GCE AS EXAMINERS' REPORTS

PHYSICS
AS

SUMMER 2017

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EDUQAS
GCE AS PHYSICS

Summer 2017

COMPONENT 1

General comments:

The standard of responses this year was very good with candidates generally attempting all the questions. Generally the mathematical elements were well answered. The practical based questions proved to be more discriminating, particularly those parts dealing with significant figures and the calculation of overall percentage uncertainties.

Specific comments:

Q.1 (a) For an easy question – marks were thrown away here. Some candidates found it very difficult to concisely explain the particle arrangements and few put the missing material as amorphous.

(b) On the whole, this question was answered well. Marks were lost when graphs looked similar to that of a rubber band i.e. went up right at the very end. The question stated ‘ductile’ and ‘until it breaks’ so a longer flattened out region should have been obvious.

(c) As expected a common mistake was to use mass instead of weight and not convert MPa to Pa. Many candidates got as far as working out the new area, but then forgot to find the diameter.

Q.2 (a) Very well answered.

(b) (i) Lots of candidates misread the velocity (as 15 m/s) from the axis, but fortunately it remained within the ± ½ small square tolerance and so was not penalised.

(ii) Many candidates chose to use equations of motion, rather than calculate the area under the graph. Those using $x = ut + \frac{1}{2}at^2$ often forgot to make the acceleration negative.

(c) Candidates lost marks when they did not specifically cross-check known points with those on the graph. The descriptions were often confused and in some cases contradictory. Few noted that the graph started and ended at zero or that it was symmetric.

Q.3 On the whole this was answered well. The conservation question was greatly improved from last year. Candidates were a lot better at explaining which conservation rules they were using rather than just writing a string of zeros and ones.

In part (d) many candidates just repeated parts of the question rather than bringing in something new. A common response ‘ I think money would be better spent on humanitarian aid’ did not provide any new information and did not evaluate the question.

Q.4 (a) (i) Many candidates spoke about it absorbing all radiation.

(ii) Lots of missing units – fortunately, marks were not penalised in this question for this.

(iii) Very few candidates scored 3 marks. Very few drew the spectrum of Vega above that of the Sun at all times.

(b) Generally answered well. The most common mistake involved treating the radius squared for Vega as $2.71 \times r^2$ rather than $(2.71 \times r)^2$. Some candidates also forgot to multiply temperature to the power of 4. Candidates were able to pick up two easy marks here just by quoting Stefan's Law and the equation for surface area.

Q.5 (a) As expected lots of candidates quoted mean time to 3dp rather than 2dp. The minority were able to determine a % error by using ½ the range. Very few candidates were able to calculate the percentage uncertainty correctly.

(b) (i) Very few candidates scored the second mark here. Lots of candidates incorrectly talked about 'taking averages of times'.

(ii) Many alternative graphs were accepted providing the gradient matched the graph e.g. $2h$ on y-axis and t^2 on the x-axis with a gradient of g.

Q.6 (a) There were many poor diagrams often unlabelled.

(b) A surprisingly large number of errors with this calculation; mainly candidates getting the distances incorrect. Even if they couldn't recall the name of a spirit-level, they could have described any number of methods to gain this mark.

(c) A number of candidates correctly stated how to alter the apparatus but didn't go on to explain their reasoning.

Q.7 A large proportion of candidates only referred to the boat rocking. A maximum of 1 mark was awarded for this response. Many of those who did grasp the lateral movement, did not use adequate vocabulary to clearly describe the motion e.g. accelerate/decelerate. Few candidates described the uniform motion whilst the ball was travelling in the air.

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COMPONENT 2

General comments:

The standard of responses was good with nearly all the candidates attempting to answer parts of the questions in the paper. Also the various aspects of the mathematical requirements in the specification included in the paper was demonstrated well by candidates. For example; most candidates were able to use appropriate units as well as basic algebra when required in various questions.

The last 3 questions on the exam paper proved to be more discriminating with only the more able candidates demonstrating the application of knowledge and techniques required to answer the questions.

Specific comments:

Q.1 (a) This question was answered well by all candidates. The definition of a longitudinal wave was clearly understood by all candidates.

(b) Nearly all the candidates gave the correct amplitude.

(c) Many candidates were able to obtain full marks for both parts. The most common errors were not realising that the wavelength was in mm for part (i) and that the time was given in μs on the axis of the diagram.

Q.2 Many candidates were able to score full marks for this question.

(a) All the candidates were able to apply Snell's law and obtain the angle of refraction.

(b) (i) Also the vast majority were able to determine the critical angle correctly.

