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2008 National Qualifying Exam – Biology
Solutions

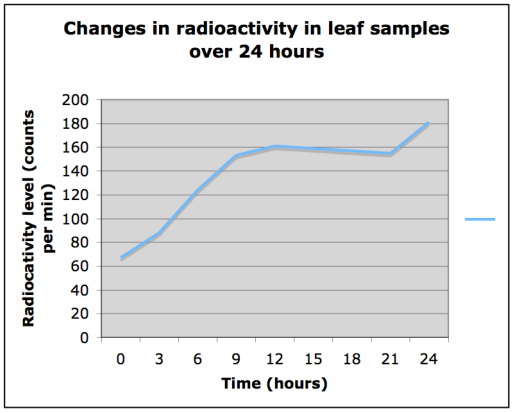
Section A & B (Multiple Choice)

Question	Answer	Question	Answer	Question	Answer	Question	Answer
Q1	C	Q18	A	Q35	C	Q52	97
Q2	A	Q19	A	Q36	A	Q53	25
Q3	B	Q20	D	Q37	D	Q54	A and C
Q4	A	Q21	D	Q38	A	Q55	F
Q5	A	Q22	A	Q39	E	Q56	T
Q6	A	Q23	B	Q40	C	Q57	F
Q7	C	Q24	A	Q41	D	Q58	F
Q8	B	Q25	D	Q42	B	Q59	T
Q9	C	Q26	D	Q43	B	Q60	F
Q10	A	Q27	B	Q44	D	Q61	F
Q11	B	Q28	C	Q45	A	Q62	T
Q12	A	Q29	D	Q46	D	Q63	0.25
Q13	D	Q30	D	Q47	A	Q64	0.25
Q14	C	Q31	B	Q48	50		
Q15	A	Q32	D	Q49	85		
Q16	E	Q33	C	Q50	2.25kg		
Q17	A	Q34	E	Q51	16		

Section C

We will always set a graphing question and expect students to determine the most appropriate format, size and choice (bar, line etc) of graph. Too few students write an appropriate title: radioactivity vs time is not a meaningful title. The title should reflect the content of the graph properly, describing the relationship between the variables.

65. a). Marks are awarded for title, correct orientation of axes, labelling of axes with units, scale, plotting and drawing a line graph. Mean score for the whole question: 7.9



b). Approx 12-21. Allow 10-22

c). Describe (1) level of radioactivity increases at first, levels off for about 12 hours, then rises again.

Explain (2) relate the increased levels of radioactivity to periods of carbon fixation and photosynthesis: the levelling off, slight decrease to periods of no photosynthesis, even some loss as a result of respiration.

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d). Drawn (1) and labelled (1) on the graph: we expect to see no rise in radioactivity in this sample from the same starting point.

e). This was most creatively answered and suggests that students are not well informed about the nature of radioactivity: some of the following were common responses: it will dissipate on its way to the leaf; radioactivity is left behind in the soil; the Caspian strip will stop it coming into the plant; insufficient carbon dioxide / sunlight / temperature humidity; oxygen is not required by the plant in any form; radioactivity is taken up by roots and not by the leaves; oxygen was already in the plant so it didn't take up any radioactive oxygen;

Examiners were looking for a response to the information (data) given. We are not expecting students to be well versed in the complexities of biochemistry: we want to test understanding and reasoning. This question does that well: it was weighted for marks for suggesting that water is split (2) during photosynthesis and the oxygen is released (2) as a waste product.

We prefer to test reasoning and understanding rather than knowledge directly and this is a trend reflected in the International Biology Olympiad.
f. Marks were awarded for layout and labelling of the graph, which asks students to process data: this is not beyond students in year 10. Graphing seems to be an issue for many students and we would encourage some direct teaching about the principles of graphing. For a user-friendly guide to graphing, look at:
http://www.lmpc.edu.au/resources/Science/research_projects/graphs/graphs.htm.nsw.edu.au

g). We would expect to see some of the following: the mass produced to increase in the absence of *Rhizobium* when fertiliser is added and that when there is no *Rhizobium* present that adding fertiliser will result in increased mass of plant produced. In future we will increase the mark allocation for these types of questions in part f and g and expect to tease more out of the data.

It was surprising how many students wrote about radioactivity in the Rhizobium infected plants.

66. The answer booklet and the question paper were not set out to help or mislead students and we regret any confusion because of the structuring of the answer booklet. Examiners awarded marks for answers in any order in part a. to minimise effects of any confusion. Mean score: 4.3

- **a.** active: 24 days, passive 6 days. We allowed 1 day either side for 0.5 mark each.
- **b.** Passive after 45 days: this is a graph reading skill
- **c.** Compare means you need to refer to both active and passive in your answer: you can get full marks from looking carefully at the data in the graph. Students should be encouraged to develop this thinking skill.

  Passive is fast acting compared to active; passive lasts a short time, whereas active lasts longer and is safer for longer or words to that effect.

No prior knowledge of immune response was required. There were some elaborate responses to include antibiotics, antibodies (seems to be a commonly held misconception that the 2 are almost the same thing) secondary immune response, helper T cells, etc. This is knowledge that we would not expect year 11 students to have.

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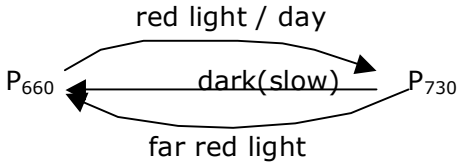
67. a). Students should be able to draw a simple flow chart given the information presented such as:



b). short day (1) night must be long enough or no flowering when short nights (1) P_{730} has to drop below a critical level (1)

This question tests reasoning and logic and demands no prior knowledge. Mean score: 2.25

68. Environmental issues such as the ozone hole and global warming are covered in lower school science lessons across Australia. Tabulating information / data should be within students abilities.

An ideal student response would be tabulated such as:

Causes	Effects
Ozone depletion results from chemical reactions high in the upper atmosphere such as CFCs used in the manufacture of coolants whereas global warming (or the enhanced greenhouse effect) results from excess carbon compounds such as methane, carbon dioxide being released in the atmosphere. Largely due to industrialisation, combustion of fossil fuel, cattle farming, waste products cause heat to be 're-radiated' back to the earth.	Increase in uv rays which allow increases in mutation / DNA damage / eg. skin cancer whereas global warming results in widespread environmental changes such as polar ice caps melting / sea temperatures / floods / droughts etc

Examiners gave credit where due. The concepts were not well understood, with a mean score of 1.7.

We expected a comparison to be made and factually correct responses to be described. We were challenged by some students to verify the claims made (and did so) and we will continue in the future to examine closely all student responses.

It was very disappointing that so many students are not well schooled in these issues, particularly given the topical debate on the environment and the urgency to promote scientific literacy in science lessons.

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69. We expect the level of the scale to rise, though the mass of the water would stay the same. Look to Archimedes for an explanation.

In summary:
We expect students to be able to demonstrate the facility to list, identify, perform simple numerical calculations, etc. through to more cognitively demanding tasks such as explain, compare and evaluate. Some guided preparation for students might be appropriate so they become accustomed to thinking about and responding to a variety of questions.

We will test directly knowledge that is specified by the curriculum bodies. This will include simple Mendelian genetics (which should be covered by all students in year 10), scientific processes and skills, environmental issues, nomenclature of biological organisms, simple calculations and comprehension of lower school science topics, many at considerable depth.

The genetics questions in the multiple choice part of the paper (32 [mean of 0.47] and 35 [mean of 0.86] suggests reasonable grasp of genetics and the performance in questions 60-64 was highly variable.

There will inevitably be questions on topics that teachers and students may not have covered in school lessons but the range of marks on this paper (less than 10% to 92%) suggests that many students are very well equipped with strong biological knowledge and the confidence to tackle difficult questions. At the other end of the scale, many other students experience a challenging paper for which they seem unprepared.

We strongly discourage students in year 9 from entering and would discourage entering whole classes. The NQEs are aimed at the most able science students in Australia, and should not be regarded as an opportunity to grade a whole class of students. We recommend that only the most able students in the school attempt the NQE for marking: once the paper has been marked, schools are free to use this and our suggested answers in school for class teaching purposes.

The evidence of collusion (identical scripts) in some papers from some schools suggests that some care needs to be taken when supervising students to maintain the integrity of the paper and competition.

We welcome suggestions, your input and feedback from teachers. We are always keen to have new question writers and teacher input to devise fair, challenging and testing NQE papers. We owe teachers a huge debt of thanks in managing the process at school level: in identifying students who can benefit from the challenge of the NQE and in supervising and supporting those most able in our schools.