



Overall it was a straightforward examination paper, which led to a cluster of candidates presenting excellent scripts. It is important that candidates aiming for 'A' ratings must give attention to detail in their responses so they differentiate themselves. This is particularly important in such an exam. For the less able candidate, there were sufficient predictable questions to allow a well-prepared candidate the opportunity to gain sufficient C ratings for an SA.

There has been a decline in the standard of presentation of work over recent years. It is far easier for the candidate and the marker to follow the logic used in answers if a little care is taken when completing problems. The simple step of putting the arrowhead on a vector is expected. There appears to be a few problems with reading calculators when using scientific notation. Too many candidates are unable to interpret the calculator display of 6.02E23 as 6.02×10^{23} .

Those candidates who know they are weak at transposing equations when completing mathematical problems should put all possible permutations of the transpositions on their information sheet to help alleviate the problem. It is probably a better use of space on the information sheet that copying a copious number of problems in tiny handwriting! A few well-chosen sample solutions and phrases is a far better tactic.

Throughout the exam the inclusion of units were good, even though they were not always the correct one, eg the unit for mass was sometimes confused – grams often being used in Physics problems rather than kg. Candidates should be aware of the more common prefixes used – eg mA (milliamp) and MW (megawatts) – and how these are converted to SI units.

Part 1

Question 1

- (a) Very well done.
- (b) Both parts were generally well done, although a surprising number of candidates did not use the speed in m s^{-1} (calculated in part (a)), instead incorrectly opting to use 50 km h^{-1} . Many candidates did not include a direction in either part. In part (ii) some candidates who used $u = 0$ rather than $v = 0$ and gained the correct answer were penalised for using incorrect processes.

Question 2

Although most candidates made some attempt at this question, it was poorly done with very few receiving full marks. Common errors were:

- Not starting at $v = 0$. (The ball is dropped.)
- Mistaking a change in gradient (acceleration) as a change in direction.
- Not indicating the change in direction and where the ball is caught.
- Having curved lines, like a displacement time graph.
- No negative velocities were included, indicating that candidates do not realise that if the ball is moving in the upward direction then it must have an opposite sign for velocity when it is travelling downwards.

Question 3

This question was either done well or not attempted. Some candidates did not indicate direction. There were a few who tried using conservation of energy. Others used $F = ma$ and substituted the velocities for 'a' and thus may have even got the correct answer, however marks were deducted. Some tried using ratios, generally getting the wrong answer (15 ms^{-1} the most common).

Question 4

- (a) Well done although a few multiplied by 0.5 m s^{-2} , or even 9.3 m s^{-2} or 10.3 m s^{-2} , to obtain the weight rather than by 9.8 m s^{-2} . The most common error was giving units for the answer as kg rather than N.
- (b) Many candidates calculated lift force here, showing that they have not understood that the acceleration is due to the resultant force. Again, the direction was often forgotten.
- (c) Poorly done. Many who had calculated lift force in (b) gave the net force here. Others just used net force or weight. Some had the right idea to combine the two forces from parts (a) and (b) but subtracted rather than added them (as scalars).

Question 5

The results in this question were polarised as candidates could either do it well, made a woeful attempt or left it completely blank. The main problem was the failure to recognise the difference between the vertical and horizontal information and both were erroneously used in the same equation. Many failed to recognise the stone was accelerating and simply incorrectly used $t = s/v$, with the s being the vertical displacement and v the horizontal velocity! There was often confusion with signs.

In part (c) the vector diagram was very poorly done. A triangle does not constitute a vector diagram and few had the concept of adding the components head to tail to obtain the resultant. It was disappointing to see a number of candidates mixed a combination of velocity, acceleration and displacement in the same diagram. A proportion did not give a direction and a small number gave their answer in terms of north and east! Some candidates obviously had

their calculator in radians, resulting in a very small angle for the answer but failed to comment on it.