(i) All candidates were able to determine that the angle refracted into the water. However, a significant number of candidates were able to use the critical angle and realise that the angle of incidence did exceed the critical angle and therefore refraction would occur. Some candidates noted that the density of oil was greater than that of water and that the ray of light was travelling from a dense to a less dense medium. This was was not credited.

(c) Nearly all the candidates were able to apply the relevant equation to determine the speed of light in the oil.

Q.3 (a) All candidates were able to plot the graph and scored marks on this question. Marks were lost by some candidates in not using an appropriate scale or not plotting the points correctly as well as not being able to draw a smooth curve through the points.

(b) (i) Few candidates were able to score full marks and give a full definition for the emf of the cell and the fact that the emf was given as 6.0 V in the stem of the question. It was expected that the definition incorporated the values as "6.0 J of energy . . "

(ii) A surprising number of candidates decided to draw a tangent to the curve and use $P = I^2R$ with the I^2 used as the gradient of the tangent. The value of the resistor was stated as being set to 4.5 Ω in the stem of the question.

(iii) In general this was answered well by most candidates with credit given for using $E = V + Ir$ and also ecf was applied for the value of the current.

(c) It was expected that candidates would be able to deduce how the graph would change from their previous answers to this question. As expected only the more able candidates were able to determine how the graph would change and that the power would be greater with the peak moving.

Q.4 (a) This was also answered well with nearly all the candidates able to score marks on the question. Marks were lost for not determining n correctly and also using the diameter value incorrectly when using the area of a circle.

(b) This was also answered well by nearly all the candidates. They were able to determine that the drift velocity would be greater. However, some omitted the fact that the current as well as n and e would stay constant in the thin section.

(c) (i) Nearly all candidates were able to state what is meant by a superconductor.

(ii) The answer to the advantages to using superconductors was disappointing. There were no answers referring to their use in MRI scanners or particle accelerators. The question stem refers to their use in being able to carry large currents and as a consequence it would be expected that an advantage would be the large magnetic field that entails from a large current which is used in the above applications. The most frequent disadvantage given was the cost and expense. This had to be qualified with a reason to gain the mark.

Q.5 (a) (i) Only a few candidates were able to explain the meaning of coherent as being a constant phase difference between B and C.

(ii) Most candidates were able to describe why destructive interference occurred at certain points on the screen and were able to score marks on this. However only a few were able to obtain the full marks and state that path differences from B and C were different and if equal to $(n + ½)\,\lambda$ then arrived in antiphase.

(b) (i) Most candidates were able to use the Young's double slits equation to determine the fringe spacing and followed this by determining that 52.8 mm was a whole number and so the statement was correct.

(ii) Only the more able candidates were able to then determine the distance to the next dark fringe.

(c) The historical significance of the experiment was poorly understood by all the candidates. As a consequence, only a few were able to gain full marks. It was expected that candidates would state that light is a wave and that this contradicted the corpuscular/particle theory proposed by Newton or reinforced the Huygens model of light.

(d) (i) Many candidates gained a mark for realising that it was electron diffraction but were not able to explain fully that the atoms or lattice in the aluminium were acting as a diffraction grating. Credit was also given if the candidate realised that the wavelength of the electron beam was similar to the interatomic spacing.

(ii) Only the more able candidates were able to deduce that the radius of the rings increased in the diffraction pattern for copper and the intensity would reduce or stay roughly the same.

Q.6 (a) The QER question tested candidates' understanding of the experiment to use LEDs to determine Planck constant. As a consequence, a significant number of candidates referred incorrectly to the photoelectric experiment with the LED used to shine on the metal surface. The candidates who had identified the correct experiment were able to describe the method clearly but were not able to give a full explanation of how the data could be analysed to determine the Planck constant. The better responses were clearly structured and coherent and covered all the marking points.

(b) Nearly all the candidates were able to score full marks on this question and were able to understand how the scientific community validates experimental results.

Q.7 (a) (i) The vast majority of candidates were able to state what is meant by a population inversion. A significant number did refer to the ground state as being the lower energy level which did not gain credit.

(ii) Surprisingly only a minority of candidates were able to state that a population inversion was needed for stimulated emission and that an incoming photon results in an additional photon being emitted i.e. the amplifying action was rarely given though the question asked for the laser action specifically.

(b) The majority of candidates were able to convert the eV to J correctly for one of the energy values but were not able to consequently determine the wavelength correctly and identify the region of the electromagnetic spectrum it appears in.

(d) Only the more able candidates were able to apply the relevant theory correctly to determine the number of photons landing on the crater. Marks were awarded for realising that the force is equal to the pressure × area and also determining the momentum of the carbon dioxide molecules. Candidates did not then appreciate that the momentum change was: $p_{\text{Final}} - (-p_{\text{Initial}})$.

WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk