The less able candidate was able to answer a reasonable number of questions whilst at least one question in each part acted as a ‘discriminator’- a harder question designed to allow the more able candidate to show their ability to analyse and solve problems. Overall, the length of the exam was good.

Markers were impressed with the inclusion, and correct use of, units. An appropriate number of significant figures were used in answers. Unfortunately, markers thought the standard of presentation of answers was poorer compared with previous years.

Too many candidates are still trying to ‘fudge’ ‘show that’ questions. Candidates MUST firstly write down the equation they are using, followed by inserting the appropriate numbers in the correct places before carrying out the calculation. If the ‘correct’ answer miraculously appears out of a jumble of numbers little or no credit is given. As mentioned in previous reports, markers are stricter on awarding marks for this type of question than a ‘normal’ question.

Many age-old problems persist, with candidates losing valuable marks for preventable errors if they only bothered to act on advice given in previous Examiner's Reports. Candidates write Fl, rather than the correct symbol of F, for fluorine; they forget that there are a number of elements that are diatomic; the term ‘covalent molecular force’ is used - there is no such thing. There are covalent bonds or covalent molecular substances/structures. ‘Thrust forces’ acting on objects in free fall DO NOT EXIST; frictional forces and the force of gravity are the only forces acting. Vector diagrams were poorly constructed, as were graphs, whether plotted or sketched. Most candidates have had plenty of practice drawing.sketching graphs in Maths and the Sciences. The same rules apply to each subject - line of best fit, labelled axes and marking the intercepts.

Answers are included at the end of this report. Other answers may also be correct, especially if a question had alternative interpretations. When doing practice exams, if a candidate is unsure about the validity of an answer, they need to chat with their teacher about its correctness.

PART 1 – Criterion 5

Question 1

a) Quite well done. When candidates used \( s = ut + \frac{1}{2}at^2 \) the solution was never fully presented and hence did not gain full marks.

b) Some difficulties were experienced in this part, especially with assigning direction to the acceleration due to gravity. It was obvious in some cases that the expected answer was not going to be obtained by the method/numbers used in this ‘show that’ question. The number 2.06 was invariably plucked out of nowhere! Unfortunately for candidates this was easily detected by markers and in such cases no marks were awarded.

b) This was reasonably well done although direction (down) was missed in some responses.

c) Overall, this was not well done. Despite being asked to identify the \( y \)-intercept in the question, some candidates failed to do so.
Question 2

a) Generally, the vector diagram was poorly done, with many failing to identify the displacement/resultant vector at all. The use of a diagram drawn to scale and a ruler makes these questions simpler and is to be encouraged, although marks were not deducted unless the diagram was very obviously out of proportion. Arrows were often left off vectors and an explanation - either using trigonometry or properties of triangles - of how the direction was determined was also necessary.

b) Both parts were quite well done. In part (i) common errors included not converting the distance to metres and time into seconds as requested, erroneous time conversions and the use of 4100 m instead of 3100 m. In part (ii) the omission of direction was a common error.

c) Several candidates erroneously subtracted the 25 seconds from the time, meaning that the second placegetter was actually faster than the overall winner! Again the use of 4100 m instead of 3100 m for the distance was common, as was using the speed obtained in part b(i); using this number assumes that both runners ran at the same speed, an incorrect assumption.

Question 3

a) Poorly done. Points were usually plotted quite well but a line of best fit was rarely drawn – joining the dots or ‘stepping’ between points was far too common. Extrapolation to the y-intercept was expected for full marks. Markers expect candidates to use rulers when drawing straight-line graphs.

b) Part (i) was reasonably well done but part (ii) proved much more of a challenge. Some candidates solved this problem using formulae and others the area under the graph; the markers accepted either, even though the instruction was ‘From the graph’. Candidates often only found the area of the triangular section, omitting the rectangle, thus only received half the allocated marks. Again, either the gradient or use of formula were accepted techniques to answer part (iii), in spite of the instruction. The question was generally well done.

c) Well answered. There is no necessity to include direction because the question only asked for the magnitude of the force.

d) Poorly answered. Some candidates knew they needed to find the weight of the glider prior to combining it appropriately with the net force calculated in part (c) to obtain the frictional force. Obtaining the weight was achieved with varying degrees of success, with multiplying its mass by 1.40 rather than 9.80 the most common error. The identification of the direction as being opposite to the original direction was expected to complete the answer.

Question 4

Overall, the examiners noted that candidates’ fundamental understanding of projectile motion was good.

a) Candidates should be consistent when they allocate ‘positive’ and ‘negative’ directions since the markers carefully check the sign of vector quantities.

b) Some candidates incorrectly used a non-zero acceleration for horizontal motion.

c) A vector diagram showing both the horizontal and vertical components of the instantaneous velocity and calculations showing how each value was determined must be present, as well as the
angle at which the stone ‘struck’ the water surface. A common error was to do a vector sum of the displacements instead of the velocities.

d) This part, along with part (e), was completed by most candidates, but, unfortunately, it was done poorly. Force was confused with acceleration, velocity and momentum. Candidates may know the statement of Newton’s 1st Law but do not understand it.

(i) the stone has left the hand so there is no longer a thrust force; it is free fall. The labels on the forces need to be clearly stated using full words, or a key if symbols are used. On the diagram the relative magnitude and direction of the vectors can be clearly communicated by using length and an arrowhead, and having all vectors drawn from the ‘centre of mass’.

(ii) required comment on the relative magnitude of the forces. Examiners expected that the response supported the observation that the stone ‘skips’ and the forces opposing the motion were small given the stone travels a significant distance horizontally.

e) This diagram is for the stone when it is not in contact with the water. Hence, normal and buoyancy forces along with friction with the water surface no longer apply.

f) Reasonably well handled.

Question 5

a) Generally well done, with units, vector direction and an appropriate number of significant figures all included. In part (i) some evidence of why the value is zero was desired. In part (ii) some candidates missed the unit conversion.

b) If an incorrect answer from part a) (ii) was used, ‘error carried forward’ was applied, so candidates were not penalised for a second time.

c) This is a ‘show that’ question so, regardless of the method used, the markers expected that full working be given and an understanding of the method demonstrated.

d) Not done well. Very few candidates realised ‘effective mass’ was the combined effect of the force of the player’s hand on the racquet and the racquet itself ie the racquet and ball are not an isolated system.

PART 2 – Criterion 6

Overall, candidates did well in this criterion, attempting many questions. They remembered units but had difficulty transposing equations; we encourage candidates to write down the general formula being used as a starting point to solve numerical problems. Candidates need to be precise with their terminology eg. Metastable nucleus.

Question 6

This was well answered. A significant minority of candidates did not put the product on the RHS. The naming of an isotope ideally is yttrium-90 not just the name yttrium. Candidates need to be careful with terminology: Hydrogen is an element; the subatomic particle is a proton or a hydrogen nucleus.
Question 7

a) Parts (i), (iii) and (iv) were all done well, but part (ii) was poorly answered, with a common misconception being that voltage is the same in each part of a series circuit instead of current. Hence the most common error was to state that I = 6/2 instead of 6/3, as current is constant; reasoning was rarely given.

b) Ammeters were rarely placed in series, with many answers having it incorrectly placed in parallel with the 3 Ω resistor. Despite the parallel circuit diagram being poorly or incorrectly drawn, parts (ii) and (iii) were completed well.

Question 8

Some candidates did not realise that the energy was not conserved in this question.

a) It was well answered.

b) Mass conversion to kg was reasonably done.

c) Some candidates used the equations of motion to solve this instead of using energy equations.

d) It was encouraging to see that many candidates attempted this question that examined a concept new to the syllabus; they came up with many novel answers. Candidates do not understand the terminology of inelastic and elastic collisions. Few candidates used the different $E_k$ values calculated in parts (a) and (b) in their discussion.

e) Many candidates did not outline the order of energy change, rather just listing the energies involved. Some missed heat and sound as energy types; these are essential elements of the energy changes. Friction erroneously is stated as an energy source by too many. Some bizarre energy types were included.

