Integrated Science

Report on Student Performance in the Practice Papers

The practice papers were piloted in seven schools with more than 70 students participating in the pilot exercise. Despite the sample size being a little small; students' performance in this exercise should still reflect some weaknesses of students. Readers are advised to study this report together with the selected samples of student performance so that they can gain a better understanding of the high, mid and low performance levels of students in this pilot exercise.

Paper 1

Paper 1 consists of 9 questions set on the compulsory modules C1 to C8 of the curriculum. All questions were compulsory. The mean percentage score was 36.7, and the standard deviation was 14.0. The students' performance is summarised in the table below:

Question Number	Performance in General
1. (a)	Students' performance was good in parts (i) and (iii). They demonstrated an understanding of the attraction between water molecules and were able to explain why the low density of ice is important to the survival of aquatic organisms. However, students were unable to explain the low density of ice with reference to its 'open structure' and performed quite poorly in part (ii).
(b)	Most students performed well in part (i). In part (ii) (1), a lot of students were able to calculate the energy required correctly. However, many of them did not realise from the calculation that a large amount of energy has to be consumed in the vaporisation of water. Hence, they were not able to point out specifically in part (2) that the high cost of distilling seawater is due to the high latent heat of vaporisation of water. Most students gave a correct source of pollution in part (iii). However, some methods suggested were too general and some were not practical.
2. (a)	Performance was satisfactory. A few students did not use the value calculated to judge whether the driver was speeding.
(b)	Poor performance. Some students wrongly regarded the response of the driver as a reflex action. Many students failed to address the role of the cerebrum in interpreting impulses for sensation and its role in coordinating the response by sending impulses to the relevant effectors. Some did not use proper scientific terms in answering the question (e.g. using 'signals' to refer to 'impulses'), and some wrongly regarded the eyes as the 'receptor'. Few students were able to give their answers in an organised way.
(c)	Performance was fair. Many students did not show an understanding of the meaning of the area under a *v*-*t* graph and failed to calculate the distance. However, a few students were able to read from the graph the required parameters and calculate the distance using a formula of linear motion.
(d)	Fair performance. Some students wrongly gave 'synapse' or 'neurone' in part (i) as the part of the central nervous system that alcohol would affect. In part (ii), while most students were able to draw a graph that indicated a longer reaction time, some failed to indicate a smaller deceleration using a graph with a smaller slope.
3. (a)	Various mistakes were found in students' drawing of the electron diagram in part (i), e.g. not indicating the number of charges of each ion or not stating the number of each type of ion present in the compound. Though many students realised that stability is achieved when a noble gas electron arrangement is attained, they were unable to attribute the attaining of a noble gas electron arrangement to the transfer of electrons from aluminium to oxygen.

