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General Certificate of Education

Physics 2456

Specification B: Physics in Context

PHYB4 Physics Inside and Out

Report on the Examination

2010 examination - June series

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GCE Physics, Specification B: Physics in Context, PHYB4, Physics Inside and Out

General Comments

All but the least able candidates attempted the majority of parts of most questions and there appeared to be little problem relating to time constraints. Candidates appeared to understand the physics relating to the vast majority of the material examined in this paper.

Question 1 (a) (iii) required a two significant figure answer but many candidates quoted their answer to three significant figures. Questions 4 (a) (iv) and 5 (b) (ii) credited correct units with dimensionally consistent alternatives being accepted in each case; responses to these were generally quite good.

Question 2 (b) required candidates to communicate their physics coherently with due care to spelling, punctuation and grammar. Technical words were too frequently misspelt and many candidates' answers lacked fluency and organisation. Candidates would be well advised to consider the briefest of essay plans before starting to commit pen to paper.

Question 1

In part (a) (i), nearly all candidates correctly identified *g* and *G*; few were rigorous in their explanations of what the quantities mean.

Few candidates did not equate the two equations in part (a) (ii), cancel *m* and rearrange into the form shown.

The vast majority of candidate performed the calculation in part (a) (iii) correctly, but a significant number quoted the final answer to either one or three significant figures (instead of the correct two). A small minority of candidates forgot to square the radius of the Earth.

In part (b) (i), most candidates recognised that the period would be 24 hours.

Difficulty was had by some candidates in part (b) (ii) who struggled to add the quantities written in different forms.

Part (b) (iii) was done well either by candidates dividing the circumference of the obit by the period in seconds or else using the mass of the Earth calculated in part (a) (iii).

Most candidates gave an appropriate use for geostationary satellites in part (b) (iv), however GPS and 'mobile phones' were not accepted.

In part (b) (v) few candidates were able to discuss the avoidance of dishes tracking by having geostationary satellites.

Question 2

For part (a) (i) few candidates were able to draw all three forces in the correct places with the correct directions. There was considerable confusion between the reaction of the wall on the person and the frictional force.

Many candidates showed misconceptions relating to part (a) (ii); they often believed that the frictional force would be greater than the weight of the rider and that the centripetal force provided the reaction, which acted outwards.

There were some very good answers to part (a) (iii), but many candidates were confused by determining whether it was the weight or the reaction which provided the centripetal force. Once candidates had decided that the weight was equal to the frictional force and that the reaction was equal to the centripetal force, they usually went on to gain full marks. A high percentage of candidates either did not attempt this part or else scored zero.

Few candidates truly understood part (a) (iv). Many believed that the centripetal force pulled the glove back to the wall where its low mass meant that the friction was insufficient to hold it up. Many talked about the glove falling without explaining that it was under the effect of gravity. Several candidates did recognise that the glove would move at a tangent to its circle and that it would then hit the wall; however few went on to discuss the effect of gravity and the subsequent reaction providing the centripetal force (or frictional force being equal to weight).

The open-ended nature of part (b) left many candidates unsure as to how much detail was expected. Some of the best answers took one or two 'thrilling' rides and explained how the design ensured that rapid changes of direction, speed and/or acceleration came about. Nearly all candidates recognised that the maximum safe acceleration of riders would be a few 'g' but it was often unclear that candidates understood that 'g-forces' are actually accelerations. Many candidates referred to resonance effects and their avoidance. Most answers were reasonably communicated but often would have benefitted from more thought in construction with related ideas too frequently separated by non-related material. Spelling, punctuation and grammar were often treated carelessly.

Question 3

In part (a) (i) few candidates appeared to fully understand what escape speed is. Many did not recognise that it was the minimum speed needed; others thought it was either the speed needed to leave the Earth's atmosphere or else to reach a stable orbit around the Earth. Some good answers related the sum of the kinetic energy at the escape speed and the potential energy on the Earth's surface to zero.

Most candidates performed the calculation in part (a) (ii) well.

Candidates misunderstanding of escape speed was frequently demonstrated by their answers to part (a) (iii). Very few candidates were able to state clearly that the escape speed equation applies to an unpowered object and that the chemical energy provided by the rocket's fuel was able to supply the gravitational potential energy needed to escape Mars's gravitational field. A significant number of candidates referred to Mars having a different gravitational constant from Earth.

The combination of the gravitational attractions of the Earth and the Sun on Mars was apparently understood well by many candidates in part (b), although many did not express this as clearly as they might have. Other candidates gain a compensation mark for recognising that Mars's orbit is elliptical.