Question 6

- (a) Satisfactory. Those candidates who tried an in-depth analysis of the Physics behind this common phenomenon became muddled. The fact that forces were equal and opposite, but acted on different bodies was not made clear. Attempted explanations using Newton's Second Law was also a common error.
- (b) (i) was generally well done, although there appeared to be some confusion over the term 'resultant' as some candidates gave a good reasoned answer but unfortunately ended by saying the resultant was greatest at 20 seconds because the air resistance was greatest at this point.
- (ii) was also well done. Candidates were not penalised for showing forces directed to the centre of mass of the body rather than from the centre of mass. Some candidates correctly drew a diagram showing drag to be greater than weight. Realising that the net upward force would result in an upward acceleration, they, unfortunately panicked, scrapped their diagram and redrew it incorrectly. These candidates failed to appreciate that an object can be moving downward, but accelerating in the opposite direction (ie decelerating, or slowing down).

Question 7

This was well done by candidates who had any knowledge of motion or analysis of numbers. Very few used Physics principles to answer part (b), rather relying on looking for patterns in the data as an alternative approach. (Maths teachers would be pleased!) Part (c) was a gift for the vast majority.

Part 2

Question 8

The symbol for graphite was a major problem. Most left it blank, whilst others creatively used symbols such as Gr. Many wrote Cl as the symbol for chlorine gas rather than Cl₂. Many just put 'covalent' for bonding type, despite the example given to indicate what was expected.

Question 9

Most candidates had a good idea of the concepts examined in these questions, but sufficient detail was often lacking in the answers. Quite a few thought KCl was covalent network.

In part (b) many candidates had the right idea, but failed to mention energy. Many waffled, telling the examiner all they knew about covalent molecular compounds without answering the question.

Question 10

Many correctly drew an electron dot diagram for PCl_3 , showing only the valence electrons. Often presentations had most strange shapes! The atoms were just listed anywhere on the page and then bonding electrons were joined up with ovals. Diagrams for C_3H_4 were not drawn to the same standard.

Question 11

Was very well answered, although many used unnecessarily complicated, polyatomic ions eg $\text{Cr}_2\text{O}_7^{2-}$. Another common error was to put water and other non-ionic compounds as the answers. Perhaps some candidates were confused by the instruction: *X and Y do not represent the symbols of elements.*

Question 12

All parts were very well answered, even if other parts of criterion 8 were poorly answered. Specifically:

- In the first naming, very few used the correct order for chloro and fluoro (2-chloro-1-fluoro, not 1-fluoro-2-chloro).
- Many candidates could not spell chloro and fluoro.
- In the second naming common errors included:
 - numbering the 'bromos' as 1, 2, 2 or 1, 2, 3.
 - many missed including 'tri' in tribromo
 - many named the functional group as 1-bromo-2, 2-dibromo. Of those who used this naming, many didn't put 2, 2-dibromo but just 2-dibromo.
- Most candidates had little idea where to put commas and dashes.
- The structural formulae were well drawn, with the most common error being including an extra H on either side of the double bond.

Question 13

Extremely poorly done. Many did not even attempt the question.

Question 14

Satisfactory responses, with a common error being incorrectly adding charges to the symbol C in the first isotope. Difficulties were encountered when working out the number of electrons in both of the charged isotopes.

Question 15

Both parts of this question were generally well answered. A common error in part (a) was to say that the delocalised electrons ‘create charge’. The thermal properties were often mentioned unnecessarily, indicating possible copying of prepared answers off the information sheet.

In part (b) many failed to discuss electrical conductivity tests on the aqueous solution or when molten. Sometimes properties of ionic compounds were quoted, rather than answering the question. Many opted to consider brittleness and non-conductivity of solid ionic compounds as defining characteristic of ionics. Candidates must realise that structures other than ionics exist that have these properties.

Question 16

- (a) Satisfactorily answered, although many failed to fully analyse the data given. ‘Very poor’ conductivity was interpreted as there being some conductivity. Very few used pH in their answer. ‘Sparingly soluble was interpreted as completely soluble. Many said NaCl had a smell and was acidic!
- (b) (i) was extremely poorly done. Many correctly gave ‘ions’ as the answer, but only a handful knew the reasons why. Candidates mixed up the terms ions and atoms, showing a lack of understanding of the concepts.
- (ii) was generally ok, but many candidates didn’t refer specifically to bonding.

