Examiners' Report

Summer 2015

Pearson Edexcel International Advanced Level in Mechanics M3
(WME03/01)

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Mathematics Unit Mechanics 3

Specification WME03/01

Most students seemed to have sufficient time to complete this paper. Some did not attempt the final part of question 6 but it was just as likely that they were unable to identify the required angle as that they had insufficient time.

As always, "show that.." questions gave rise to the most problems. Leaps of faith that may be accepted in a question where the answer has not been given are never allowed when the answer is in the question; every step in the working must be written down clearly. Equations should be solved, not simply followed by the given answer. Quadratic equations generally have two answers both of which must be shown and the unacceptable one eliminated. Fiddling the working in order to arrive at the given answer will be spotted by the examiner with consequent loss of marks.

Students need to write clearly. Sometimes their writing is so poor that the students themselves mis-read it. When students cannot read their own writing they cannot criticise examiners who have similar problems.

Report on Individual Questions

Question 1

This was generally answered well, at least in terms of knowing what was expected. Many solutions, however, suffered from very poor notation, with confusion of the meaning of *r,* with the same letter being used to represent both the radius of the sphere and the radius of the motion. Many students simply replaced *r* with $r\sin\theta$ to obtain the correct result, in a way that was not terribly convincing but had to be condoned. A common error was to simply use *r* to represent the radius of motion, giving $\tan\theta = \frac{1}{2}$. A double error here often led to the given answer.

Question 2

Part (a) was often very poorly answered, considering how little was actually required and that an identical question featured in a very recent paper. Physicists often introduced G*mM* and then made a lot of work out of relating this back to the *k*. In part (b) most knew what was required, but most failed to get to the final result. The most common mistake was to omit the – sign (leading to -4*R*g/3) but other mistakes were to take the distances as 0 and 2*R*. Some attempted a work done approach and in so doing managed to avoid having to commit to signs initially, but where this was successful it did feel like the answer had been fudged.

Question 3

This was probably the easiest question on the paper. Most got (a) correct, although a significant number again managed to get the sign wrong. Sadly for them, rather than realising that they needed a minus sign before integrating, they just wrote down the answer. In most cases they must have realised that they were doing something wrong, as they inevitably had no trouble with their signs in (b). Most clearly showed where the 16 came from, although as ever many did not give as much working as would have been desired for a given answer. The majority knew exactly what to do in (b), correctly finding the required time and performing the integration. Whilst indefinite integration was the most popular approach, since many found $t = 2$ first, there were many correct attempts at definite integration.

Question 4

The vertical circle proved to be the most difficult question to mark due to the poorly explained working. Whilst most realised that they needed to be considering the top of the circle in (a), this was often not made explicit and energy equations simply appeared with no indication of what points were being considered. A lot of students seemed to jump straight to (the presumably learnt result) $\frac{mv^2}{r} \geqslant mg$ which did make the result seem almost fudged. As always there were some students who knew that they had to introduce an inequality, but sadly chose to do so in their energy equation, resulting in the loss of most of the marks available. A lot of students decided to find a tension at a general point, although this often got combined with energy at specifically the top or bottom. In general they managed to make it the correct energy in both cases however. Of course students who set up this general tension then found that the rest of the question fell out very easily. For some reason the most popular way to measure the angle seemed to be down from the positive horizontal, rather than the more usual downwards vertical, but they nearly all did this correctly. Almost everybody who managed to find two tensions went on to correctly achieve the given result.

Question 5

Part (a) in general did not cause problems. Lengths were usually taken either as the extension of *AP* or the distance from *A*, although various other distances were used (distance from centre, extension of *BP*) and usually these were seemingly correctly converted into the required result. In part (b) it seemed that more were successful in proving SHM than in previous examinations. Certainly there was far more use of $\ddot{x}$, which made it all the more frustrating when students forgot to put a concluding statement. Many still failed to take their distances from the equilibrium point that they had successfully found in (a) and quite a lot made sign errors leading to $\ddot{x} = -5x$ or $\ddot{x} = -25x$. Many got (c) correct, but there were others who did not know what to do, or even appreciate that $x = 0.8$. A significant number attempted an energy approach, but forgot that there would be EPE in *AP* when *BP* became slack and so lost all (apart from maybe B1) marks. Part (d) caused plenty of confusion about which energy terms were required, with many including EPE in *BP* when the particle comes to rest, presumably not appreciating the difference between a string and a spring. By far the easiest approach was to ignore the speed found in (c) and conserve energy (only EPE) at the start and end, although not many did this. Some did attempt to find the acceleration after the string went slack and generally this approach was successful.

Question 6

Very few students had any real difficulties achieving the given answers to parts (a) and (b) and most gave sufficient working. However, there were students who ignored the instruction to use algebraic integration and so lost most of the marks. There were also quite a few students who seemingly could not do (a), but then did find the volume in their working for (b), which really did amount to 4 marks lost needlessly. You would have thought that once they saw the given answer for (a) appear, that they would at least go back and insert it into (a).

Part (c) managed to cause many problems, with most getting either the necessary distances or masses (or both) wrong, although they generally did then form the equation correctly. It was surprising how many worked out the angle that was required in (d), (i.e. subtracting from $\tan^{-1}\left(\frac{6}{7}\right)$), although they often failed to find the correct distance for finding the angle to be subtracted.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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