Version 1.0

General Certificate of Education (A-level)
January 2011

# Physics B: Physics in Context PHYB4

# (Specification 2455)

# Unit 4: Physics inside and out

# *Report on the Examination*

Set and published by the Assessment and Qualifications Alliance.

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Registered address: AQA, Devas Street, Manchester M15 6EX.

## GCE Physics, Specification B: Physics in Context, PHYB4, Physics inside and out

**Question 1**

In part (a)(i), many candidates thought that '*a*' represented area and '*v*' represented volume in the Stokes' law formula. Candidates who have studied and practised using the law should not make such errors. Part (ii) was successfully completed by about 40% of the candidates.

Many candidates seemed to have difficulty interpreting the demands of part (b). The correct response was that the value in (a) was too high. Some stated that 'it' was lower but their logic went on to make it clear that they realised that the 'it' they were referring to was the actual viscosity. Many were, however, unable to make this clear so that answers were ambiguous. Only a third of the candidates gave a sensible reason why the value in (a) was higher than the actual value.

Part (c) was similar to a question in a previous paper and it was disappointing that both marks were scored by only half of the candidates.

**Question 2**

For part (a)(i), the majority of candidates ignored the gravitational force in their working which was opposite to the thrust and so ended up with an acceleration of $15.3\,\mathrm{m\,s^{-2}}$. Others did not take account of the two booster rockets.

Almost all candidates were able to give one reason, and a majority was able to provide two reasons, in answer to part (a)(ii). The language used by many did not distinguish adequately between the reduction in the mass being accelerated, the reduction in the weight of the vehicle due to this reduction in mass (which opposed the thrust) and the change in the gravitational field strength as the rocket moved away form the Earth.

There were many very good responses in part (b)(i) but 40% of candidates did not make any progress with this question. A significant proportion began using $mr\omega^2$ and, not using $v = r\omega$, associated $\omega$ with $v$.

Part (b)(ii) required multi-stage calculations. Candidates needed to calculate both the change in potential energy and the change in kinetic energy and add them together. The vast majority did one or the other and few of these made the decision to give the answer to two significant figures, this being determined by the lowest number of significant figures in the data used.

**Question 3**

For part (a)(i), nearly half were able to correctly show this force.

Many candidates did not label the forces appropriately in part (a)(ii). The tension arrow was often labelled 'reaction' and the weight arrow as 'g' or 'gravity'. Arrows were often shown 'floating' rather than being shown acing on the body. At this level, candidates need to show greater attention to detail in their responses.

Most began part (a)(iii) by quoting and trying to use the correct equation, but did not determine the radius correctly; either using *2.5 sin 40* or adding 8 instead of 4 to *2.5 sin 40*. It was clear from answers than many had their calculators set to angles in radian.

Many candidates could not correctly use their calculator in part (b). 1.21 ÷ (2 × 3.14), which gives the correct answer, is not the same as 1.21 ÷ 2 × 3.14. Many candidates did the latter.

Part (c)(i) was generally done well with a majority gaining three marks. Some did not use the average angular speed and some thought they need to do something with $2\pi$ after finding the value 15.1 to convert it to radian although it was already in radian.

Again in part (c) (ii), some candidates did not use average angular velocity which led to incorrect responses. The easier route to the answer of calculating the final angular KE and dividing by the time taken to reach this was used by relatively few.

Part (c) (iii) was answered poorly. Some wrote about the change in mass distribution but did not go on the say how it applies in the context. A very common incorrect response was to suggest that the acceleration of the ride was increasing (perhaps confusing acceleration with velocity) and then to say that $I = T/\alpha$, so, if $\alpha$ is increasing, the moment of inertia is decreasing.

**Question 4**

Part (a) was not done well by the majority of candidates. Many quoted $F=BIL$ but did nothing with it. Others stopped at saying that $B$ was the force per unit current per unit length or force per A per metre.

Three clear distinct reasons were rare, but the vast majority were able to give at least one correct factor in answer to part (b) (i). The link with the need to consider the current requirements was essential, rather than just mentioning the resistivity which was fairly common.

For part (b) (ii), candidates did not express positively that superconductors have no resistance and therefore dissipate no thermal energy. When they wrote about low resistance and lower energy dissipation, they could just as easily have been comparing the use of copper conductors with steel wires, rather than the particular property of a superconductor.

Answers to part (c) (i) were frequently vague in whether the uniformity was related to no variation with time or with position. Answers often stated that in a uniform field the force was **constant on a particle** whereas in a gradient field the force **on a particle varied**. It was expected that answers gave some indication than the variation was position related.

Most knew how to approach part (c) (ii), but some disregarded the number of significant figures in the data on the graph and in the question so ended up rounding to three or even two significant figures.