Question 9

Quite a number of candidates did not attempt this question at all.

a) Changing watt hour into joules was poorly done. Some candidates wrote the answer as Ws, unaware that a Ws is 1 J.

b) Generally well answered, with candidates often solving the problem as a ratio, thus making the question quite straightforward. Those who tackled the question from first principles did not always double the time since two batteries are involved.

c) Done well.

Question 10

a) & b) Both parts were well done, but a number of candidates had the alpha and beta particles on the left instead of the right.

c) The key to answering this complex question was to realize that only the emission of alpha particles, and not beta particles, affects the mass number, changing it by 4 for each emission. Hence, 7 alpha particles are emitted (change in mass no/4). A disappointingly large number of candidates did not pick up on this. Some candidates incorrectly looked at atomic number change,
which is affected by both $\alpha$ and $\beta$ emissions. Even if the incorrect assumption is made that the pattern of alpha, then beta decay continued, there are still 7 alphas emitted. Some candidates neatly presented their solution as a nuclear equation, manipulating it correctly to read:

$$^{235}_{92}\text{U} \rightarrow ^{207}_{82}\text{Pb} + 7^4_{2}\text{He} + 4e^-$$

**Question 11**

a) Key words examiners were looking for included detect, penetration, ionisation and an explanation that the thickness of paper will affect the reading of the Geiger counter with a beta source. Too many just wrote out the properties of each type of radiation and did not link them to the question. It is a paper machine not aluminium.

b) Answered well.

c) This was also done well. Background radiation would probably not give the huge variation stated in the question so was only given part marks.

d) Health concerns are a viable answer, although death was a little dramatic. A concern that the paper became radioactive from the beta particles was a common misconception.

e) A range of responses was given. Some explained well why the gamma emission occurred. Many others thought it was a fission reaction; others were confused, thinking it was bombardment.

**PART 3 – Criterion 7**

**Question 12**

This predictable question was generally well answered. The naming of $\text{K}_2\text{Cr}_2\text{O}_7$ was the worst part; even though it was usually correctly identified as an ionic compound, candidates incorrectly used the naming rules of covalent molecular compounds (ie use of di). 'Covalent' to describe a structure received no marks – the term covalent molecular describes the structure; covalent describes the bond.

**Question 13**

a) Candidates either knew how to calculate the number of particles or had no idea - no half measures! While there were too many careless errors, the most common was calculating the number of electrons in $\text{Cl}^-$.

b) Incorrect responses included drawing the Bohr model for a single $\text{Cl}$ atom or a Lewis diagram for $\text{Cl}$ rather than $\text{Cl}_2$.

c) This was well answered; some candidates worked out the answer using ratios.

d) Most candidates left this blank. Marks were given for anything resembling the data given.

**Question 14**

These questions were very poorly done. Too many candidates just wrote down irrelevant facts or repeated the question as the answer. Too often 'intermolecular forces' and the word 'molecule' appeared in every section! In part (d) candidates correctly identified the substance as ionic but then
wrote about electrons or only mentioned anions as charge carriers. A more novel (but clearly incorrect) answer suggested that Na\(^+\) became a metal and therefore carried electricity! Candidates must realise that protons are not the same as cations.

**Question 15**

This question required candidates to explain the differences in aspects of elemental reactivity. Generally well answer, indicating a sound depth of knowledge by the majority of candidates.

a) In part (ii) candidates needed to indicate relative size difference and the effect this would have on outer shell electrons.

b) This was answered very well, however, in part (i) it was insufficient to refer to fluorine and neon having the same number of shells – they needed to mention that both had 2 occupied shells. Unfortunately, many candidates personalised the answer, using words like ‘happy’, ‘satisfied’ in part (ii).

c) Many recognised the difference in size between the chlorine and fluorine atom, but failed to link this to reactivity.

**Question 16**

a) Well answered and presented in concise and sufficient detail by most candidates.

b) In part (ii) a third of candidates correctly drew isomers based on cyclopentane or cyclobutane. Many candidates incorrectly drew a cyclic alkene as their isomer. Part marks were awarded for a correct name for an incorrect isomer.

