently demonstrate perception in the critical analysis of integrated contexts.
3(a)	Good discussion of the effect on the returning beam of: • the angle the beams are transmitted at • interaction at the seafloor • rock types on the sea floor • scattering from fish and / or sea mammals. Depth is measured from the echo time, rather than the strength of the signal. The time may be affected by: • currents • change in water density due to varying salinity • temperature variations within the sea water. Answer shows good understanding, mentioning some but not necessarily all the factors mentioned above.	Answer shows good understanding of the effect of the angle of the sonar and mentions many of the factors listed for scholarship. Evidence of critical thinking – eg the need for calibration, using known terrain.
3(b)	Oceanic subducting under continental: forms a line of volcanoes generally on land, continental crust more buoyant than oceanic but edge may still be pulled down to form a relatively shallow trench, volcanoes may be from magma from the mantle, or from the melting of the continental crust or a combination of both, andesite and / or rhyolite volcanoes. Oceanic subducting under oceanic: forms a volcanic arc, offshore oceanic trench which is often very deep, volcanoes made of basalt or andesite, the two dense oceanic plates drag each other down forming a very deep trench. Must show good understanding of the relationship between the type of crust, viscosity of magma, type of rock, type of volcano.	
3(c)	Dacite is a silica rich rock so possible explanations are: • the silica rich sediment on top of the subducting plate is being melted • the melted silica poor, denser magma sinks to the bottom of the magma chamber so that the less dense silica rich magma is at the top and therefore erupted • there may be remnants of the continental crust left over from when NZ was formed off the coast of Gondwanaland. Calderas are being formed because • the magma chambers when emptied after an eruption are large enough to mean that the roof collapses to form a caldera • the sea water meeting the magma means that the eruptions are especially violent, emptying the magma chamber and causing the roof to collapse forming a caldera. Answer may go through how a caldera is formed but there must be at least one valid point as to <u>why</u> there are calderas and dacite erupts.	Discussion shows a good understanding which comes through in the discussion of why these calderas and the dacite rock has formed.

Question	Scholarship Critically analyse integrated contexts using the knowledge and methodology of Science.	Outstanding scholarship Scholarship plus consistently demonstrate perception in the critical analysis of integrated contexts.
4(a)	Must not simply restate one table or statement. Must show integration of the information, using data from the tables. For example: Category I: The risk from these additional X-rays is very small and is equivalent to less than 2 weeks' natural background radiation. C IIb The risk from these additional X-rays is low and is equivalent to 1 year's natural background radiation. It is less than the annual risk of death from any cause when aged 40. C I and C IIb These could be used in research with very little additional risk. C III: The risk from these additional X-rays is equivalent to the annual dose limit for radiation workers and is similar to the annual risk of death from any cause when aged 40. If the patient is part of a trial of an experimental treatment in patients who are terminally ill then the additional radiation risk is of no consequence given the circumstances of their illness.	When the risk is trivial, for example, it is acceptable to use an X-ray in research just to find out something new. In Category III, where there is a moderate risk and repeated exposures may lead to an unacceptable risk, the use of an X-ray examination should lead to direct patient benefit before it can be justified. A CT scan, for example, just to show how much the tumour has shrunk in the trial of a new chemotherapy drug may not be justified unless it changes patient management. Excellent integration of information, with good use of data to support the argument. Must relate to safety levels **and** research.

Judgement Statement

Scholarship: 7 out of 9 scholarship criteria

$7 \times S$

Outstanding: 3 outstanding criteria and at least 4 scholarship criteria

$4 \times S + 3 \times O$