PHYSICAL SCIENCE

Paper 8780/01
Multiple Choice

Question Number	*Key*	*Question Number*	*Key*
1	**C**	16	**B**
2	**D**	17	**D**
3	**C**	18	**B**
4	**C**	19	**C**
5	**D**	20	**C**
6	**B**	21	**C**
7	**A**	22	**B**
8	**D**	23	**C**
9	**A**	24	**A**
10	**B**	25	**B**
11	**A**	26	**C**
12	**D**	27	**B**
13	**D**	28	**C**
14	**D**	29	**A**
15	**B**	30	**A**

Key messages

Candidates who performed well were able to use their knowledge in familiar and unfamiliar contexts, as well as in simple recall of factual information.

General comments

The physics based questions were generally done well, with many candidates showing a good basic knowledge. Candidates performed particularly well on **Questions 4**, **8**, **9**, **10** and **23**. Candidates found **Questions 2**, **7**, **17**, **21**, **22** and **29** to be more challenging.

Comments on specific questions

Question 2

Many candidates struggled with this question and many did not realise that the velocity of this object remains in the same direction throughout.

Question 3

Although many candidates gave the correct answer, a considerable number thought that the bob was in equilibrium and the resultant force on it was zero

Question 4

Many candidates successfully determined the torque and selected option **C**.

Question 5

Some candidates thought that the two cars gained the same amount of kinetic energy.

Question 7

Option **D** was selected more often than the correct answer suggesting that some candidates were unfamiliar with interpreting oscilloscope traces.

Question 9

The representation of the position of particles was correctly selected by the majority of candidates.

Question 11

Many candidates were not able to determining the enthalpy of combustion and **A**, **B** and **C** were all popular responses.

Question 17

Many candidates were not familiar with the properties of Group II metals and their compounds.

Question 18

All options were chosen equally, indicating a lack of knowledge regarding ammonium chloride.

Question 21

Option **D** was a more popular choice than the correct answer of **C**, indicating that candidates were not confident in their understanding of scalar quantities.

Question 22

The majority of candidates recognised that the speed of the two objects would be the same, however, nearly one third did not recognise that if the speeds of identical objects are the same, their kinetic energies must also be the same.

Question 30

Many candidates were not confident interpreting the formula of the organic species.

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Paper 8780/02
Paper 2: Short Response

Key messages

Some responses lacked the detail expected at this level.

Balancing chemical equations and presenting structural formulae were a general area of weakness.

General comments

Candidates appeared to have sufficient time to complete the paper and responses were generally clearly presented.

Candidates found **Question 10** to be particularly challenging and **Question 2** to be relatively easy.

Comments on specific questions

Question 1

Many candidates described macroscopic properties of gases and liquids, rather than the microscopic properties that explain these properties.

Question 2

(a) Most candidates identified polymerisation. A common misconception was that the reaction shown is called cracking.

(b) Being non-biodegradable was identified by some candidates. Very few candidates knew that harmful combustion products are produced.

Question 3

Explanations of the conditions for equilibrium, in this context, were often imprecise. The linking of this example to the required conditions was done rather better.

Question 4

The terms, random and spontaneous, when referring to radioactive decay were reasonably well understood.

Question 5

(a) Some candidates knew that a catalyst increases the rate of a reaction; fewer knew that the catalyst is not consumed itself or that an alternative reaction pathway with a lower activation energy is provided. Some candidates gave vague answers such as ‘the reaction changes’, which was not credit worthy.

(b) Many candidates stated the catalyst was a catalytic convertor, rather than giving the name of a suitable catalyst.

(c) Some candidates could identify the correct reactants and products, but very few candidates could give a fully correct balanced symbol equation.

Question 6

(a) The shape of the electric field was well known. The most common errors included not starting and finishing the lines of force on the plates and not drawing the lines with equal spacing across the whole of the plates.

(b) There were a few candidates who did not convert the centimetres to metres and a few who introduced the charge on an electron into the equation.

Question 7

Some fully correct responses were seen. It was common to ignore the percentage of Na_2SO_4 in the calculation. A few errors in the determination of the *M*r of Na_2SO were also observed**.**

Question 8

Many candidates knew that there is an increase in the number of protons and there is stronger attraction between the nucleus and electrons. It was less common to see answers that included a reference to the same number of shells or the same amount of shielding.

Question 9

Many candidates thought that the gap width had to be smaller than the wavelength of the light, rather than of the same sort of order of magnitude as the wavelength.

Question 10

Candidates found this a challenging question and fully correct responses were rarely seen. Many candidates were unaware that carbon is tetravalent.

Question 11

Generally, this was done well with most candidates correctly calculating the resistance of the heater. The most common error in calculating the decrease in power was to use the calculated value of current from **(a)**, forgetting that if the supply voltage is decreased and therefore there would be a decrease in the current.

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Paper 8780/03
Paper 3: Structured Questions

Key messages

- Some responses lacked the detail and specific references required at this level of examination.
- Candidates were not confident balancing chemical equations or representing compounds using displayed formula.

General comments

There were some excellent papers which showed that candidates had been well prepared for the examination and had a good understanding of Physical Science, both of basic and more challenging concepts. There were, however, other papers where candidates had no real knowledge of the subject and were clearly entered at a level which was beyond their capabilities.

There was no evidence to suggest candidates ran out of time. Reponses were mostly presented clearly.

Comments on specific questions

Question 1

Although the better prepared candidates answered this question well, there was a large number who had no understanding of uncertainties at all, not even recognising that the total uncertainty when subtracting two values is the sum of the individual uncertainties of the two values. The calculation of the percentage uncertainty caused even more problems. It is more understandable that calculating the uncertainty from a more complex formula caused even more problems.

uncertainty = ± 2 cm
percentage = 4.2%
uncertainty = 1900 N

Question 2

(a) Many candidates were familiar with the increasing strength of intermolecular forces; some related this to increased numbers of electrons.

(b) Responses were often vague and did not include specific references to outer electrons or reduced attraction between the nucleus and outer electrons. Some responses referred to reduced force, which is not specific enough, as forces can also be repulsive.

(c) A minority of candidates were familiar with a suitable experiment to show that chlorine is a stronger oxidising agent than iodine. A correct observation was rarely seen and it was common to see incorrectly balanced equations.

Question 3

(a) The most common error was the failure to recognise that the displacement of the force must be in the direction of the line of action of the force.

(b) The majority of candidates were able to calculate the work done on the sphere by the Moon's gravitational field. Fewer, however, recognised that the loss in gravitational potential energy of the sphere was equal to this work done.

work done = 2.84 J
loss in gravitational potential energy = 2.84 J

(c) (i) This was done well, with the vast majority of candidates scoring both marks.

power = 600 W

(ii) This section showed the lack of experience of candidates regarding thinking through a problem and working through it in a logical fashion. Those who showed some understanding rarely showed any order in their layout and it was very difficult to determine what the candidate was trying to do, from the jumble of numbers that were written down.

area of solar panel = 17.8 m^2

Question 4

(a) (i) The correct name was usual seen.

(ii) Common errors were to not include the dot to show the formation of a free radical.

(iii) It was rare to see two fully correct steps in the propagation stage.

(iv) Some candidates gave a correct displayed formula; many incorrect structures were seen and errors in the representation of a displayed formula such as missing hydrogens or non-tetravalent carbons.

(v) Most candidates could write a correct termination equation.

(b) **P** was usually correctly given as ammonia; **Q** was rarely seen.

Question 5

(a) Although the vast majority of candidates understood the meaning of the term momentum, a small minority confused this with the term moment of a force about a point.

(b) This was done fairly well with many candidates scoring all three marks. Some were confused and tried to use the kinetic energies of the gliders to find the velocity of glider **A** after the collision.

velocity = –0.80 m s^{-1}

(c) Another section that was done quite well. It was pleasing to find many candidates set out their working clearly and linked their calculations to their conclusions.

Question 6

(a) (i) The effect of increased rate was usually correct; the explanation was often lacking in detail. Some candidates commented on more collisions but did not qualify this by reference to more 'successful' collisions 'per unit time'. Better performing candidates also noted that more molecules have energy greater than the activation energy.

The effect of decreased yield as often incorrect and the correct reason for this was usually unknown.

(ii) Responses tended to focus on cost implications rather than rete of reaction being too slow at low temperatures and yield being too low at high temperatures, as a reason for the compromise conditions used in the Haber process.

(iii) Many candidates made errors in their initial calculation; often not multiplying by two where required or subtracting the wrong numbers.

(c) (i) Hydrogen bonding was well known.

(ii) The explanation for hydrogen bonding often lacked sufficient detail for this level of examination.

Question 7

(a) (i) Most candidates recognised that monochromatic light is light of a single frequency. It is not enough to state that it means light of a single colour. Colour is subjective, and there are many shades within a colour and each shade will encompass a significant range of frequencies – scientists need to be more precise than this.

(ii) Coherence was also well understood, the most common error is to think that the waves from the two sources must be exactly in phase, rather than the more general case where there is a constant phase difference between the light from the different sources.

(b) Fewer candidates correctly answered this section. Although a good number recognised that the fringes are closer together when violet light is used and that this is because violet has a shorter wavelength than red light, few went on to explain that this means that a smaller path difference between the two rays is required to make up a full wavelength.

(c) Although some candidates did this well, there was a general lack of knowledge as to the experimental changes which would lead to an increase in the spacing between the fringes,

Question 8

(a) A minority of responses were fully correct. The ratio of HNO_3 to $Mg(NO_3)_2$ was often not taken into consideration in this calculation. The *M*r of $Mg(NO_3)_2$ was often incorrectly determined.

(b) (i) A small number of candidates could describe a correct observation such as brown fumes or relighting a glowing splint.

(ii) Candidates found this a challenging question and frequently did not progress beyond the number of moles of magnesium nitrate.

(iii) A common error was to incorrectly convert the pressure.

Question 9

(a) Most candidates recognised that the straight line graph through the origin indicates that the current is proportional to the potential difference.

(b) Many candidates recognised that it was the raising of the temperature in the lamp filament which caused the resistance of the filament to increase and hence the current no longer being proportional to the p.d.