**Question 17**

Well answered in many cases.

a) When answering part (i) a reasonably common error made by candidates was a failure to include an observation (eg. decolourised), despite indicating an understanding of the reaction.

b) Despite the instruction ‘using structural formula’, many wrote a molecular equation in part (i). Little credit was given for that, since it does not convey the knowledge that the addition of the bromine across the double bond occurs Depending on the chemical equation chosen in part (i), either addition or substitution was accepted in part (ii).
PART 4 – Criterion 8

Candidates handled this part very well.

Question 18

a) Some candidates did not give the names for both products and/or did not use the solubility table for the states. Candidates need to name using ‘words’. They also named ionic compounds using covalent molecular compound rules (eg dicalcium triphosphate rather than the correct name calcium phosphate).

b) Many failed to write magnesium chloride as MgCl$_2$ and did not recognise that hydrogen was diatomic. No marks were given for MgCl + H. In part (ii) a laboratory test was expected rather than just referring to the equation.

Question 19

Candidates calculated the molar mass and the number of moles quite well. Candidates need to remember the diatomic nature of oxygen when calculating its molar mass.

Question 20

a) Well answered

b) The most common error was that candidates did not make the necessary subtraction to determine the mass of water.

c) Done well.

d) Even though part a) and c) required candidates to determine the number of moles of copper(II) sulfate and water respectively, they did not use this information to calculate the empirical formula.

Question 21

a) Candidates answered this question well.

b) Was poorly answered. Candidates had difficulty converting mmols to moles and grams to mg.

c) Candidates completed this well.

d) This was an excellent discriminator due to the mathematics involved in calculating the mass of sodium chloride.

e) A number of different methods were used to come to the correct solution.

Question 22

a) This question was poorly answered due to the nature of the equation given, but the markers made allowance for this. Terminology was often poor. Only a few candidates pointed out that low solubility led to a dilute solution of carbonic acid. Some candidates chose two terms from the four
given in the stem of the question and discussed them without referring to carbonic acid as requested.

b) Explanation of the pH scale was often poor, with the scale reversed. A number of candidates referred to the reaction with the limestone rather than the properties of the acid itself. Candidates did not read the question carefully and omitted suggesting a value for the pH of carbonic acid.

**Question 23**

a) Well answered.
b) A number of candidates substituted incorrect value(s) in their calculations but were, otherwise, able to apply the chemical equation correctly.
c) Surprisingly, very few recognised the original 1 in 10 dilution of brick cleaner, which simplifies the calculation of the original concentration; rather they reapplied C =n/V.

**Question 24**

a) Most candidates received at least part marks because they could suggest a solution to add to form a precipitate with AgNO₃. Examiners were pleased that most candidates could successfully write a net ionic equation.
b) Some candidates suggested barium chloride solutions to form a precipitate with K₂SO₄ without realising BaCO₃ and BaSO₄ are both insoluble. Candidates did not read the question carefully and thus did not justify their choice with an ionic equation.
**PHYSICAL SCIENCES (PSC.24514)**

**TCE EXAMINATION NOV. 2014**

**ANSWER SUMMARY**

**CRITERION E:**

**Q1(a) u = +320 ms^{-1} | v = 0 ms^{-1} | a = -90 ms^{-2} | t = ? sec**

\[ V = u + at \]
\[ t = \frac{V - u}{a} = \frac{0 - 320}{-90} = 3.56 sec \]

**Time to max. ht: 3.56 x 10^1 s.**

**b) S = \frac{u^2 + V^2}{2} = \frac{320^2 + 0^2}{2} = 5,120 m**

**Height above ground: 160 + 5,120 = 5,280 m.**

**c) u = +330 ms^{-1} | a = -90 ms^{-2} | S = -150 m**

\[ V = \sqrt{u^2 + 2aS} = \sqrt{330^2 + 2(-90)(-150)} = 402 m/s \]

**Ball's velocity as hits ground is 402 m/s (up), or 225 m/s (down).**

**Q2(b)**

**i) Displace. = 1000 m (N 45° E)**

\[ t = \frac{d}{v \times c} = \frac{1000}{200} = 5 sec \]

**ii) Ave. velocity = \frac{1000}{1200} = 0.75 m/s.**

\[ V = u + at \]
\[ t = \frac{V - u}{a} = \frac{0 - 320}{-90} = 3.56 sec \]

