TASMANIAN QUALIFICATIONS AUTHORITY

The 2007 Physical Sciences examination paper proved to be demanding on two fronts – it was long and the questions were, on the whole, more difficult than in the last couple of years. In fact, full marks on any section of the exam were rare.

Too many candidates are still completing their scripts in pencil rather than biro. The usual reason given by candidates for using pencil is that it can be easily erased and corrected. The counter argument is that if candidates use biro and cross out what they perceive as errors, their work is still visible to the marking examiner. During correcting, a marker takes note of all that it written on the page as they endeavour to do the best for the candidate. Erased work cannot earn the candidate an unexpected mark but crossed-out work is still visible and may be marked.

Some general comments made by those marking the scripts include:

- Criterion 9 markers had the feeling that a number of candidates had focused on either radioactivity or electricity, as the standard of only one of these sections was often satisfactory.
- The markers felt that the candidates did not always understand the context of the questions, sometimes being confused by the terminology used.
- Candidates often gave a jumble of facts when answering descriptive questions, but did not necessarily address the question.
- Leaving questions blank is unwise. A 4 mark questions represents $1/8^{th}$ of the available marks for a criterion. It is usually easy to earn the first mark in such a question eg in question 10 recognising $NaHCO_3$ as ionic and Na as metallic was sufficient.
- Setting out continues to deteriorate, as it is no longer assessed. Confusion with units was common. Careless errors were made when completing calculations.

The lower values of the cut-offs in a number of the criteria reflected the overall difficulty of the paper. These cut-offs are listed below:

Criterion	A	B	C
6	22	17	11
7	25	18	11
8	23	17	11
9	22	16	10
10	25	18	11

When reviewing scripts it was evident that the requirement to gain 2As in the external examination prevented a significant number of candidates from gaining an HA.

Part 1

Question 1 – *Criterion 7*

This was quite well answered but a surprisingly large number of candidates thought weight was measured in kg or g and was a scalar quantity rather than in Newtons and is a vector quantity.

Question 2 – *Criterion 7*

(a, b & c) These parts were well answered; units were remembered but often not direction.

(d) Many attempted to answer this question by using the acceleration given in the first part of the question (when rhe cyclist was accelerating) rather than calculating the value as the candidate decelerated. Some approached this question from an alternative path of using work and energy equations rather than Newtonian mechanics. Units were often incorrect.

Question 3 – *Criterion 7*

(a) It was very rare to give 3 marks for drawing the graph, with the large majority of candidates not understanding how to convert the data from the first graph to the second. There were histograms, direct copies of the distance ~ time graph and straight lines of all descriptions. Many showed no working out. It may have been better to have Part (c) as the first part of the question as many candidates accurately described the motion of the ball bearing in terms of velocity but did not draw the graph accurately.

(b) Terminal velocity was partly answered well, with most understanding that this occurs when the acceleration is zero (or constant velocity). Some thought that **all** examples of constant velocity indicated terminal velocity. Not all candidates understood that balanced of forces are a necessary condition of terminal velocity. Many did not clearly link their example to their explanations, or totally missed giving an example.

Question 4 – *Criterion 7*

(a) This was well answered, with most candidates basing their answer on Newton's First law. A few answered using Newtons Second or Third law.

(b) Many candidates answered this question well, commenting on the different velocities of the spanner and the astronaut in accordance with their masses, as well as their opposite directions of travel. Most realised it was an illustration of Newton's Third Law.

Some candidates have some odd ideas of what happens in space eg that things merely float in space and that, since there was no gravity and no atmosphere, that Newton’s laws do not apply. Perhaps the most common mistake was assuming that the velocity of the spanner and the astronaut would be the same, despite their different masses.

(c) This was a very difficult question for many candidates. There were a number of valid approaches, the most common and simplest approach being that, by increasing the time of impact, the stopping force and hence the stress on the jogger is reduced. Many explained this in words and/or equations. Other approaches used the absorption of energy into a soft ground and/or discussed momentum.