3. (a)	Students' performance was good in part (ii)(1), showing that students have a good understanding of how elements are arranged in the periodic table. However, many students failed to apply their knowledge of the properties of elements in a specific Group in putting down a balanced ionic half in part (2). The performance was fair in this part. Most students showed an understanding of the fact that the relative atomic mass of an element is related to the presence of isotopes. However, quite a number of them did not take the relative abundance of the isotopes into account in their answers.
(b)	Students showed they understood the attraction between carbon dioxide molecules and their performance was good in part (ii). However, students generally were unable to relate the non-polar nature of carbon dioxide to the cancelling of dipoles resulting from the C=O bonds in part (i). While most students were able to refute the proposal that silicone dioxide has a simple molecular structure on the grounds of its high melting point, many of them did not support their argument by relating the attraction between the molecules to the melting point.
4. (a)	Well answered. Some students did not point out the importance of delivering *more* oxygen and nutrients to the muscle cells with a higher breathing rate and faster heartbeat.
(b)	Performance was satisfactory, especially in part (i). In part (ii), some students were unable to explain clearly the significance of vasodilation.
(c)	Performance was very good, showing that students understand quite well the importance of water to the body.
5. (a)	Most students were unable to describe how identical twins were formed in part (i). A few students pointed out the fact that identical twins have the same genetic make-up in part (ii). None were able to explain that the difference in fingerprints is due to the effects of the environment on gene expression.
(b)	Satisfactory performance. Most students gave the correct genotypes of the couple in part (i). The question in part (ii) required students to draw a punette square and find the chance of having an affected child. However, some students worked out the chance using a genetic diagram instead of a punette square. Students performed well in supporting their views, using the probability worked out.
6. (a)	A lot of students chose the correct set-up for the investigation in part (i), but not many of them were able to express their ideas clearly in giving the predicted result. Students were generally weak in presenting the magnetic effects of a current-carrying wire diagrammatically and their performance in part (ii) was only fair.
(b)	Almost all students worked out the 'no. of turns per metre' correctly in part (i). Their skills in plotting the graph in part (ii), however, need to be improved. Some chose the wrong axes, some forgot to put down the units, and some did not put in the best fit line. In giving the conclusion in part (iii), some gave very general answers like 'the size of the magnetic field increases with the no. of turns per metre' and failed to recognise that the two parameters show a direct proportionality. While some students were able to give a correct precaution, few were able to explain how the precaution suggested could improve the accuracy of the measurements.
7. (a)	Well answered.
(b)	As revealed from students' answers, the misconception that 'the insects will actively develop a resistance to counteract the insecticide' was common. Some even suggested that the insects would produce antibodies when coming into contact with the insecticide and wrongly regarded it as the reason for the existence of variations among the insects. In addition, quite a number of students failed to realise the fact that it was the increase in the *proportion* of the resistant insects in the population that rendered the repeatedly used insecticide ineffective.
(c)	Students showed a good understanding of the fact that the nutrients locked up in crop remains and animal manure can only be released via decomposition by soil microbes. However, they did not realise that soil fertility is reduced after harvesting and thus failed to appreciate the importance of covering the field with crop remains and animal manure for nutrient replenishment.

7. (d)	Very few students grasped the focus of the question. Instead of giving the biological principle genetic engineering is based on, most of them gave a detailed procedure for genetic engineering. They failed to relate the ability of the transferred gene to produce its gene products in a new host to the fact that all organisms share the same codon table and have the same mechanism of protein synthesis.
8. (a)	Many students did not include the symbol '*' in the equation to represent the state of the unstable nucleus. Students should note the fact that there is no change in the atomic composition of the nuclei in the process of decay. Hence, they should denote the unstable nucleus with an '*' in the equation to show its change to a stable nucleus with an emission of γ radiation.
(b)	A lot of the students failed to realise the fact that radioactive decay is a random process and suggested measurement errors to account for the distribution of the data points in part (i). Many students were able to estimate the half-life in part (ii) and calculated correctly the activity of Tc-99m in part (iii).
(c)	Students generally were able to explain why isotopes that emit γ radiation are not suitable for use as medical tracers. However, some students used the 'poor penetrating power' of α radiation to explain why radioisotope *Y* is not suitable for use. They overlooked a more important fact that as α radiation is highly ionising, isotopes emitting α radiation should not be injected to the human body.
(d)	Students demonstrated difficulties in understanding the scenario set in the question and in handling the data. They tended to put down the harmful effects of exposure to radiation in their answers instead of making a risk-benefit analysis, as required in the question.
9.	Most students showed a better understanding of the ecological impact of deforestation than its impact on the socioeconomic aspect. A common weakness among the students is the lack of organisation in their answers. After putting forward a particular point, some of them elaborated on the same point in other paragraphs and treated it as a separate point.

Paper 2

Section A (multiple-choice questions)

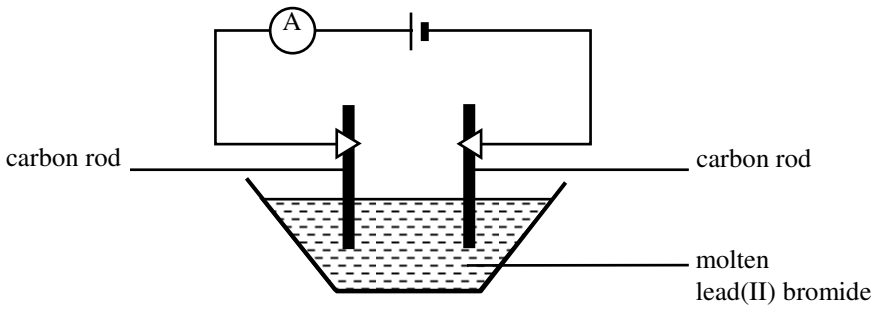
There were 32 questions in this Section. Students' performance was good in general. The mean percentage score was 53.3, and the standard deviation was 12.6. Some misconceptions of students were revealed from their performance in the following items:

6. In a 100 metre sprint, a girl completed the first 35 m in 6.3 s. What was her average acceleration during this period?

	A.	0.88 m s^{-2}	(22%)
*	B.	1.76 m s^{-2}	(22%)
	C.	5.56 m s^{-2}	(51%)
	D.	11.1 m s^{-2}	(5%)

This question required students to apply their knowledge of linear motion to a daily situation. Half of the students divided the distance (35 m) by the time (6.3s) and wrongly chose option C. They failed to recognise that the value obtained from this calculation is the speed of the sprinter. To calculate the acceleration, they need to apply the equation '$s = ut + \frac{1}{2}at^2$' to arrive at the answer in option B. For those who applied the correct equation, some were careless in their calculation, e.g. forgetting to multiply *s* by 2 and arrived at the wrong option A, or dividing *s* by *t* instead of t^2 and wrongly chose option D.

14. When electricity is applied to molten lead(II) bromide, a gas appears at the positive electrode and a metal is formed at the negative electrode.



Which of the following statements can be inferred from this experiment?

*	A.	Molten lead(II) bromide contains mobile ions.	(34%)
	B.	Lead(II) ions and bromide ions in lead(II) bromide are attracted to each other by ionic bonds.	(21%)
	C.	Lead forms ions with two units of positive charges and bromine forms ions with one unit of negative charge.	(20%)
	D.	Lead(II) ions are attracted to the positive electrode and bromide ions are attracted to the negative electrode.	(25%)

This question required students to make an appropriate inference from an experiment. All except option D are facts. While the appearance of a gas and the formation of a metal at the respective electrodes indicate that there are mobile ions attracted to the electrodes and undergo chemical changes there, the results shed no light on the number of units of charges of each ion. In addition, the type of attraction between the two ions cannot be inferred from this experiment.

19. Which of the following is an application of electromagnetic induction?

*	A.	generator	(28%)
	B.	fuel cell	(3%)
	C.	motor	(23%)
	D.	electromagnet	(46%)

This question required students to have an understanding of the meaning of electromagnetic induction and the working principles of the devices in the options. About half of the students chose option D. This shows that students confused the magnetic effect of a current-carrying solenoid (in an electromagnet) with the generation of electricity by means of magnetism (i.e. electromagnetic induction).

31. If an mRNA sequence has 1200 nucleotides from the start codon to the stop codon inclusive, how many amino acids does the polypeptide translated from this mRNA sequence have?

	A.	398	(10%)
*	B.	399	(4%)
	C.	400	(51%)
	D.	1200	(34%)

This was the most poorly answered question. A lot of the students knew that each amino acid is coded by three nucleotides (which make up a codon), but only 4% of the students remembered that a stop codon terminates the translation process by coding for no amino acids. Some students might have wrongly thought that the start codon also codes for no amino acids and chose option A.

Section B

Section B consists of three questions set on the elective modules E1 to E3 of the curriculum. Question 1 was set on E1 'Energy, Weather and Air Quality'; Question 2 on E2 'Keeping Ourselves Healthy'; and Question 3 on E3 'Chemistry for World Needs'. Students were required to attempt all parts in two of the questions.