**Q4(a) Vertical motion**

\[ u = 0 \]
\[ a = 9.8 m/s^2 \]
\[ s = 0 \]
\[ v = ? \]

\[ \frac{v^2}{2} - \frac{u^2}{2} \]
\[ \frac{v^2}{2} = \frac{9.8}{2} \times s \]
\[ \frac{v^2}{2} = 4.9 \times 10^2 \]
\[ v = 420 m/s \]

**Q4(b) Horizontal motion**

\[ u = 0 \]
\[ a = 0 \]
\[ s = 470 m \]
\[ t = ? \]

\[ s = ut + \frac{1}{2}at^2 \]
\[ 470 = 0 \times t + \frac{1}{2} \times 0 \times t^2 \]
\[ t = 470 sec \]

**Horizontal velocity = 110 m/s.**

**Q5(a)**

**i) Initial speed (at t = 0) = 0.30 m/s (aboe)**

\[ V = u + at \]
\[ t = \frac{V - u}{a} = \frac{0.30 - 0}{0} = 0 \]

**Distance travelled = 0.30 m.**

\[ w = \frac{u + v}{2} \times t \]
\[ w = \frac{0.2 + 0.11}{2} \times 0.4 = 0.24 m \]

**Q5(b)**

**i) Distance travelled by stone is 118 m at 20° below horizontal.**

\[ F = mg \quad \text{(weight force)} \]
\[ F_F = \text{frictional force (air resistance)} \]
\[ F > F_F \text{ because the stone moves after contact with water.} \]

\[ \text{upwards = stone accelerates upwards.} \]
Q11. (c) The paper thickness caused the page thickness to vary. Change in shielding is a statistical 'average' of variations.

Q11. (d) The beta decay is a random process and the half-life is merely the statistical average time for half of the particles to decay. Background count variations are due to the naturally occurring radioactive elements in the environment.

Q12. The meta-stable nickel-60 nucleus, formed by p-emission from cobalt-60, is still unstable and the further emission of gamma rays forms the stable Ni-60.

Q14. The strong metallic bonds between the Ag atoms are due to the attraction between the fixed silver cations and the delocalised e⁻. Ag exists as a solid at room temperature.

Q14. (a) The strong metallic bonds between the Ag atoms are due to the attraction between the fixed silver cations and the delocalised e⁻. Ag exists as a solid at room temperature.

Q14. (b) Metals react by losing their outer (valence) e⁻. The valence e⁻ in potassium is in the 4th shell, much weaker attraction than occurs with Li. K loses its e⁻ more easily than Li.

Q14. (c) K is more reactive than Li.

Q14. (d) Both F and Ne have their outer e⁻ in the second shell. F is 7 valence and Ne is 8 valence and are thus included in period 2.

Q15. (a) Li = 2 and F = 7; K = 3 and Cl = 17.

Q15. (b) Metals react by losing their outer (valence) e⁻. The valence e⁻ in potassium is in the 4th shell, much weaker attraction than occurs with Li.

Q15. (c) F is a highly reactive non-metal and reacts by gaining (or sharing) one e⁻ per atom, i.e., F + e⁻ → F⁻. Thus achieving a stable octet of electrons.

Q15. (d) This is an addition reaction. Ne has already had a completed outer shell of e⁻, no tendency to lose or gain further electrons.

Q16. (a) H₃C≡C—Cl

Q16. (b) H₃C—Br (bromocyclopentane)

Q16. (c) C₆H₅—Br (bromobenzene)

Q17. (a) Br₂ + H₂O → HBr + HBrO

Q17. (b) The unsaturated cyclopentene would rapidly decolorise the brown bromine solution. The cyclopentene would give no immediate colour change.
CRITERION 5 (continued)

-3-

CRITERION 6.

-4-

Q6. (a) $q \rightarrow e + q_f$

other product is a lithium $q_p$

nucleus.

(b) $14N + n \rightarrow ^{14}C + ^{1}H$

sub-atomic particle = PROTON!

Q7.