In part (d) (i), fewer than half of the candidates identified the amplitude or strength of the signal as the relevant factor.

Most of those who gave an acceptable answer to (d) (i), gave a correct answer in part (d) (ii) too.

Part (e) was done well with the vast majority of candidates giving one correct response and half giving two. The avoidance of metal objects and possible interference with pacemakers were the most common responses with the effect of claustrophobia also being frequently mentioned.

**Question 5**

The majority of candidates made some sensible comment in answer to part (a), although the quality of communication was variable both in clarity of response and grammar. The identification of an eddy current as one which circulates was usually clear when it was discussed. That the eddy current alternates at the same frequency as the applied ac was also often mentioned. Many tried explaining the production of eddy currents in terms of flux cutting which was a less convincing approach than an explanation in terms of changes in flux linkage. Candidates frequently forgot to mention that is the **change** in flux linkage that causes the currents. The most difficult part to explain is the direction of the currents and those who discussed this often gave inaccurate descriptions of Lenz's law and found it difficult to explain how it applied in this situation. Discussions in terms of the motion of magnets were inappropriate here. Most candidates who made progress with this part of the question stated that the eddy current direction was opposite to that in the ac coil, which is true for some of the time. With a good reasoned argument such responses could lead to full credit if other aspects were well discussed. It is worth noting, however, that the argument about direction does not stop there and at times when the current in the coil is decreasing, so that the flux linkage is also decreasing, the eddy current can be in the same direction to create flux in the same direction and so oppose the decrease that is causing the induced emf and therefore current.

Only candidates who noted that part (b) was about the ring – and not the coil – were able to make any progress. Most candidates identified one or more sensible factors. Of these, some did not say how this affected the current at all and others did not explain why the factor had an effect on the current. Almost a fifth of the candidate gained a creditable performance of five or six marks.

**Question 6**

80% of the candidates correctly answered part (a) (i).

A similar proportion did part (a) (ii) correctly. 3 cm was a common incorrect answer and many simply miscounted when reading the scale.

It was surprising that almost a quarter of candidates were unable to score in part (b) (i). The most common error was to determine the incorrect period. Some confused frequency and period and used a period of 1.25 s.

In part (b) (ii), although appreciating the lower inertia, many candidates thought this would lead to a higher displacement. What was surprising is the number who did not appreciate that the period of a simple pendulum is independent of the mass of the bob and is dependent only on its length and the value of *g.*

Few candidates were able to undertake a suitable test for an exponential change and the majority gave a qualitative response to part (c) (i) along the lines the rate of change decreases. Some thought that the peaks should fall by half each time. Others thought that if the amplitude changed by the same amount each time it would be exponential. It was anticipated that as an understanding of the exponential is a mathematical requirement, this test would be learned and investigated when discussing damping.

In part (c) (ii), a majority of candidates mentioned that the oscillations were damped or that air resistance was the cause, but few went on to give any further explanation in terms of energy or work done.

Again, for part (c) (iii), more than half appreciated that the pendulum should come to rest in a shorter time but explanations were generally poor. Many concentrated on the pendulum having lower momentum which, as the pendulum's momentum changes continually during the oscillation even when undamped, was not a sensible approach.

**Question 7**

Part (a) was generally done well with a high proportion of candidates gaining two marks.

Part (b) (i) was a straightforward question, the only significant problem being the conversion of $mm^2$ to $m^2$. This proved too demanding for a significant proportion of candidates. Some tried to avoid the issue by giving the answer in $\Omega\ mm^2$ which, on the surface, is not incorrect. However, it is poor physics in the context of A2 and not worthy of full credit.

For part (b) (i), many candidates are likely to have met the easy sketch graph at both GCSE and AS level. Those who appreciated that it was a straight line through the origin did not inset values on the axes and some who did then spoiled it by extending their graph beyond the 1.5 V limit.

Very few gave a convincing response to part (c) (i). There was some confusion between the use of the term anomaly, as used to indicate a single reading that was not in consistent with other readings due to measurement error and a variation caused by a body that made the medium non-homogeneous. Many candidates wrote loosely about the voltage dropping when the probe is over the copper rather than there being a change in the pd per cm.

Candidates were more successful in part (c) (ii) than in (c) (i) and a good proportion of candidates gained both marks. Many who appreciated the resistivity of copper was involved, did not compare it with that of the copper sulphate solution or considered it to be more resistive which was not consistent with the data.

To gain both marks in part (c)(iii), candidates needed to provide the readings that indicated data at both 'ends' of the anomaly within an accepted range and also provide the answer. Giving an acceptable reading for one end gained one mark. Many provided only a 'final' value for the length with no indication of where it had come from. Misreading the graph was common.

## Mark Ranges and Award of Grades

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