Part 3

Candidates generally scored well in this section. Specific comments include:

- Answers were occasionally rounded off too much, sometimes to the nearest whole number!
- There was confusion between N and J for correct unit for energy.
- Energy was made a vector quantity eg Joules up or Joules down!

Question 17

- (a) Well done. A surprising number gave Conservation of Momentum or Newton's Laws of motion.
- (b) Poorly done by many as they had difficulty interpreting the picture. Many thought that the wheel was driving the water rather than vice versa (no knowledge of water-driven mills?) Many just restated the law.

Question 18

- (a) An alarmingly large percentage of candidates did not convert grams to kilogram in the calculation. Also many failed to square the velocity even though they had the correct formula.
- (b) Well done.
- (c) Candidates often only calculated the KE and did not subtract their answer from part a (total energy) to determine the PE. Many tried to use the velocity given as the height in the PE formula.
- (d) Well done by most. A number found the displacement down from the maximum height rather than the height from the ground.

Question 19

Candidates scored well but did not apply their knowledge to answer the question regarding penetration. Many quoted paper, aluminium and lead instead of distance travelled in air. A few candidates did not have a clear idea of mass number and electrical charge in relation to γ -radiation.

Question 20

- (a) Done very well.
- (b) Many candidates wrote a nuclear equation where Th was irradiated with α particles, rather than Th decaying to give α particles.

Question 21

- (a) This question was generally well done by the majority of candidates. On occasions candidates put the emitted particle on the LHS of the equation and generated a molybdenum isotope.
- (b) Generally done well. Common errors included using number of half-lives one less than required and incorrectly stating the units as g instead of mg.
- (c) Not well understood. Many suggested that the mass disappeared into the air.
- (d) Common errors included number of half lives one less than required and complications from using a formula rather than illustrating with simple maths.

Question 22

- (a) Commonly transposition errors were evident. The current of 56 mA was not dealt with very well.
- (b) The most common error involved converting 20 min to 1200 s.
- (c) Done well.

Question 23

- (a)
 - (i) candidates displayed a poor understanding of the concepts of voltage, current and resistance, resulting in vague explanations. The easiest approach was to complete a sample calculation: eg consider a 60 W light globe. Calculate the current it would draw in Aust and compare the current drawn for the same globe connected to the 110 V electricity grid in USA.
 - (ii) was generally well done.
- (b) Although it was generally well done candidates often could not logically develop the answer. Too many said $2.5 < 3$ therefore it works!

Very few candidates were able to give any sort of a reasonable answer in part (ii). The longer path increases the resistance was incorrectly offered in many answers. Also some confusion about coils and heater elements occurred. Electricity can't go through 'kinks' was another common erroneous answer.

Part 4**Question 24**

- (a) A few had problems balancing the equation.
- (b) Well done in general. States of matter were omitted on several scripts even though they had been provided in the question. Some candidates did not recognise formula for hydrogen carbonate even though it was on the Information Sheet; others failed to recognise sulphuric acid as H_2SO_4 or wrote potassium sulphate as KSO_4 instead of K_2SO_4 .
- (c) Many wrote CuOH_2 instead of $\text{Cu}(\text{OH})_2$. Some failed to include 2OH^- or did not recognise that $\text{Cu}(\text{II})$ meant Cu^{2+} .

Question 25

- (a) Very well done.
- (b) Many candidates omitted to include units or mixed up the units e.g. mol^{-1} , g or amu (a common error).
- (c) Generally well done. Some candidates wasted time trying to identify the compound when this was clearly not required. (The compound does not exist, our apologies.)

Question 26

- (a) Many candidates experienced problems here. Many rewrote the equation or just added charges.
- (b) Problem with units as in 25 (b). Several candidates used molar masses of boron or beryllium instead of barium. Too many candidates used atomic number instead of mass.
- (c) Several strange methods used here – using mass ratios or percentage mass instead of mole ratio was disturbingly common. Marks were deducted for not clearly indicating the 1:1 ratio i.e. $n(\text{BaCl}_2) = n(\text{BaSO}_4)$. Several candidates calculated using BaCl as barium chloride; others confused BaCl_2 with BaSO_4 in their calculations.

