# GCSE EXAMINERS' REPORTS

## GCSE
## PHYSICS

## SUMMER 2022

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**PHYSICS**

**GCSE**

**Summer 2022**

**UNIT 1: ELECTRICITY, ENERGY AND WAVES – FOUNDATION TIER**

## General Comments

Year 10 Foundation Tier Physics candidates did not seem as well prepared for this paper as they had been in previous series. Many candidates' responses were characterised by a lack of knowledge of key facts. The quality of writing and poor punctuation was an issue and the legibility of many scripts was problematic. Many blanks were seen on the scripts. There was much evidence that candidates did not consider all of the information presented to them in each question. Conversion of units was poor. Questions on seismic waves and domestic electricity proved particularly challenging.

## Comments on individual questions/sections

**Q.1** **(a)** Most were able to identify the ammeter, incorrect responses included ammeter and voltmeter.

**(b)** **(i)** Candidates were asked to identify the obvious anomalous point and then complete the line of best fit. Spotting the anomaly was usually correct although it was not uncommon to see this missed or the last point identified.

**(ii)** Most were able to draw a reasonable line. Common errors here included not using a ruler, not including the point at the origin or joining point to point including the circled anomaly.

**(iii)** The majority of candidates were able to use the graph to determine the current at 12 V and then use the given equation to calculate the resistance.

**(iv)** The calculation in the previous question part was designed to assist candidates in thinking about the resistance of the resistor, but despite this it was rare to see a correctly answered response when asked to describe what the graph shows about its resistance. Most candidates simply stated that it increases, describing the shape of the graph line. A large number did not attempt this question part.

**(c)** There were a variety of responses seen here, it was rare to award all three marks. The relationship between current, voltage and resistance was not well known.

**Q.2** **(a)** It was rare to award all three marks here. The most frequent incorrect responses were that em waves are longitudinal or that their frequency decreases from radio waves to gamma rays.

**Q.2** **(b)** **(i)** Here candidates were required to state the amplitude, number of waves and wavelength shown on a wave diagram. A common error was to give the total length of the 2 waves shown rather than halving this to determine wavelength. Amplitude was usually correct, helped by the addition of numbers for candidates to select from.

**(ii)** Few candidates were able to select both responses correctly in part I. In the calculation in part II ecf was frequently applied which allowed many candidates to score full marks.

**(c)** Evaluating a new wave diagram to determine if the frequency had doubled proved challenging, with many candidates making vague statements such as yes it does because you can see that it has. Understanding that doubling frequency halves the wavelength was not well understood.

**Q.3** **(a)** Most were able to determine the mass of the empty measuring cylinder from the graph although it was not uncommon to see a range of answers including 0 g.

**(b)** A variety of answers were seen here. All that was required was to subtract the mass of the empty measuring cylinder from its mass at 100 g. A common error was to multiply the mass by 100. A lack of practical experience and not reading the information in the stem possibly caused issues here for candidates.

**(c)** The unit of density was not well known with g or $cm^3$ often seen. Although most were able to select the correct equation and divide mass by 100 it was often not the mass they had determined in the previous question part.

**Q.4** **(a)** **(i)&(ii)** A large number of correct responses were seen here.

**(b)** **(i)** It was intended that the previous calculation would assist candidates in this section where they were evaluating the cost effectiveness of turbines over a five year period. Simply comparing payback times would have allowed access to both marks. Many responses were too vague to credit with no reference to numerical values seen.

**(ii)** Understanding that changes to the cost of electricity or changes to the number of units produced would affect payback time was not well understood.

**(c)** **(i)** This was usually done correctly.

**(ii)** Most candidates were able to identify the correct traces here.

**(d)** This was poorly done. Many candidates discussed the size rather than the strength of the magnet and it was rare to see both marks awarded.

**Q.5** **(a)** This QER question required candidates to discuss the role of transformers in the National Grid, a familiar context for questions. The role of the step-down transformer linking to safety was often done reasonably well but it was rare to see responses that linked step-up transformers with reducing current and hence heat loss, increasing efficiency. The quality of candidates' writing was often very poor and most responses seen were in the bottom band.

**Q.5** **(b)** Reasons given here for the requirement to connect houses with solar panels to the National Grid were often poorly expressed, it was rare to award both marks.

**(c)** **(i)** There were many correct responses although it was not uncommon to see candidates divide the current by the number of houses rather than multiplying to determine the total required current.

**(ii)** Most candidates were able to gain marks here for determining the maximum power supplied to the houses, often with ecf, but converting their answer from W to kW was badly done. Multiplying or dividing by 100 was commonly seen despite the prefixes being provided on page 2 of the paper.

**Q.6** **(a)** This explanation was rarely answered well by Foundation Tier candidates who struggled to identify that a change of state was occurring. It was rare to see any reference to breaking bonds.

**(b)** **(i)** This simple numerical work was answered well by most candidates.

**(ii)** In the first part the conversion from minutes to seconds proved problematic for some candidates although many were able to go on to determine the power of the heater from the previous two question parts.

**Q.7** This question was set in the context of domestic electricity and began the common section of the paper. This was the least well answered question on the paper.

**(a)** Stating a difference between a.c. and d.c. was not well known. Many described a.c. as having waves and it was rare to award marks here.

**(b)** **(i)** Candidates here were required to select an electrical fault that puts the user at risk of an electric shock, linking with a suitable safety feature. The most common response was too much current in the ring main which is of course incorrect.

**(ii)** This was surprisingly poorly answered. Few candidates recalled the advantages of miniature circuit breakers.

**(c)** Candidates were unable to describe the function of the live and neutral wires, it was rare to award a mark here.

**Q.8** **(a)** The explanation of what is meant by a longitudinal wave was not known by many, so it was rare to award a mark.

**(b)** This section demanded that candidates read two values from the graph and subtract. Interpreting the scale was sometimes poorly done but many gained some credit here.

**(c)** **(i)** This proved very challenging. Candidates often failed to realise or communicate that the mantle is a solid and comparisons of the speeds in different regions were often not clearly expressed.

**Q.8** **(c)** **(ii)** In this section candidates were required to determine the mean speed of the P waves from the data clearly given in the stem and then to compare with the graph to evaluate the claim. It was surprising to see how many candidates were unable to determine the mean speed with incorrect distances frequently selected. When the mean was correct it was rare to see a sensible comparison with the speed shown in the graph.

**(d)** **(i)** In this question candidates were asked to determine the time that P waves would take to travel through the Earth from one side to another. They were directed to use the time given in (c)(ii) where they were told that P waves travel to the centre of the Earth in 550 s. It was rare to see Foundation Tier candidates realise that they simply had to double 550 s to determine the answer.

**(ii)** Many candidates did not realise that no S waves would be recorded at station C and that the trace would have a lower amplitude. It was rare to award all 3 marks here.

**Summary of key points**

- Encourage candidates to read the questions carefully and also consider the information given in graphs and tables.
- Remind candidates to write as legibly as possible and to use appropriate punctuation.
- Provide ample opportunity to complete questions requiring conversion of units using prefixes.
- Practise different revision methods with candidates to build confidence and knowledge.
- Provide opportunities for candidates to determine values from graphs with a variety of scales.

**PHYSICS**

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**UNIT 1: ELECTRICITY, ENERGY AND WAVES – HIGHER TIER**

## General Comments

The entry policy in many schools needs to be reviewed in light of the performance of so many of the candidates dropping off so severely towards the end of the paper. Having said that, there were a number of good answers to describing Fleming's left-hand rule, using the gas laws and calculating the specific heat capacity of air. What were not well done were descriptions of the operation of a split ring in a motor and giving a clear, concise explanation of what constitutes a longitudinal wave.

## Comments on individual questions/sections

**Q.1** **(a)** This was poorly answered by many.

**(b)** **(i)** Reading the question carefully was the key to answering this question correctly and it was reasonably well answered.

**(ii)** The reasons are listed in the teacher guide, not many candidates had learnt them.

**(c)** There was little success in clearly stating the functions of live and neutral wires in household circuits. These are stated in the teacher guide and need to be learned by entrants to examinations.

**Q.2** **(a)** The first part involved another bit of learning and regurgitation of what constitutes a longitudinal wave - but was poorly answered.

