PHYSICS (PHY415115)

Overall students performed well and it was pleasing to see more correct answers this year. There was still good discrimination, with a broad spread of marks. The cutoffs for the ratings were in the more conventional ranges of about 18 for C, about 26 for B and about 32 for A.

Communication was generally good, significant figures appropriate and plenty of diagrams/graphs used as required. One thing that seemed more prevalent this year was mistakes being made in the actual calculations. The formula used was correct, the substitution into the equation accurate but the final answer was wrong. This suggests more practice using scientific calculators is required.

PART 1 – CRITERION 5

QUESTION 1

Parts (a & b) were either completed well or poorly done due to poor reading of the questions. Part (b)(ii) was marked based on the solution to part (b)(i). Part (c) was a direct question and answered reasonably, as was part (d), though few calculated the total force opposing the motion correctly. Part (e) was usually very badly answered with sentences and logic that failed to address the question.

QUESTION 2

Most candidates correctly calculated the answers for parts (a) and (b). Few correctly identified that the surface normal force is smaller than the weight by the value of F_c but added the latter as an additional force. This was corroborated in part (d), where few obtained the correct value. Part (e) was very badly completed; few identified the work done as zero because the motion is perpendicular to the force of gravity.

QUESTION 3

Parts (a), (b), (c) and (d) were generally well done, although a significant number of students only considered the vertical component of velocity in parts (b) and (d). Part (e) caused difficulty for most students as they failed to recognize that the change in momentum was in the vertical direction.

QUESTION 4

Most students chose the correct approach to answer parts (a), (b) and (d) although approximately half used an incorrect value for the radius of the satellite's orbit. In part (c) many students did not appreciate that the orbital period would decrease as the radius of the orbit decreased.

PART 2 – CRITERION 6

QUESTION 5

(a) Few students realised the meaning of 'density of field lines'. Many think this just means more lines. Some drew diagrams of equal density and then wrote 'lines on this side more dense'. Almost no students considered the addition of fields outside the gap between charges, which makes field lines elliptical. Students should mention that the strongest field is just right of X and the weakest is just right of Y.

(c) Many did not realise that their diagram indicates the direction of B.

QUESTION 6

(a) For full marks the diagram needs some consideration for symmetry and for approximately consistent line density at the charges.

(b) Many tried to incorporate the sign of the charge into the formula for E, and unsuccessfully use the sign of the answer to predict direction. The diagram shows the direction of E.

QUESTION 7

(a) Many students thought that positive charges should be attracted to a north pole, as if north is equivalent to positive.

(c) Few students attempted to describe the direction of the spiral. It is useful to describe CW or ACW looking down the field lines.

QUESTION 8

Most students correctly answered both parts of (a). Simple transposing errors caused most problems in (b), with a large proportion of inappropriate formulae chosen. Problems with part (c) included error in the direction of deflection of charged particles, failure to recognize difference in mass or unreasonable relative acceleration of particles with respect to each other. Approximately half of all answers to part (d) recognized that the field was uniform.

QUESTION 9

Mostly answered correctly. Many candidates chose an inappropriate formula for part (b). Part (c) was answered well.

QUESTION 10

A very wide range of answers! Students need to review the steps of Lenz' Law, and would benefit from reciting them in point form. Parts (b) and (c) were answered well.

PART 3 – CRITERION 7

QUESTION 11

Parts (a), (b) and (d) were very well done. The direction of oscillation required in part (c) was rarely correct, with candidates forgetting sound is a longitudinal wave.

QUESTION 12

Parts (a) and (b) were fine, but parts (c) and (d) were very poor, with the word 'phase' rarely used, so consequently few marks were earned.

QUESTION 13

Very well answered. There was an ambiguity in the question in part (b), so two different answers were taken as correct for parts (b) and (c).

QUESTION 14

Part (a) required a diagram with gradual changes of direction but this was rarely seen. Part (b) was consistently only partially correct with only one of the two possibilities mentioned. Part(c) was well answered and part (d) trapped a lot of candidates into using 80° instead of 10° as the angle of incidence. An incorrect angle of incidence of 20° was a common error. A diagram would have been a good thing to draw!

QUESTION 15

Part (a) was well done. Parts (b) and (c) caused issues with 50% of candidates with them not realizing 4.5 was the appropriate number. Part (d) was well answered, but it was obvious that many candidates had not played with two pieces of Polaroid enough.

PART D – CRITERION 8

QUESTION 16

A well-answered question throughout.

(a) In part (i) highest intensity was the key to the answer. Part (ii) required peak of wavelength vs intensity, with drop off to the right.

(b) The vast majority correctly answered all 3 parts.

QUESTION 17

(a) Well answered, but needed 'minimum' amount of energy to get an electron off the surface of a material.

(b&c) Well answered, with an answer in eV or J both accepted.

(d) The vast majority gave correct answers.

(e) This was the most challenging part. Many found energy correctly but did not divide by total energy of photons to find number of photons per second; a number incorrectly divided by E_k.

QUESTION 18

(a) This question was well done. Although trivial, candidates need to relate the energy in eV of the electron to the potential difference in V.

(b) Well done by most students. Some students did not identify that if Plank's constant and wavelength were both used in SI units then momentum would also have the units kg m s^{-1}.

(c) This question was poorly done. Too many students referenced Compton scattering without considering the practical risk considerations made by a doctor.

QUESTION 19

(a&b) Well done by most candidates.

(c) Many candidates did not identify that $A/A_0 = 1/10$. The answer could have been expressed in seconds or days; however, some students did not use time and the decay constant with the correct units.

(d) Well done by most candidates. If activity is given in Bq then the decay constant needed to have the units s^{-1}.

QUESTION 20

(a) Many students could not write the correct isotopic symbol for tritium.

(b) A variety of correct methods were used here. Converting between MeV and J as a first step, then using $E = mc^2$ was a good method here.

(c) This was done poorly with follow on issues from part (a). The antineutrino was rarely included and/or written correctly.

(d) Students need to have a better understanding of the units to use in the formula $N = mN_A / M$.