Question 27

Many also ignored the mole ratio in this question. Several candidates confused 'c' with 'n' assuming $n = 0.102 \text{ mol}$ instead of $c = 0.102 \text{ mol L}^{-1}$. Adding the volumes, using 45 mL instead of 25 mL, also was an error; others insisted on converting to grams.

Question 28

A complex question that many candidates did not attempt. Those who did usually achieved a majority of marks, with the most common error being multiplying both the number of moles and the molar mass of oxygen by 6.

Question 29

- (a) Use of N_A was often badly done or not done at all. In part (ii) the majority of candidates did not correctly demonstrate that a water molecule contains two hydrogen atoms.
- (b) Few candidates understood how to start the calculation.
- (c) Many candidates seemed unaware of the dilution equation and attempted to find the number of moles, but couldn't correctly substitute the values into the equation. A significant number of candidates who converted one of two volumes from millilitres to litres failed to convert the other.

Question 30

- (a)
 - (i) Candidates offered little information that actually addressed the criterion for this 2-mark question. There was a great deal of ambiguity in the phrasing of many responses.
 - (ii) Many candidates may have been confused by the use of plural *gases* in the question and gave reaction equations that included two or more of C, CO and CO₂ for products.
- (b) Most candidates could correctly formulate reactants although a few didn't know nitric acid was HNO₃. Many had trouble identifying and formulating products – so balancing became difficult. It was an advantage to indicate that none of the products would be solid in an aqueous environment. Use of colloquial terms for the action of the acid, such as 'melts' and 'burns', tended to obscure the candidate's explanation.

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PHYSICAL SCIENCES '5C
TCE EXAMINATION 2006
ANSWER SUMMARY

CRITERION 7

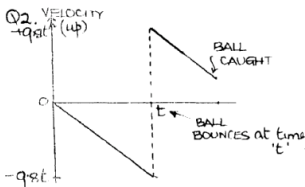
Q1. (a) speed = 50.0 km h^{-1}
 $= \frac{50.0}{3.60} \text{ m s}^{-1}$
 $= 13.9 \text{ m s}^{-1}$

(b) (i) $u = 13.9 \text{ m s}^{-1}$ (north)
 $v = 0$
 $t = 5.00 \text{ sec}$
 $a = ?$

$\therefore a = \frac{v-u}{t} = \frac{0-13.9}{5.00}$
 $= -2.78 \text{ m s}^{-2}$
 $\therefore \text{Accel} = -2.78 \text{ m s}^{-2}$ (north)

(ii) $s = \frac{(u+v)t}{2} = \frac{(13.9+0) \times 5}{2}$
 $= 34.7 \text{ m}$

\therefore Displacement is 34.7 m (north)



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Q3. $\begin{matrix} 00.0 \text{ g} & 45.0 \text{ g} \\ \text{A} & \text{B} \end{matrix}$
 $\leftarrow 20 \text{ m s}^{-1} \quad \rightarrow x \text{ m s}^{-1}$

$P_{\text{INIT}} = 0 \text{ kg m s}^{-1}$
 $P_{\text{FIN}} = P_A + P_B$
 $= \{0.020 \times (-20.0)\} + \{0.045 \times x\}$
 $= 0.045x - 1.20 \text{ kg m s}^{-1}$

Thus from LCM $P_{\text{INIT}} = P_{\text{FIN}}$
 $\therefore 0 = 0.045x - 1.2$
 $\therefore x = \frac{1.2}{0.045} = 26.7 \text{ m s}^{-1}$
 \therefore Smaller part moves at 26.7 m s^{-1} to the right.

Q4. (a) Balloon's wt. = mg
 $= (350 \times 9.81) \text{ N}$
 $= 343 \text{ kN}$ (down)

(b) $F_{\text{NET}} = ma$
 $= (350 \times 0.500) \text{ N}$
 $= 175 \text{ N}$ (upwards)

(c) $F_{\text{LIFT}} = F_w + F_{\text{NET}}$
 $= (343 + 0.175) \text{ kN}$
 $= 361 \text{ kN}$ (upwards)

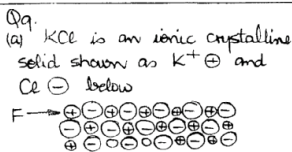
Q5. (a) VERTICAL MOTION:
 $s = 95.0 \text{ m}$
 $a = 9.81 \text{ m s}^{-2}$ (down)
 $t = ?$
 $u = 0 \text{ m s}^{-1}$

Thus $95.0 = 0 + \frac{9.81t^2}{2}$
 $\therefore t^2 = \frac{2 \times 95.0}{9.81} = 19.4$

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CRITERION 8

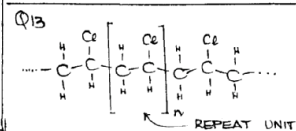
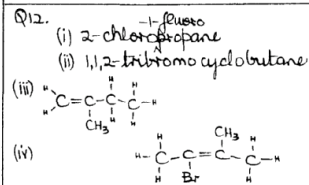
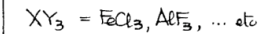
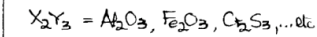
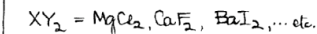
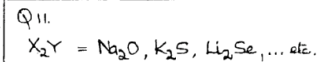
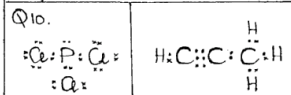
Q8. calcium fluoride = CaF_2 and is IONIC.
 Graphite = C_{60} and is a (2D) COVALENT NETWORK.
 Uranium = U and has metallic bonding
 Chlorine gas = Cl_2 and is COVALENT MOLECULAR



When a force is applied as shown with F above. The dislocation causes like charge ions to come closer (i.e. $\oplus-\oplus$ and $\ominus-\ominus$) and electrical repulsion forces (opposites attract but like charges repel!) cause the crystal to fly apart i.e. shatter.
 \therefore KCl is brittle!

(b) Perfumes are organic compd. comprising covalent molecular compounds with weak van der Waals (dispersion) forces between molecules. These weak

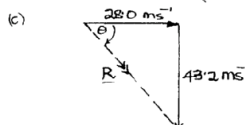
intermolecular attractions mean that molecules are able to break away from others in the liquid and become gaseous molecules. \rightarrow odour is detected by inhaling gaseous compounds.



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Q5. (a) cont.
 \therefore Stone took 4.40 sec to hit the sea.

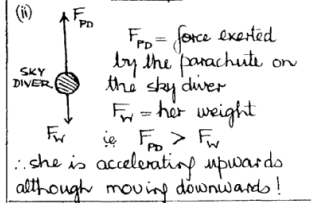
(b) $v = u + at$
 $= 0 + 9.81 \times 4.40$
 $= 43.2 \text{ m s}^{-1}$ (down)
 Vertical impact velocity = 43.2 m s^{-1} (down)



Thus $R^2 = 28.0^2 + 43.2^2$ (Pythag)
 $\therefore R = 51.5 \text{ m s}^{-1}$
 $\theta = \text{atan} \left(\frac{43.2}{28.0} \right) = 57.1^\circ$
 \therefore Resultant velocity of the stone is 51.5 m s^{-1} at 57.1° below horizontal.

Q6. (a) the force exerted by the insect on the car (F_{IC}) is equal in magnitude but oppositely directed to the force exerted by the car on the insect (F_{CI}) i.e. $F_{\text{IC}} = -F_{\text{CI}}$. This is in direct agreement with Newton's Third Law (NIII).
 (b) (i) At 100 sec the net force on her is downwards \therefore she is accelerating downwards but at 20.0 sec the net force on her

accelerating and has reached terminal velocity.



Q7. (CRITERION 6)
 (a) Reaction time = $\frac{\text{reaction distance}}{\text{speed}}$
 $= \frac{6.00 \text{ m}}{10.0 \text{ m s}^{-1}}$
 $= 0.600 \text{ sec}$ (const)

(b) Stopping distance = $x \text{ m}$ where
 $x = \left\{ \text{speed} \times \left(\frac{\text{speed}}{10} + 1 \right) \right\} (0.600)$
 \therefore At 50.0 m s^{-1}
 $x = 50 \times (6 \times 0.600) = 180 \text{ m}$
 \therefore Stopping distance = 180 m at 50 m s^{-1}

(c) Road surface, tyre wear, brakes being worn or overheated, driver inattention, ... Stopping distance is largely determined by the force exerted by the road on the car. If the road surface is icy or loose gravel \rightarrow less frictional force \rightarrow longer stopping distance \therefore DANGER

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Q14.