Question Number	Performance in General
1. (a)	Most students were able to relate the development of high pressure in a region to the low surface temperature in part (i). However, many of them failed to point out the contribution of the movement of surrounding air into the space left by the sinking of the cold air in the development of the high pressure. While most of the students were able to give the cause of the Coriolis effect in part (ii), some of them were unable to take the Coriolis effect into account in determining the direction of air flow in part (iii). Some wrongly drew the arrows along the isobars.
(b)	Some students overlooked the requirement to give an explanation in terms of 'surface-atmosphere radiation exchange' in part (i). For those who did, most of them were able to point out that more solar radiation will be reflected by the icy surface. However, few students showed an understanding of the mechanism of how surface air is warmed up and the role of greenhouse gases in the process. In addition, not many students were able to point out the difference in water holding capacity of warm air and cold air. In part (ii), although students were aware of the fact that the northeasterly monsoon prevails during winter in Hong Kong, not many students were able to account for the origin of the wind with reference to the different specific heat capacities of land and water. Hence, they failed to explain the difference in air pressure between Siberia (a land mass in the north) and Hong Kong (a coastal city).
(c)	Performance in parts (i) and (ii)(3) was satisfactory, showing that students understand the health hazards of RSP and the washing out effect of rainfall on air pollutants quite well. In part (ii)(1), students generally were not able to use the weather chart to identify the condition that brought the RSP from the sandstorm hovering over Taiwan to Hong Kong. In part (ii)(2), very few students were able to point out the fact that light is scattered by RSP. Some just reiterated that a high RSP concentration will lead to low visibility and did not give an explanation.
2. (a)	In part (i)(1), not many students were able to pinpoint the reason behind the experimental design. They gave vague answers like 'to ensure a fair experiment'. The performance in (i)(2) was quite good . Most students were able to give a correct description of the non-specific defence response. In part (i)(3), while students were generally able to explain the role of memory cells and the rapid production of a large number of antibodies in the secondary response, many of them failed to mention that it is the rapid elimination of the pathogens *before* they can grow to a sufficiently large population that prevents us from being taken ill by the same type of pathogen. The performance was satisfactory in parts (ii) and (iii). Many students were able to relate the general trends shown in the figures, predict the effect of global warming on the spread of dengue fever, and suggest a practical method for controlling the spread of dengue fever.
(b)	Many students did not mention in part (i) that the evidence comes from the *consistently* higher incidence rate of liver cancer among males over the years. In part (ii), many students were able to calculate the relative risks and determine correctly whether infection by HBV and consumption of fruit are risk factors. However, they were not able to give the criteria that are necessary for the establishment of a causal relation. In part (iii), students generally demonstrated an understanding of the importance of suppressing the immune response in a patient who is receiving a transplant.

3. (a)	Most students were able to identify the type of polymerization involved in part (i). However, many were not able to draw the structure of the polymer. Some students were able to point out in part (ii) that the high water affinity is due to the formation of hydrogen bonds between the polymer and water molecules. Few, however, related the formation of hydrogen bonds to the structure of the polymer. In part (iii), students performed quite well in suggesting a factor that needs to be considered in manufacturing diapers and giving the reasons why cellulose is more environmentally friendly than polyacrylamide. Although many students were able to relate the high water affinity of polyacrylamide to the advantage of improving water retentivity of soil for agriculture, some students wrongly thought that polyacrylamide would increase soil fertility.
(b)	The performance was good in part (i), showing that the students understand what a reversible reaction is. However, some students were not able to use appropriate scientific terms in explaining why the Haber process requires high pressure. In part (ii), students failed to apply the knowledge learnt in C6 to describing a natural process of fixing atmospheric nitrogen. Some wrongly stated that the nitrogen fixing bacteria convert atmospheric nitrogen directly into nitrates. Their performance in describing the effect of leaching of nitrates into a water body on aquatic life was, however, quite good.