Part (c) (i) was generally done well. There was some confusion between signs and a minority of candidates used $mg\Delta h$.

With error carried forwards from any mistakes in the previous part, many candidates gained the mark in part (c) (ii). A minority of candidates attempted to calculate the potential energy from scratch rather than adding the values from the table.

In part (c) (iii) there was apparent confusion between the magnitude of the change in potential energy and whether or not it was increasing or decreasing. A decrease in a negative potential energy implies that its magnitude is increasing and vice versa for an increase – many candidates contradicted their answers by adding incorrect amplification such as in ‘gpe becomes more negative and therefore increases’.

For part (c) (iv), most candidates showed an appreciation that the relative positions of the planets could be a help or hindrance to flights. Frequently, answers were vague and did not relate the fuel benefit to the gravitational effects. The most successful answers were often those specific to the diagram, where the candidate explained how the alignment could be used to save fuel.

Question 4

A high proportion of the candidates simply quoted Faraday’s laws for part (a) (i) – although some leeway was given relating to the relative motion between the magnet and the coil credit was only given when answers related to the situation in the geophone.

Part (a) (ii) was generally well known.

Most candidates recognised the need for vertical vibrations in part (a) (iii).

Part (a) (iv) was done well and an appropriate unit usually given, although $Tm^2 s^{-1}$ was more common than $Wb\,s^{-1}$ and Ws^{-1} was not uncommon.

In part (b) (i), many candidates interpreted this phrase as simply ‘wave speed increases with depth’; this is not the case; within a layer the wave speed is constant but the speed in deeper layers is greater than that in shallower ones.

Part (b) (ii) was generally done well.

The majority of candidates correctly labelled the critical angle in part (b) (iii).

In part (b) (iv) rays were usually drawn neatly and straight, with multiple rays and poorly drawn freehand rays being penalised. A slight majority of candidates recognised that the ray bends away from the normal at the first interface and back to be parallel with the original ray at the second interface.

Answers to part (b) (v) were relatively polarised; many did not attempt this part but of those that did they often went on to give a completely correct solution. The most common error was to simply use one wave speed for the whole path whereas the portion of the wave travelling through the sandstone travels at $3400\,m\,s^{-1}$.

Question 5

The arrangement in part (a) (i) was apparently not fully understood by many candidates, who sought to do more than recognise the need for the torques to balance. Few fully explained why the magnetic force would be acting downwards on the frame inside the field. Several did, however, go on give the direction of the magnetic field; although this was not required by the question a compensation mark was allowed when this was correctly argued.

Most candidates correctly rearranged the force equation in part (a) (ii) but many had difficulty with converting the units into newtons, amps and metres.

For part (a) (iii), few candidates made a direct comparison of the two flux density values – most simply stating that the Earth's field would produce a negligible effect.

In part (a) (iv), many candidates discussed either changing the field or the length of wire in the field – neither of these changes were credited (although using a coil was – since it effectively lengthens the wire but can still be within the already present field).

Most candidates used the gradient of a triangle to calculate *k* in part (b) (i). A large number either chose too small a triangle or else misread the vertical scale. Those not converting the prefixes to units were not penalised providing they were consistent in the following part.

Part (b) (ii) was generally correct.

Many candidates appeared to be unsure what to do for part (b) (iii), but those that attempted it were usually correct, notwithstanding difficulties with conversion of nT to T or μT.

Although most candidates appeared to understand what precession is in part (b) (iv), few could give a clear explanation of the two rotations about different axes; diagrams were sometimes very helpful here. A minority of candidates confused 'precession' with 'precision'.

Most candidates were able to quote two further techniques in answer to part (c) (i).

Many advantages/disadvantages were unclear in part (c) (ii), since candidates were imprecise about the exact nature of the technique which they were comparing with the proton magnetometer. More accurate/less accurate, cheaper/more expensive, portable/less portable etc. should be avoided unless detail is given as to the exact nature of the technique. The most successful comparisons were made with resistivity surveying and metal detection – in these cases comparisons were usually very clear.

Although it was possible to gain the mark in part (d) by arguing in either direction, many candidates did not support their stance. It was expected that candidates arguing for the use of magnetic anomaly detection would mention the presence of metallic components in which eddy currents could be induced and those arguing against its use would mention plastic explosives or the risk of detonation by the current – this was often not the case.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results statistics page of the AQA Website.