(a) $P_{in} = 2 + 3 + 4 = 9\Omega$

(b) for the $3\Omega$ resistor:

$I = V / 3\Omega = 200A$

Thus, as the three resistors are in

series, each has a current of 200 A.

(c) $q = I \times t = (200A \times 5x60)C = 600C$

Q8. (a) $(E_k)_{initial} = \frac{1}{2}mv^2$

$(E_k)_{initial} = \frac{1}{2} \times (0.0005)(20)^2 J$

(b) $(E_k)_{final} = \frac{1}{2}mv^2$

$(E_k)_{final} = \frac{1}{2} \times (0.0005)(900)^2 J$

(c) $E_{kmax} = q \cdot 9 \cdot 09 J$

Thus, the collision is not the same

as the total $E_k$ before the

collision $E_k$ is $9.17 \times 9.09 J$

In a perfectly elastic collision,

kinetic energy is unaltered!

(d) $E_k = \frac{1}{4}mv^2$

(e) The $E_k$ of the bullet is transformed

into $E_k$ of the block plus a large

amount of heat & sound as the

bullet imbeds in the wood. The

$E_k$ of the wood is then trans-
mformed into $E_p$ as the block rises.

At $h = 0$, the $E_p$ and

the $E_k$ is at a maximum. It

then swings down again and

$E_p$ decreases as $E_k$ increases.

Q9. (a) $E = P \cdot t$

$E = (20.8 \times 3600) J$

(b) $2 \Omega$ cells: $E = 2 \times 1.49 \times 10^4$

(c) $t = \frac{\Delta E}{P} = \frac{1800 \times 10^3}{0.80} W = \text{seconds}$

Replace every 52 hours (approx).

(d) $t = \frac{20.8\ \text{kWh}}{0.026\ W} = 0.096\ \text{hours}$

A single D cell would only

last for about 1 minute!!!

(e) Totally unsuitable.

P10. (a) $\frac{32}{2} + \frac{1}{2} = \frac{31}{2}\ \text{He} + E$

(b) $\frac{31}{2} \text{He} \rightarrow \frac{31}{2} \text{H} + \frac{1}{2} \text{He} + E$

(c) $7 \times \text{EM} $ (and $4 \times \beta$ decay)

The mass no. has to decrease from $32$ to $204$ (i.e. $3 \times \text{He}$).

This would decrease the atomic no. by

14, but this is $4 \times \text{He}$.

$4 \times \text{EM}$ not needed to

increase atomic no. up to 82.

Q11. (a) $\alpha$ particles would pass

through the paper and $\gamma$ rays would

not be affected by paper at all.

However, $\beta$ rays will pass through

this paper, but not thick paper.

$\beta$ is ideal for this process.

(b) A long life of source would

mean the activity of the source

would not vary significantly

with time. Thus, changes in counter

readings are due to paper thickness.
Q20. A 15.6 g NaCl was dissolved in 15 mL of water. 
\[ \text{M}(\text{NaCl}) = \frac{15.6 \text{ g}}{1.0 \text{ mol}} = 0.0224 \text{ mol} \] 
\[ \text{mass} = 15.6 \times 0.0224 = 0.352 \text{ g NaCl} \] 
\[ \text{mole} = \frac{0.352}{1.0} = 0.352 \text{ mol NaCl} \]

Q21. A 170 mg NaCl/day permitted. 
\[ \text{mass} = 170 \times 0.000001 = 0.00017 \text{ mol NaCl} \]
\[ \text{intake} = \frac{0.00017}{0.0224} = 0.0076 \text{ mol NaCl}\]

Q22. (a) Only a small amount of CO_2(g) is dissolved. The AgNO_3(aq) solution will give a white ppt of AgCl(s). The 2M NO_3(aq) will give no ppt. 

Q23. (c) \( \text{H}_2\text{CO}_3 \) is a weak acid. 

Q24. 
(c) \( c(\text{HCl}(aq)) = \frac{0.025 \times 2 \times 10^2}{0.05} = 0.93 \text{ mol/L} \)
TASMANIAN QUALIFICATIONS AUTHORITY

PSC315114 Physical Sciences

ASSESSMENT PANEL REPORT

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Student Distribution (SA or better)

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