**(b)** Higher Tier entrants should have had no difficulty in reading two values from the graphs at a depth of 100 km but, remarkably, there was limited success achieved on this part.

**(c)** **(i)** There were many good answers but too many failed to note the word "maximum" in the question and chose to write about speeds in the inner core and the increasing speed in the outer core, often without even stating that the outer core is liquid and that the mantle behaves as a solid.

**(ii)** There were many examples of correct calculation of the mean speed of the P wave on its way to the Earth's centre but too many instances showed of another, erroneous calculation of the mean speed to a depth of 3500 km.

**(d)** **(i)** This part begins with the words: Use the time given in part (c)(ii) to …. The majority of candidates failed to simply double the given time to come up with the answer.

**Q.2** **(d)** **(ii)** The answer in part (i) should then have been used to draw what should have been a P wave only at the appropriate position (ecf allowed) for station C and of an amplitude no bigger than that at station B. The performance on question 2 was reasonable if not staggering.

**Q.3** The properties of geostationary and geosynchronous satellites was not well known by entrants – another piece of bookwork not learned, though the remainder of this question was reasonably well answered.

**Q.4** This question was well answered on the whole but in retrospect, possibly a graphical representation of the data would have helped candidates better than a table of results. The suggestions for improvements to the experiment was not well answered.

**Q.5** The old nutmeg of heat transfer is still not understood. The answers to this QER question were by and large weak, of bottom band standard on the whole.

**Q.6** **(a)** Not many made the point that without the safety resistor there would be zero resistance but a good number made the point that the current would be very high without its inclusion.

**(b)** Many of the scripts gave a correct calculation of the mean though were not so successful in giving the resistance of the safety resistor. Oddly, finding the value of each of the identical resistors labelled $R$ turned out to be easier! The graph plotting was straightforward once a linear scale was created and it is good to see that nearly all straight lines are drawn with a ruler nowadays.

**(c)** Difficulties became apparent in the final three parts: some success was noted in candidates finding the value of 5.8 (ecf) from the graph but there wasn't the awareness that its reciprocal was required to give the value of the current.

**(d)** **(i)** Not many scripts showed success at finding the gradient of the line as a way of calculating the required voltage, with most reverting to $V=IR$ from the table of results. It was decided that this would be an acceptable means of finding the supply voltage. Faced with the possibility of having used the $V=IR$ rule for finding the previous answer, it was decided that reference to $P=VI$ as a means to calculating the voltage would be accepted.

**(ii)** What else could be used? The inclusion of a voltmeter was not accepted as an answer as it requires no calculation as demanded by the question. This unusual approach to a question on understanding of electrical principles caused considerable difficulty for many candidates.

**Q.7** **(a)** The pointing finger, the middle finger, and even the thumb quoted as the first finger! All possibilities were on offer, but the line was drawn at the thumb being referred to as the first finger. A useful rule to remember is: thu**M**b for **M**otion, **F**irst finger for **F**ield and se**C**ond finger for **C**urrent.

**(b)** The function of the split ring was not well understood.

**Q.7** **(c)** **(i)** The calculation in the next part was invariably presented with substitution of numbers into the equation of a distance in cm thus losing the conversion mark. Whilst many failed to identify which distance to use with some adding 6 cm to 3 cm, others finding the circumference and some using the area of the coil in the calculation. To these, some marks were awarded.

**(ii)** Not many identified that each of the two effects would result in doubling of the force and that in combination the force would be quadrupled.

**Q.8** **(a)** There was a plethora of unusual answers to the first part of this question. "The volume would increase (having been told that it decreases), the motion of the molecules would increase (despite the constant temperature), successful collisions would increase" etc. These demonstrated a total failure of understanding of kinetic theory.
A mark was given in the second part of the question for identifying that the volume decreases for those who failed to note that the pressure had in fact doubled and so the volume would halve. Again, some unusual answers were seen.

**(b)** Just over 50% of the candidates noted that 27 $^{o}$C converts quite nicely to 300 K. It would benefit some to look at the inside cover of the exam paper and the information that is contained therein. It is questionable whether some candidates had even been exposed to this conversion of a temperature from Celsius to Kelvin. The application of the pressure law to the data was very poorly executed by many, with the exception of a distinct minority of candidates.