Many candidates assumed that the force of a person on hard ground was dramatically more than on soft ground but gave no understanding about why; just that it was harder and softer. Many confused force and energy and thought that force could be absorbed in the soft ground.

Question 5 – *Criterion 7*

Considering this was a more difficult example of a Conservation of Momentum problem for Physical Science candidates it was reasonably well done. The vast majority of candidates made a start but made various mistakes - the most common being failing to take direction into account. Some made the assumption that the bodies joined. Perhaps an incorrect 'sample' was often followed from information sheets. Weaker candidates again struggled with relatively easy arithmetic and gave ridiculous answers (eg 10^{-4} ms^{-1}).

Question 6 – *Criterion 7*

(a) Was well done.

(b) Many candidates struggled with the concept of having to treat the horizontal and vertical components separately. For those who reached the vector diagram stage to find the velocity, many neglected the direction.

Question 7 – *Criterion 6*

Parts (a) and (b) were well done with most candidates giving the answer in m s^{-1} for (b).

Parts (c) and (d) showed that at least 90% of candidates are Aristotelian in their thinking, by incorrectly including a thrust force on the football after it had left the hand. This continues to be an area on which teachers need to concentrate, as this misconception is very persistent. Very few gained full marks for (d). Their efforts were not helped by the diagram, as most put the air resistance force along the axis of the ball rather than horizontally. Credit was given for this.

Part 2

Question 8 – *Criterion 8*

(a) This was usually well answered. Many candidates were careless with the use of terminology, using mass, weight, lighter and heavier instead of relative atomic mass.

(b) Again, well answered although the symbol of the atom/ion presented problems. Rather than $^{41}_{20}Ca^{2+}$, a significant number of candidates opted to suggest argon formed a positive ion, Ar^{+} or Ar^{2+}. Also $^{20}_{41}Ca^{2+}$ was written.

Question 9 – *Criterion 8*

Well answered, except for the naming of CS_2 – opting for carbon sulfide rather than carbon **di**sulfide.

Question 10 – *Criterion 8*

(a) Very few candidates scored full marks on this question. Candidates needed to use bonding models to address why $NaHCO_3$ was abrasive and why Na is not. Rather than mindlessly recounting information about ionic and metallic substances, candidates need to make some reference to the point of the question – the 'abrasive' property. Candidates had differing ideas about what abrasive meant. Some centred their answer on toothpaste, clearly distracted by the photo, and others incorrectly discussed acid/carbonate reactions, acidity and alkalinity.

(b) Again poorly answered. Despite being told both substances were ionic some candidates tried to justify the difference in terms of other bonding models or by stating that MgO was a gas. Several mentioned a protective oxide layer!

Question 11 – *Criterion 8*

(a) Satisfactory, especially for F_2, although a wide variety of 'electron dot' diagrams were presented.

(b) Often candidates did not use the electron dot diagram, as requested, to answer this question, choosing to answer it by stating that flourine (sic!) needed to gain 1 *e* to gain stability compared with nitrogen, which needed 3 *e*. The spelling of fluorine was atrocious.

(c) Satisfactory, with most candidates realising a transfer of electrons occurred. Unfortunately some went on to erroneously mention sharing of electrons after the transfer and some did not understand which element was the donor and which was the recipient. ‘Happy’ atoms and equivalent terms still appear in the answers to such questions, despite repeated requests to be more scientific in explanations to bond formation.

Question 12 – *Criterion 8*

(a) Well done, although some candidates thought the answer had to be an isomer with a triple bond, considering single and double-bonded compounds had already been given in the question.

(b) This part was poorly expressed, with many candidates not making it clear as to whether they were commenting on attractions within or between molecules.

(c) Many candidates had difficulty answering this part directly, often explaining the chemistry behind the test of their choice, even though it was not asked for in the question. 'Expected observations' were required. The terms 'clear' and 'colourless' were used inappropriately. Clearly the difference is not understood.