(c) (i) Although the majority of the candidates recognised the component to be a diode and were able to give a sensible explanation of their choice, there were a considerable number who incorrectly guessed either that it was a variable resistor or a thermistor.

(ii) Not surprisingly this section caused a great deal of difficulty, with few candidates scoring well. In particular, very few recognised that the reverse current would be (nearly) zero.

Question 10

(a) (i) Candidates were not confident in balancing chemical equations.

(ii) The determination of which element was reduced, in this case nitrogen, and a correct reason (change in oxidation number from +5 to +2) was not well known.

(b) (i) The electron for copper atom was usually incorrect; candidates were more successful in their responses for Cu^{2+}.

(ii) The equation was not well known.

(iii) Most candidates could give a correct diagram; it was rare to see a description with sufficient detail for this level of examination. Better performing candidates described the attraction between the positive ions and the delocalised electrons.

Question 11

(a) Most candidates showed a clear understanding of Kirchhoff's first law and a good number also had some understanding of the second law. However, there was some confusion over tracking round a complete loop, which led to candidates (in section **(iii)**) including the e.m.f. E of the cell in their equation.

(b) Whilst most candidates recognised that the reading of the voltmeter would drop, few were able to explain that this is a result of the current in the circuit increasing and thus, there being a larger potential drop across the resistor R_2.

Question 12

There were some good answers to this question, but also some very poor ones. Many candidates confused the Rutherford Model with Thomson's Plum Pudding Model; others wrote their own question and discussed the scattering of α-particles.

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Paper 8780/04
Advanced Practical Skills

General comments

The paper set for this AS level examination was appropriate for the students who were entered for it. The practical work involved proved to be about the right level of difficulty in that it enabled almost most candidates to carry out the manipulative work required. Some candidates had difficulties processing their results but most managed to gain some of the processing marks even when they could not complete all that was required of them.

Taken together both questions produced a satisfactory distribution of marks with a reasonable range being shown. Once again there were fewer very low marks this year and a reasonable proportion of high marks.

All candidates had enough time to complete the paper; there is no evidence that they ran out of time.

The practical skills required proved to be within the capabilities of most candidates: where marks were lost it was often where not enough care was taken with recording readings and/or observations. Most candidates gave answers using consistent and appropriate numbers significant figures and decimal points when making measurements; this was an improvement on previous years, very pleasing.

It is important that candidates continue to take care when recording their observations and to use acceptable terminology with the units clearly included where appropriate.

Comments on specific questions

Question 1

Most candidates were able to carry out this experiment which was well within their capabilities.

They were able to follow the instructions and were able to make a reasonable attempt at the experiment.

Satisfactory readings/results were obtained by most candidates.

Where they lost marks it was because they made mistakes in the recording and processing of their results.

(a) Most candidates had two different readings but some failed to realise that one of them should be negative with a minus sign.

(b) (i) Some answers were outside the acceptable range of 30 ± 10 cm.

(ii) Candidates were expected to have the range equal to or less than 1 cm with the uncertainty being half the range. Some candidates failed to achieve this.

(c) (i) Only a minority of candidates suggested taking several readings and averaging or finding the mid-point of a range. Only some of these went on to show this technique in their results table even though it is clearly stated that they should record all readings.

(ii) Most candidates were able to complete their tables correctly with headings and units. Most were able to record 6 readings to 1 mm as expected. A few candidates seemed to be only able to obtain 5 readings because of problems with their apparatus: they were not penalised for this.

(d) (i) The graph drawing was generally good. A few candidates chose to ignore the axes and/or origin printed on the graph. This meant that they were unable to read off the intercept for **part (e)**.

A small number missed out plotting one of their points.

(ii) Finding the gradient was generally well done. Sometimes the chosen triangle was much too small. A small number used figures from their table instead of using their drawn line.

(e) Most candidates realised that *T* was their gradient but some were confused about the units. Only a small proportion of candidates realised that *U* was the intercept on the *y*-axis and that it was a negative number: many tried to calculate it, usually unsuccessfully.

(f) Very few could work out that the resistance was their value of *U* with a positive sign.

Question 2

(a) (i) Most candidates gained these two marks for a negative chloride test and a positive sulfate test. However some lost a mark for giving cations as the reagents instead silver nitrate and barium chloride/nitrate.

(ii) A few lost a mark for omitting the 'insoluble in excess' in one or both cases.

(b) (i) Most candidates recorded all their temperatures to the correct precision of one decimal place. Almost all were able to calculate the increases correctly and to have a smaller increase for experiment 2.

(ii) There were many answers about enthalpy change instead of Z being less acidic. Some stated that they were different concentrations but did not state which was which.

(c) Some candidates thought that the glass absorbed more heat or that it was colder to start with.

(d) (i) Many correct ratio calculations to give the correct molarity.

(ii) Again reasonably well done being one tenth of their answer to **(d)(i)**.

(iii) This proved to be more difficult. Some tried to divide various concentrations or other numbers instead of subtracting their answer for **(d)(ii)** from 0.1.

(iv) For some reason many candidates tried to multiply by 23 or 27 instead of 24.