**(c)** The last part of this question should have been bread and butter to genuine Higher Tier candidates. There was no conversion of units involved, just simple substitution into a given equation for the first mark. Rearrange the equation to make $c$ the subject get your second mark and do a simple calculation for the third mark. Only around 40% of candidates could do this.

**Summary of key points**

- Candidates should be encouraged to read questions carefully in order to earn marks from their responses.
- Good quality of writing should be exercised as some responses are at times almost unreadable.
- When using an equation, candidates should be encouraged to substitute data into the equation before undertaking any necessary rearrangement in order to maximise the awarding of marks.
- The conversion chart on page 2 of the exam paper needs to be brought to the attention of candidates along with opportunities being given for making those conversions.
- Rote learning of certain principles should be encouraged, e.g. laws and rules in physics.
- Principles of kinetic theory of gases need to be learned.
- Exercises on creating a linear scale on graphs should be developed.

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**UNIT 2: FORCES, SPACE AND RADIOACTIVITY – FOUNDATION TIER**

## General Comments

There were approximately 1120 entries for this tier paper. Not a single question had a 100% attempt rate but lots of parts exceeded 90%. Only in five parts of questions did this drop below 80% with the lowest being 72.4%. It is disheartening to see the lack of motivation that results in some candidates not even attempting questions that require the ticking of boxes or underlining words in brackets to complete a sentence or selecting words from a box.

Generally questions requiring calculations (2(b)(iii), 3(a), 7(a)(ii)) or data analysis (10(a)(i)) were answered better than those requiring recall of information (4(a), 5(a), 9(a)). Graph work was good.

Candidates often seemed not to have read the question fully. As a result, their ability to draw conclusions was severely hampered. This was evident in 8(b) and 10(b). Poor basic literacy severely limited the quality of responses of some candidates. Some answers or part answers were partly or wholly illegible, making it very challenging for examiners to interpret.

Some candidates have difficulty in substituting into equations correctly.

## Comments on individual questions/sections

**Q.1** **(a)** It's surprising that just over 1% of candidates did not attempt this part of the question since all that was required was underlining one word in each of the two parts. About half of candidates identified the correct option in each case. A common error was selecting pressure in part (i) and gravity in (ii). Some candidates still ignore the instruction to underline their choice and use other means to do so e.g. use a circle.

**(b)** **(i)** Most candidates gained at least one mark here, most often for selecting neutron star as the end stage in the sequence.

**(ii)** Candidates had more success in this part compared to part (i) with over half gaining both marks.

**Q.2** **(a)** This question part had the highest attempt rate on the paper and most candidates earned at least two marks. Some errors were seen in the plotting of points (4,18) and (6,22). Usually only one plot was incorrect so some candidates must have forgotten, during the plotting process, that each small square along the $x$-axis represented 0.5 and not 1.0. Sometimes the last point was plotted as (7,25) instead of (7.5,25). Most lines were drawn with a ruler.

**(b)** **(i)** Just over half of candidates obtained the correct length here. Some incorrect answers of zero were seen.

**Q.2** **(b)** **(ii)** Most candidates gained both marks. In part I some answers were smaller than the answer in (i). These candidates should have realised that when a force is added to a spring its length cannot be shorter than its unstretched length. In II some subtraction errors were seen. Negative answers scored zero.

**(iii)** An ecf from the previous part was allowed here. The majority of candidates gained both marks. It is worth pointing out here that the answer must match the substitution. So, for example, $\frac{6}{3}$ = 0.5 scores zero.

**(iv)** This tested whether candidates knew that for a straight line graph the spring constant remains the same value. About 20% of candidates underlined this option. The remainder selected 'doubles'.

**Q.3** **(a)** This was a straightforward calculation and mostly correct answers were seen. Surprisingly, about 2.4% of candidates did not attempt it.

**(b)** Less than half of candidates earned any credit here. Some referred to the spanner being longer which is just a rewording of the question, so no marks were given. Others referred to momentum also scoring zero. Some candidates completed another calculation using a spanner length greater than 0.25 m and this was acceptable and scored both marks if accompanied by a qualifying statement.