SYMBOL	PROTONS	NEUTRONS	ELECTRONS
${}^6_6\text{C}^0$	6	6	6
${}^{27}_{13}\text{Al}^{3+}$	13	15	10
${}^{16}_8\text{O}^{2-}$	8	8	10

Q15. The outer (valence) e^- in metals are not strongly held in their orbitals and are thus able to move readily from atom to atom. This e^- movement is random until an electric potential is applied and then these outer delocalised (no fixed position) mobile e^- move towards the \oplus electrode.

This regular flow of e^- is described as an electric current. \therefore metals conduct electricity very well because of the weakly held outer valence electrons.
 (b) Dissolve CuCl_2 solid in water. The previously rigidly held ions (Cu^{2+} and Cl^-) were unable to move (apart from vibrate) \therefore solid CuCl_2 = non conductor. Now the solution will give the ions the property of being

mobile. Thus an electric potential to test the conductivity of $\text{CuCl}_2(\text{aq})$ shows it to be a v. good electrical conductor as Cu^{2+} ions move to the cathode and Cl^- ions move towards the anode.
 This information:
 (i) $\text{CuCl}_2(\text{s})$ = non conductor
 (ii) $\text{CuCl}_2(\text{aq})$ = good conductor
 is sufficient to come to the conclusion that CuCl_2 = IONIC

Q16 (CRITERION 6)
 (a) $\text{NaCl}(\text{s})$ = ionic \therefore has a high melting point (actually 801°C)
 $\text{NaCl}(\text{aq})$ = neutral $\therefore \text{pH} = 7.0$
 $\text{NaCl}(\text{aq})$, $\text{NaCl}(\text{l})$ = v. good electrical conductor
 \therefore all information suggests that the powder is NOT NaCl!

(b) (i) Milk will contain Na^+ & Ca^{2+} ions, not atoms. Metallic sodium atoms (s Ca) would react explosively with the water in the milk.
 (ii) The organic fat molecules have only C-C single bonds between the carbon atoms if the molecules are described as 'SATURATED' (no double or triple bonds!)

CRITERION 9.
 Q17 (a) For any closed system the total initial energy before a change is equal to the total final energy after the change.
 i.e. $(E_k + E_p)_{INI} = (E_k + E_p)_{FIN}$
 (b) Despite the optical illusion of the Escher Water Wheel the potential energy of the water initially will be greater than the E_p of the water when it returns due to the energy needed to overcome friction in the water wheel's axle and friction between the water and the channel through which it flows. i.e. "perpetual motion" is impossible due to energy losses in doing work to overcome friction. Some of the energy losses occur as heat, sound and even evaporation!
 Q18.
 (a) $E_k = \frac{1}{2}mv^2 = \frac{0.055 \times 120^2}{2} = 3.96 \text{ J}$
 (b) E_p at highest point = 3.96 J
 (c) $E_{TOT} = 3.96 \text{ J} = E_k + E_p$
 Now $E_k = \frac{1}{2}(0.055 \times 400^2) = 0.44 \text{ J}$

Thus $E_p = (3.96 - 0.44) \text{ J} = 3.52 \text{ J}$
 (d) $mgh = 3.52 \text{ J}$
 $\Rightarrow 0.055 \times 9.81 \times h = 3.52$
 $\therefore h = 6.52 \text{ m}$
 \therefore Ball's ht. is 6.52 m

Q19. SPECIES	MASS NO.	ELEC. CHGE.	PENETRAT'N. IN AIR
α	4	+1	1-4 cm
β	0	-1	10-20 cm
γ	0	0	v. large distance
neutron	1	0	v. large distance

Q20.
 (a) ${}^1_0\text{C} \rightarrow {}^1_7\text{N} + {}^0_{-1}\text{e} + \bar{\nu}$
 $X = \beta$ (beta particle)
 (b) ${}^{234}_{90}\text{Th} \rightarrow {}^{230}_{88}\text{Ra} + {}^4_2\text{He}$
 Q21. (a) ${}^{99}_{43}\text{Tc} \rightarrow {}^{99}_{44}\text{Ru} + {}^0_{-1}\text{e} + \bar{\nu}$
 (b) ${}^{135}_{53}\text{I} \rightarrow {}^{135}_{54}\text{Xe} + {}^0_{-1}\text{e} + \bar{\nu}$
 $36\text{h} = 6 \times \frac{1}{2} \text{ lives}$
 $1.56 \text{ mg} \rightarrow 0.78 \text{ mg}$
 \therefore Only 0.78 mg of Tc remains
 (c) The missing mass has undergone transmutation into the new

(c) contd.
 isotope of ruthenium 99 (see nuclear equation (a))
 (d) ${}^{200}_{84}\text{Po} \rightarrow {}^{160}_{84}\text{Po} \rightarrow {}^{125}_{84}\text{Po} \rightarrow {}^{75}_{84}\text{Po}$
 \therefore After 3 half-lives the activity will be approx 40 Bq
 i.e. time needed = $3 \times 6 = 18.0 \text{ h}$
 (NB This assumes ${}^{99}\text{Ru}$ is NOT radioactive!)

Q22.
 (a) $V = 900 \text{ volt}$
 $I = 0.0560 \text{ A}$
 $R = ? \Omega$
 $\therefore R = \frac{V}{I} = \frac{900}{0.056} = 161.52$
 \therefore Resistor is 161.52
 (b) $Q = I \times t$ (t = seconds)
 $= (0.0560 \times 20 \times 60) \text{ C}$
 $= 67.2 \text{ coulombs}$
 \therefore Charge passing = 67.2 C
 (c) $E = \sqrt{I \times t} \text{ J (or QV)}$
 $= (900 \times 0.0560 \times 20 \times 60) \text{ J}$
 $= 605 \text{ J}$
 \therefore Energy dissipated = 605 J
 CHECK
 $E = Q \cdot V = (67.2 \times 900) = 605 \text{ J} \checkmark$

Q23. NO! Consider a 1000W heater designed for use with US 110V supply.

$P = 1000 = V \times I = 110 \times I$
 \therefore current = 9.09 A and thus its resistance is
 $R = \frac{V}{I} = \frac{110}{9.09} = 12.1 \Omega$
 Thus, if used in Australia with 240V
 $I = \frac{V}{R} = \frac{240}{12.1} = 19.8 \text{ A}$
 $\therefore P = 4750 \text{ W}$
 \rightarrow twice the current for which its power rating (1000W) is designed i.e. A 1000W appliance for the US behaves as if it's a 4750W heater \therefore highly DANGEROUS to operate (fuses will blow hopelessly!)
 (ii) We pay for energy (E) not power. Its the time (t) as well as the power (P) that determines energy used $E = P \times t$
 eg Aurora sell us energy at around 12¢ per kWh (not per kW)
 Q23 (b)
 (i) $P = V \times I$
 $2500 = 240 \times I$
 \therefore heater needs a current of 10.1 A
 \therefore lead can't be used coiled or uncoiled!
 (ii) lead may not be adequately ventilated and become excessively hot \therefore insulation may melt and sparking could result in a fire \therefore great danger. An uncoiled lead will be kept cooler.

CRITERION 10.
 Q24.
 (a) $3\text{HNO}_3 + \text{Fe}(\text{OH})_3 \rightarrow \text{Fe}(\text{NO}_3)_3 + 3\text{H}_2\text{O}$
 (b) $2\text{KHCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + 2\text{CO}_2 + 2\text{H}_2\text{O}$
 (c) $\text{Cu}^{2+} + 2\text{OH}^- \rightarrow \text{Cu}(\text{OH})_2$
 Q25. Ratio of moles of atoms is
 (a) $n(\text{C}) : n(\text{H}) : n(\text{O})$
 $= \left(\frac{37.5}{12.0}\right) : \left(\frac{12.5}{1.00}\right) : \left(\frac{50.0}{16.0}\right)$
 $= 3.13 : 12.5 : 3.13$
 $= 1 : 4 : 1$
 \therefore empirical formula is CH_4O
 (b) $0.200 \text{ mole} = 12.8 \text{ g}$
 $\therefore 1.00 \text{ mole} = 5 \times 12.8 \text{ g} = 64 \text{ g}$
 \therefore molar mass = 64.0 g mol^{-1}
 (c) $M_r(\text{CH}_4\text{O}) = (12 + 4 + 16) = 32$ (i.e. half of 64)
 \therefore true formula is $\text{C}_2\text{H}_8\text{O}_2$
 Q26
 (a) $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$
 (b) $M(\text{BaSO}_4) = (137 + 32 + 64) = 233$
 \therefore molar mass = 233 g mol^{-1}