Question 13 – *Criterion 8*

Both parts were well answered.

Question 14 – *Criterion 8*

A diagram showing part of the polymer with three-and-a-half monomers may have contributed to the confusion of some candidates. There were more than a few 'heptane' responses. Many candidates failed to note that the monomer would need to contain a double bond. A large number of papers were correct except for naming the monomer – propene was incorrectly named as 'methyl ethene'.

Question 15 – *Criterion 6*

(a) This part was generally well done by those who addressed the question. A few candidates failed to realise that Part (ii) was also related to the drill bit and questioned the choice of steel, rather that explaining its use. Many only gave one property.

(b) On the whole, many responses showed a good mastery of electrical conductivity by electrons, and a number of plausible explanations were offered. Of less joy were the explanations that suggested the increase of conductivity was due to electrons getting out of the way and allowing the current to pass through unhindered.

Part 3

Question 16 – *Criterion 9*

(a & b) Generally well done but many had trouble converting mA to A.

(c) Most focused on a means to get an electric shock rather than on decreasing the resistance. Answers were nearly always related to the car battery rather than the connections between the battery and the person.

Question 17 – *Criterion 9*

(a) Well answered but, once again, converting kW to W was a problem for many.

(b) This was very well done – again this was a question the weaker candidates were able to answer. Many just multiplied the two numbers together, ignoring the heater's power rating.

(c) Not well answered. There were several ways to make the comparison, but the presentation of answers was so poor it was often difficult to decipher whether candidates knew what they were writing about.

Question 18 – *Criterion 9*

(a) Surprisingly, not well answered. Many candidates included the beta particle as a 'reactant' in the nuclear equation. Several candidates used $A_r(I)$ rather than the isotopic mass of 123, showing a misunderstanding of isotopes. Rather than writing $^{123}_{53}\mathrm{I}$, many incorrectly wrote the isotope as $^{53}_{123}\mathrm{I}$.

(b) Many left this part of the question blank. Those who attempted it considered the penetrating ability of the isotope, often without specifically answering the actual question. Many thought the thyroid gland was a cancer or bacteria that needed to be removed!

Question 19 – *Criterion 9*

(a) There was a general inability to balance nuclear equations. Many candidates could balance the equation but did not know that $^{1}_{0}\mathrm{X}$ was a neutron, opting for either a proton, or a H or a beta particle.

(b) Generally well done.

Question 20 – *Criterion 9*

(a) Quite well answered, even by those who could do little else! Often there was little working out. Many candidates unsuccessfully attempted to use the equation $A = A_0/2^n$, using logarithms to find n. This was an unnecessarily complicated method, which was poorly understood!! Many candidates did not understand what 'n' was.

(b) Many incorrectly stated that the number of half-lives, $n = A_0/A = (1.7x10^7)/(2x10^6) = 8.5$, rather than $2^n = 8.5$. Logic, rather than use of a formula usually results in more success. Many tried to find the exact time even though the question only requested an approximate time.

Question 21 – *Criterion 9*

(a) A large number of candidates assumed the skateboarder was stationary, even though a speed was given in the stem of the question. Almost everyone quoted the correct formula but a surprisingly large number ignored the squaring of the velocity when completing the manipulation.

(b) Many did not know that mechanical energy was the sum of potential and kinetic energies.

(c) Most realised that it was heat due to friction that accounted for the 'lost' energy, although some indicated that friction itself was a form of energy.

(d) Many would correctly answer (c) but would not apply it to the numerical calculations in (d). About half used some form of energy formula but many used kinematics formulae.

(e) Not very well answered. The majority tried to use a kinematics formula and, even when 'W = Fs' was used, there was some doubt as to whether 'W' represented all the energy, 80% of the energy or 20% of the energy.

Question 22 – *Criterion 9*

(a) Most obtained the numerical answer, although a number were unable to transpose the appropriate formula given in the information booklet. There was a range of units given in this answer, including amps, ohms and Newtons.