**Q.4** **(a)** The attempt rate of 78% was one of the lowest on the paper. Most candidates who attempted the question did not know the two conditions. Some candidates stated temperature or pressure but failed to earn credit due to the omission of the word 'high'.

**(b)** The mark most often gained here was for the mass number of $\mathrm{He}$. Common errors were $^{4}_{1}\mathrm{He}$ and $^{1}_{1}\mathrm{n}$ . This was likely due to copying the atomic numbers, which were both 1, from the left-hand side of the equation.

**Q.5** **(a)** **(i)** The most common answer for X was gravity. This was not accepted. Common answers for Y were resistance or wind, neither of which were accepted.

**(ii)** This was generally poorly answered. Only a minority of candidates earned any credit. There was a mixture of increasing and decreasing for both X and Y. Very few answers of constant for X. Phrases like 'speeds up' were not accepted for increases.

**(b)** This was well answered. There were more correct answers for (ii) than (i).

**(c)** **(i)** The attempt rate dropped below 90% for this part. The correct answer was seen in a minority of instances. Commonly, $u$ = 10 was used. Candidates still appear not to appreciate that starting from rest means that $u$ = 0.

**Q.5 (c) (ii)** The attempt rate of 73% was the lowest but one on the paper. An ecf was allowed for $v$ from the previous part. A mark was given for selection of the correct equation from page 2 but this was not always written down but the mark could still be awarded by implication. Again lots of instances where $u$ = 10. Correct answers were seen in a minority of cases.

**Q.6 (a) (i)** Mostly correct answers seen.

**(ii)** Not as well answered as the previous part. The answer needed to convincingly describe that only the remaining dice were thrown again and this was only achieved in a minority of instances.

**(iii)** The majority of candidates earned at least 1 mark here and usually for part I. The probability was not always used correctly to predict the number of dice out of 240 that would land with 6 facing upwards.

**(b) (i)** The table was completed correctly in most instances.

**(ii)** This part was not well done. Answers usually copied a value from the table. The correct answer of 120 was seen in a minority of instances.

**(iii)** Slightly better answered than the previous part but still less than half of candidates interpreted the data to give the correct number of throws.

**Q.7 (a) (i)** This one mark question was included so that if candidates' answers were incorrect then an ecf would be allowed in the calculation in part (ii). This turned out to be a wise decision since less than half of candidates arrived at the correct answer for change in speed. Instead of just subtracting 30 - 0=30, candidates performed other calculations, most commonly the following;

- (30-0) $\times$ 1.5 = 45
- $\frac{30}{1.5}$ = 20

**(ii)** An ecf was allowed and as a result mostly correct answers were seen. In a few instances the following error was seen: $\frac{30}{1.5}$ = 28.5. Candidates who did this obviously think the division line means subtraction. Another error was incorrect substitution, so the following was seen:

$$30 = \frac{\text{change in velocity}}{1.5}$$

This leads to an incorrect answer of 45. Candidates either misread the question and / or didn't know how to relate terms in the equation to the given values.

**Q.7** **(b)** **(i)** The attempt rate for this QER question was almost 96%. It was pleasing to see the mean mark was slightly more than half marks. Most candidates were able to describe the motion shown by the graph. The majority of candidates also included data from the graph for times and / or speeds. Those candidates who included just values for time or speed typically scored a middle band mark. Top band answers included data for times and speeds relevant to each section of the graph. It was a pleasure to award full marks in some instances.

**(ii)** This was well answered. Most candidates used the required equation, read the time from the graph and substituted correctly. Some candidates lost the answer mark because of incorrect rounding.

**Q.8** **(a)** Most candidates earned at least one mark here and usually in part (i). A popular distractor in part (ii) was a supernova.

**(b)** **(i)** A minority of candidates earned any credit here. More often it was for a difference between the spectra. Very few answers describing similarities were seen.

**(ii)** A minority of answers earned credit. The answer needed to be clear about which galaxy was being described. Where credit was given it was usually for the difference in distance. On very few occasions was a mark earned for the difference in speed. Some answers included differences between the spectral lines again. Some of the more unusual answers include the following: X and Y are further away from Earth than Earth; X and Y move faster than Earth.

**Q.9** This is the first of the common questions.

**(a)** The attempt rate for this question at just over 72% was the lowest on the paper. The question was poorly answered. Very few candidates earned any credit. This was the least well answered question on the paper.

**(b)** **(i)** About half of candidates gave the correct answer. Others added 18+30, others subtracted 30-18 and some divided incorrectly $\frac{30}{18}$.

**(ii)** The most common answer was repeat the measurement. This earned a mark. Few answers were given a second mark for measuring for longer. Comments about better or more accurate equipment did not get a mark. The oddest answer of the year goes to this; ‘remove the bananas from the room.’

**(iii)** This was poorly answered. Very few references to radon seen. Instead there were comments about nuclear power station, factories and hospitals.

**(c)** **(i)** The majority of candidates earned at least two marks here. The row for source 2 was completed better than for source 1. Not all candidates followed the instruction to write yes (Y) or no (N) in each box. Blank boxes did not earn any marks.

**Q.9** **(c)** **(ii)** This was another question that was poorly answered. Credit was given in few instances and then it was usually for referring to use of lead.

**Q.10** This is the second of the common questions.

**(a)** **(i)** This was very well answered with most candidates selecting the two correct options.

**(ii)** This mark was earned by less than half of candidates. Answers such as Pluto is small or smaller or smallest did not earn credit unless qualified.

**(iii)** Answers were usually way outside the acceptable range so it was rare to award a mark.

**(b)** This was very poorly answered. There was poor expression and there were obviously cases where the question was misread. Errors included answers about year length, not naming planets in answers and thinking Jupiter, Saturn, Uranus and Neptune are rocky planets.

**Summary of key points**

Candidates must be encouraged to:

- read questions carefully and follow the instructions given.
- develop the skills required to interpret scales on a graph especially when each small square is 0.5 instead of 1.
- develop strategies to retain information since 40% of the marks are allocated to recall.
- write legibly and succinctly.

Centre staff:

- should provide page 2 of the exam paper at the outset of the course so candidates get used to selecting equations for calculations, writing them down and showing substitutions into them.
- need to address the misconception that the horizontal line that separates numerator and denominator means subtraction.
- need to reinforce the fact that an object starting from rest means $u = 0$ m/s.

**PHYSICS**

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**UNIT 2: FORCES, SPACE AND RADIOACTIVITY – HIGHER TIER**

## General Comments

It was pleasing to see that many candidates had prepared well for this examination, most questions were attempted and some good recall was shown, especially in the QER where most candidates were able to state Newton's laws. Graph plotting was usually sound although some inexperience in this area was evident in the unsuitable scales that some candidates chose. One aspect of graphical work that was very poor was determining the gradient of a tangent, despite the tangent being provided for candidates. Candidates were generally more comfortable with numerical questions than those that requiring extended explanations and it was evident that in many cases key information from the questions was missed by candidates.

## Comments on individual questions/sections

**Q.1** **(a)** Some pleasing responses here showing good recall although many candidates either didn't know the nature of the types of radiation or they had not understood the question. Many incorrect responses described the properties of alpha, beta and gamma.

**(b)** **(i)** Most candidates were able to do this simple sum correctly.

**(ii)** Most candidates could suggest at least one improvement here.

**(iii)** This was answered poorly with few candidates relating their answer to either radon gas or cosmic rays. Lots of answers were vague and linked to the proximity of nuclear power stations.

**(c)** **(i)** It was pleasing to see many correct responses here with candidates demonstrating a good understanding of the penetrating properties of alpha, beta and gamma. It was disappointing to see a minority of candidates not following the instruction to write yes or no in the boxes instead opting to put ticks in some spaces. This earned no credit.

**(ii)** Many candidates incorrectly referred to performing repeat readings, missing the idea of extending the investigation. Where candidates were able to make other suggestions they were usually credit worthy.

**Q.2** **(a)** **(i)** This was a straightforward and very accessible introduction to this question, requiring candidates to interact with the data in the table which most were able to do correctly.

**(ii)** Most candidates realized that the data revealed Pluto to have an extremely small mass and diameter, both smaller than that of the Moon. Candidates tended to lose marks here for poor expression where they failed to compare Pluto sensibly to either the Moon or all of the other planets.

**Q.2** **(b)** To correctly estimate the distance of Ceres from the Sun required candidates to recall the location of the asteroid belt. From the range of answers it was evident that only around half had memorized this fact.

**(c)** This was a challenging end to the common section. The question demanded that candidates consider the relationship between mass and day length for the rocky planets. It was evident that many either did not know which planets were rocky or did not read the question carefully.

**Q.3** **(a)** This was generally done poorly. Common errors that were seen included using a capital N for neutron, not recalling the symbol for a neutron and placing numbers on the right-hand side of the symbols. Many candidates had difficulty with identifying the proton number and nucleon number for the hydrogen isotopes from the information they were given.

**(b)** **(i)** Many correct responses were seen here. Most candidates were able to discuss at least one factor that makes fusion difficult to achieve on Earth.

**(ii)** This was very poorly answered. Many candidates did not read the question which demanded that candidates identified the properties of radioactive waste that makes it difficult to store safely. Many instead discussed why it would be expensive to store safely.

**Q.4** **(a)** **(i)** Most Higher Tier candidates were able to demonstrate good graph plotting skills. A common error was to choose an inappropriate scale, so that the points occupied less than half of the paper. Candidates should be encouraged to use a small cross rather than a dot to identify their plots.

**(ii)** Lots of correct answers here but a common error was to read from the graph the dice remaining after 3 throws and to not then subtract that from the previous figure to obtain the number of dice remaining.

**(iii)** Most candidates were able to correctly identify from the graph how many throws were required for the number of dice remaining to halve.

**(iv)** This was not well-answered with generally a poor understanding of half-life. It was common to see no attempt to halve 1000.

**(b)** The idea of the randomness of decay requiring a large sample size to smooth out fluctuations was lost on almost all candidates. Credit was most commonly given for references to improving accuracy.

**Q.5** **(a)** This was a very low-scoring section of the paper. Credit was most commonly given for references to light being absorbed. Only a minority of candidates made reference to either gas atoms or to where absorption was taking place.

**(b)** Many candidates were able to recall the evidence for the Big Bang and some good responses were seen here.

**Q.6** **(a)** **(i)** This numerical work required no rearranging but still proved problematic for many. Where candidates lost marks it was either because they did not recognise that they should include a negative sign as the car was decelerating or they forgot the final step and did not evaluate the square root.

**(ii)** Rearranging the work done equation to determine the mean force acting on the driver was done well by most candidates.

**(b)** Many candidates struggled to relate their explanations to the Physics of how airbags worked. The best answers were structured around a suitable equation.

**Q.7** **(a)** The QER yielded a range of pleasing responses; many candidates were able to recall Newton's laws accurately giving full definitions. Fewer candidates than in previous series referenced 'action and reaction' hence giving a much clearer definition of Newton's third law. Applying the laws to the motion of the parachutist was however difficult for most. References to Newton's third law often included the misconception that weight and air resistance were a Newton's third law pair. The quality and legibility of candidates' writing was often poor and punctuation was absent in many cases.

**(b)** **(i)** The majority of candidates ignored the tangent shown and rather than determining the gradient they used values off the curve to determine the acceleration.

**(ii)** This question asked candidates to describe from the velocity-time graph how the acceleration changed. Despite the previous question stating that the gradient of the graph gives the acceleration, it was common to see responses that simply described the shape of the line or referenced how the velocity changed. This was one of the poorest attempted parts of the paper.

**(iii)** Most candidates were able to gain some credit here by calculating the area under the line.

**Q.8** **(a)** The definition of conservation of momentum was attempted by most, it was pleasing to some a small percentage of candidates who had obviously learnt the definition and attained both marks.

**(b)** Most candidates were able to gain credit here for using the momentum equation to determine the momentum of the skateboarder and the ball. Fewer candidates recognised that the momentum of the ball was negative, despite the direction of positive velocity being clearly indicated on the diagram. The unit of momentum was not well known.

**(c)** It was more common to see blanks on the last two question parts than in earlier sections of the paper, whether because candidates found this difficult or they ran out of time. A common error in determining the velocity of the skateboarder was to ignore the mass of the ball.

**(d)** This was a challenging end to the paper. It was pleasing to see candidates obtaining all four marks although it was more common for candidates to gain partial credit for either the kinetic energy before or after the collision

**Summary of key points**

- Encourage candidates to read questions carefully, paying particular attention to anything in bold print.

- Refer to the mathematical skills section (Appendix B) contained within the specification and ensure that candidates have the opportunity to develop skills such as determining the gradient of a curve.

- Focus on the quality of extended writing, including suitable punctuation, and remind candidates of the importance of ensuring their work is legible.

- Remind candidates of the importance of recalling or determining units.

- Provide plenty of opportunity for candidates to produce balanced equations from data.

# PHYSICS

## GCSE

## Summer 2022

## CONTINGENCY UNIT 2: FOUNDATION TIER

### General Comments

This paper was available for candidates to sit if they were unable to sit the original Unit 2 examination due to Covid. Very few candidates sat this paper, so no general observations can be made.

# PHYSICS

## GCSE

## Summer 2022

## CONTINGENCY UNIT 2: HIGHER TIER

### General Comments

This paper was available for candidates to sit if they were unable to sit the original Unit 2 examination due to Covid. There was a very small number of entries for the paper but its inclusion in the timetable clearly gave the opportunity for some able candidates to demonstrate their understanding and application of Physics. In general, the ability to present answers clearly to the written (as opposed to numerical) questions has highlighted how the difficulties of the past two years has affected the education of entrants. Numerical work, it may be said, was better handled.

### Comments on individual questions/sections

**Q.1** A small number of candidates gained full marks for the early parts of this question and parts (a)(i) and (ii) were well answered by the majority of candidates. However, in the multiple-choice parts of (b)(i), only half of them gained 50% of the marks on offer. Similar success was achieved in the last part.

**Q.2** Unsurprisingly, all candidates answered (a)(i) correctly but a small percentage of them failed to calculate the mean of three numbers correctly. Most gained two marks for ticking the correct boxes in (b)(i), as they did in part (c) too, where about half a dozen of them earned full marks. The ability to give a clear and concise explanation of interrogating the data for (b)(ii) was suspect – an exemplification of the point made in the general comment above.

**Q.3** The graph plotting was well done with everyone using a ruler to draw their straight line – a distinct improvement on years gone by but many did not know how to calculate the gradient of a straight line. The way in which work was set out with no explanation or reference to the numbers that were being presented made it difficult / impossible to interpret the workings of an incomplete answer: were the candidates finding the ratio of the weights or the gradient of the line? The last part was generally poorly explained and poorly answered.

**Q.4** Careless rounding of the numbers in answer to part (b)(i) lost marks for a number of candidates but there were a number of good answers to the questions here. Many are reluctant to substitute into an equation where the subject is given to them and there is a need to offer lots of practice is such questions.

**Q.5** The unusual reverse temperature scale on the HR presentation gave rise to a number of wrong answers but this question was generally well done.

**Q.6** It was disappointing to read poor answers to part (a) – and in a large percentage of cases! One mark out of the three was generally awarded in the last part of this question.

**Q.7** Of the small number of entries for this paper, there was only one whose answer put it in the top band for the QER, showing again reluctance to write clearly and at length. There were no good suggestions for an answer to (b)(ii).

**Q.8** Part (a)(i) – generally well done. Despite being directed to the information leaflet given in the question, not many candidates could transfer from an extension to the weight that produced it. Confusion over which of Newton's laws of motion is the first, the second or the third was evident from answers to part (b)(i). Half marks were often given in answers to (b)(ii) but (c)(i) was well answered and it was pleasing to read that so many of the candidates knew that it the force was doubled, then the extension would double too, giving a quadrupling of the value for the energy stored.

**Summary of key points**

- Candidates should be encouraged to read questions carefully and to follow the instructions given therein.
- Substitution of numbers into equations should be carried out before any rearrangement to get a final answer.
- Many opportunities for practice in extended writing should be used to develop these skills.
- The HR diagram is based on unusual scales. The nature of these should be stressed.
- Candidates should be given many, many exercises on using equations of motion to gain confidence in answering questions which demand their use.

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