(c) $n(\text{BaSO}_4) = \frac{\text{mass}}{M_r} \text{ mole}$
 $= \frac{11.7}{233} = 0.0502 \text{ mole}$
 $\therefore n(\text{BaCl}_2) = 0.0502 \times 1 \text{ mole}$
 \therefore mass $\text{BaCl}_2 = (0.0502 \times 208) \text{ g} = 10.4 \text{ g}$

Q27.
 $n(\text{NaOH}) = (\text{molarity} \times \text{L}) \text{ or } (C \times V)$
 $= 0.102 \times 25 \times 10^{-3}$
 $= 2.55 \times 10^{-3} \text{ mole}$
 $\therefore n(\text{HCl}) = (2.55 \times 10^{-3} \times 1) \text{ mole}$
 \Rightarrow Conc of $\text{HCl} = \frac{\text{moles}}{\text{L}}$
 $= \frac{2.55 \times 10^{-3}}{201 \times 10^{-3}}$
 $= 0.127 \text{ mol L}^{-1}$

Q28. $M_r(\text{C}_6\text{H}_{12}\text{O}_6) = (6 \times 12.0) + (12 \times 1.0) + (6 \times 16.0) = 180.0$
 $\therefore n(\text{C}_6\text{H}_{12}\text{O}_6) = \frac{\text{mass}}{M_r} = \frac{36.5}{180} = 0.203 \text{ mole}$
 $\therefore n(\text{O}_2) \text{ needed} = (0.203 \times \frac{6}{1}) = 1.22 \text{ mole}$
 \therefore mass of $\text{O}_2 = (\text{mole} \times M_r) \text{ g}$
 $= (1.22 \times 32.0) \text{ g} = 38.9 \text{ g}$
 \therefore Mass of O_2 needed = 38.9 g

Q29. $M_r(\text{H}_2\text{O}) = 18.0$
 (a) $n(\text{H}_2\text{O}) = \frac{4.50}{18.0} \text{ mole} = 0.250 \text{ mole}$
 \therefore No. of water molecules = $0.250 \times 6.02 \times 10^{23} = 1.51 \times 10^{23}$ molecules
 (ii) No. of H atoms = $2 \times (1.51 \times 10^{23}) = 3.01 \times 10^{23}$
 (b) 6.02×10^{23} molecules of H_2O have a mass of 18.0 g
 $\therefore 1 \text{ molecule} = \left(\frac{18.0}{6.02 \times 10^{23}}\right) \text{ g} = 2.99 \times 10^{-23} \text{ g}$
 (c) New conc. = old conc. \times dilution ratio
 $= (0.400 \times \frac{15.0}{250}) \text{ mol L}^{-1} = 0.0240 \text{ mol L}^{-1}$

Q30. (CRITERION 6)
 (a) The incomplete combustion of petrol may produce as well as CO_2 and H_2O some unburnt carbon (black soot = C_s) and some CO_g = carbon monoxide eg
 $\text{C}_8\text{H}_{18} + 9\text{O}_2 \rightarrow 2\text{C}_s + 3\text{CO}_g + 3\text{CO}_2g + 9\text{H}_2\text{O}_g$
 etc....
 (any equation with C_s & H_2O_g)

Q30 (b)
 Acid rain contains H^+ from such acids as H_2SO_4 , H_2CO_3 , etc. The acid rain will dissolve CaCO_3 and cause egg shells to be thin (or even break) \therefore the likelihood of successful reproduction in birds is lowered
 $\text{CaCO}_3 + 2\text{H}^+ \rightarrow \text{Ca}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$
 SHELL from acid rain

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