(b) This was generally poorly answered. Many found the electrical power using P = VI rather than the mechanical power (P = W/t) or would find the work done (W = Fs) on the mass and not go on to find the power.

(c) Again not well answered. Many calculated some or all of the work done, the power or some energy values but then did not know what to do with them to answer the question.

Question 23 – *Criterion 6*

(a) Most people could suggest an appropriate situation, although electricians and photographers would be surprised at how dangerous their occupations are perceived as being by candidates due to exposure to radiation!

(b) It was assumed that candidates would relate the penetrating abilities of the types of radiation to the various materials in the windows rather than just recite them. Some seemed to think there was some sort of reaction between the metals and the radiation and did not make it clear that the materials were acting as barriers to decrease the fogging of the film.

(c) Many seemed to think that the badge was meant to protect by acting as a shield to the radiation and commented on its small size. Most realised that a Geiger counter would be a useful adjunct, although 30 different versions of the name were noted!

(d) Mostly answered in a general and vague way; it was hoped that some specifics would be included such as the use of dense materials (e.g. lead) for shielding or that distance would cause alpha and beta radiation to be absorbed by the air. Some thought that the 'time' aspect meant that the handler of the radioactive material must move slowly so that he/she would not make mistakes!

Part 4

Question 24 – *Criterion 10*

(a & b) Generally well answered, although some candidates did not notice that it was a different substance for each part and carried the same molar masses or formulae through the question.

(c) Some had trouble with this part, especially when working out the number of moles.

(d) Generally well done. The most common mistake was to only use one Al atom, rather than two, when calculating the percentage.

Question 25 – *Criterion 10*

(a & b) Both parts were well answered.

Question 26 – *Criterion 10*

(a) Well done.

(b) Quite a few errors were made here, with many being unsure of states and used (l) for aqueous solutions. States were sometimes missed it out all together. Quite a few candidates did not give the correct formula for aluminium chloride ($AlCl_3$) or used H or H_3 for hydrogen instead of H_2 possibly because it seemed to balance more easily!!!!

Question 27 – *Criterion 10*

(a) This was a similar to question to 26(a) in terms of difficulty and required a lot of work for 1 mark! The most common problems were not giving the correct formulae for the compounds and not checking the solubility of NiS.

(b) The net ionic equation was not done well. Many gave a random assortment of ions in their equation; this was not helped by the fact that many did not realise it was NiS that had changed ion status.

Question 28 – *Criterion 10*

(a) Candidates who knew how to solve this stoichiometry problem did well. Unfortunately for them they had to complete a lot of work for 2 marks!

(b) Well done.

Question 29 – *Criterion 10*

Most candidates were able to calculate that 125 ml of the more concentrated acid was needed, but then did not take the question any further i.e. Candidates needed to mention that 375 ml of water was required.

Question 30 – *Criterion 10*

(a) The majority of candidates had some idea about what is meant by the term 'end point'.

(b) Again, most were able to do this. Those who made a mistake tried to use n = m/M rather than n = cV.

(c) Poorly done by most. The majority failed to find the correct number of moles of the acid since they could not use mole ratios. Many were confused and used the wrong volumes in parts b and c.

Question 31 – *Criterion 10*

Most candidates had some idea about how to identify the contents of each of the bottles, with several gaining with full marks. The main problems arose from the way the answer was structured and a failure to give expected observations.

Question 32 – *Criterion 6*

(a) Even if they guessed, candidates had a 50/50 chance to get this question right.

(b) Most correctly identified a rise in pH but failed to give any adequate reason(s) for their answer.

(d) Well done.

(e) Mostly well answered, although *many* said the sulphate ion and barium ion 'neutralised' each other.

(f) Poorly done. Whilst most thought to react the barium chloride solution with a sulfate solution, very few were able to write the corresponding ionic equation and even fewer thought to take their answer further by reacting with *excess* sulfate and washing with deionised water etc.

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