Examiner’s Report
Principal Examiner Feedback

Summer 2019

Pearson Edexcel International A Level
In Mechanics M3 (WME03/01)

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2019
Publications Code: WME03_01_1906_ER

General

This paper tested all areas of the specification giving all candidates the opportunity to demonstrate their knowledge. Most candidates were able to start all questions and it was clear that there was a good understanding of the basic techniques required in M3. The questions that introduced unusual situations or required more complicated approaches (Q3, 7c) caused significant difficulties.

The paper contained many "show that" questions and these highlighted that candidates are often not careful to fully justify each step and to show all necessary working. It should be emphasized that the expectation of a clearly communicated solution is greater in these questions.

Question1

This question proved to be a very accessible start to the paper, with very few candidates failing to score and many fully correct responses. Most candidates could set up the initial equations and integrate correctly. By far the most common error was not having a minus sign in the equation of motion. Candidates need to read the question carefully as many did not interpret the fact that the force was directed towards O and should be negative. This was a costly error as only 4 out of 8 marks were then available. Candidates were careful with their working and very few numerical slips were made in finding the values of the constants. A small number used limits in the integration and were able to obtain the value of k, but a significant number of these candidates could then not also find the value of c.

Question 2

This question was accessible to the majority of candidates, with many fully correct responses. Nearly all candidates knew that they needed to consider Elastic Potential Energy and Work Done. It was common, however, to miss out one of the EPE terms, resulting a maximum of 2 marks. Where all 3 terms were present, candidates generally completed the work accurately, although common mistakes were using $\frac{\lambda x^2}{l}$, rather than $\frac{\lambda x^2}{2l}$, and missing l in the distances.

Question 3

This question proved to be far more discriminating, with few candidates presenting completely correct solutions. In particular candidates struggled to use the information about the masses to correctly formulate a mass ratio. Common mistakes were to attempt to compare all masses using their volumes, rather than in terms of M, or to assume that M was the mass of the cylinder **after** the cone had been cut away.

Candidates seemed to be evenly divided between forming a single 4 term equation, or finding the centre of mass of the cylinder with the cone removed $\left(\frac{89}{92}h\right)$ and then attempting to find the CoM with the shell added. Whilst most candidates had correct distances for the cylinder and cut away cone, a common mistake was to use the centre of mass of a solid cone for the shell, so candidates should take great care when using the formula book for standard shapes.

Question 4

This question was well answered, with most candidates clearly being comfortable with the approach required for horizontal circular motion. Very few had difficulties with the trigonometry and generally 2 correct equations were produced, with very little confusion over the required radius for the motion. The final 3 marks, however, discriminated between the candidates that really understood the mechanics and how to form a clear argument. Many simply said that $T_b = \frac{5}{4}mg$, with no attempt to justify why this should lead to the maximum angular velocity, losing the last 3 marks. Most candidates that correctly worked from $T_b \leq \frac{5}{4}mg$, did go on to give a value for ω, rather than leaving an inequality.

Question 5

Part (a) was generally answered well, with most candidates adopting the correct approach and showing a good level of detailed working to arrive at the given result.

Whilst almost all knew what to do in (b), it was common for slips to occur in completing the integration and substitution of limits. The most popular approach was to split the integral and only use Integration by Parts for $\int_0^{\frac{\pi}{4}} x\cos 2x\,\mathrm{d}x$, but many candidates realised that they could use the integral from (a) to do Integration by Parts for the whole integral. Either approach required care with multiple minus signs, as well as halves that were often taken out of integrals. It was also common for π to be cancelled incorrectly. In particular candidates often cancelled π from the top and bottom of the fractions before integrating, but then put in the result from (a), leading to an incorrect result.

Part (c) had many correct solutions, although some candidates were confused about exactly what angle they were trying to find. It was frustrating that even clearly very strong candidates sometimes lost the final mark in (c) and (b) by not giving the specified accuracy.

Question 6

This proved to be very straight forward for many candidates and there were plenty of fully correct responses. However there were still a surprising number of errors made, particularly in part c).

In part a) most candidates gained the full 4 marks, although this was often achieved after far more work than was necessary. Many candidates automatically considered energy, completing the work for part (b) and producing very complicated equations of motion, although generally the correct result was found with sufficient working. Candidates should be reminded that the requirements of a show that question are greater than others. In this case, we needed to clearly see the use of correct trigonometry. Candidates who went straight to $\frac{mg}{2}$, which led almost immediately to the given result, could not score full marks

Part b) was well answered and often followed on from correct working in part a). Incorrectly using SUVAT was rarely seen. A small number of candidates made a sign error or there was confusion of sin/cos in their energy equation.

Part c) was often answered well but there were a significant number of errors seen. Most candidates who attempted to use energy in the projectile motion were unsuccessful. They did not usually consider that there was still kinetic energy at the top of the motion, or they used only the vertical speed in the initial kinetic energy. Of those who used SUVAT sometimes the initial speed was not resolved at all or vsin30 was used instead of vsin60. It was not uncommon to see u, the speed at A, from part b) being used in some way which scored no marks. A significant number of candidates only added r instead of 1.5r to the height above B essentially finding the height above A rather than C, emphasising again the need to read the question carefully. Likewise some candidates misinterpreted the question and attempted to find the height when the particle was above C rather than the greatest height.

Question 7

Parts a) b) and c) were mostly answered well, but fully correct answers to part d) were uncommon indicating that most candidates had trouble with the final part.

Part a) caused very few problems, with most candidates reaching the given answer with sufficient steps to score all of the marks.

Part (b) caused more difficulties, with many candidates dropping marks. It was still common for “a” to be used for the acceleration rather than $\ddot{x}$ which scored 2 out of the 4 marks. Most did attempt an equation of motion with both weight and tension, although the tension was not always variable. There was the occasional sign error and others did not clearly state “therefore SHM” in conclusion which was required for the full marks.

Almost all candidates gained the mark for a correct answer to b) part (ii).

Part c) was often answered correctly by finding a quarter of the period, although some successfully used $x = a\cos\omega t$ or $x = a\sin\omega t$ with $x = \frac{4l}{5}$ or $x = \frac{2l}{5}$ respectively. A small number of candidates did not realise that they needed only a quarter period.

Part d) was poorly answered, on the whole, and very few fully correct answers were seen. In many cases a clear diagram would have helped, as candidates seemed to be unclear as to where the string went slack and often assumed SHM or SUVAT when it was not appropriate. An attempt at an energy equation and consideration of E.P.E. was common, but was often used incorrectly or there was often a term missing. A few candidates did use it successfully to find the speed when the string went slack. Candidates who were successful usually found the time under SHM by first finding the time from the centre of the oscillation and then adding a quarter of the period. A significant number of candidates were able to find the speed when the string goes slack by using $v^2 = w^2(a^2 - x^2)$ even if they were unable to find the times correctly. It was not uncommon for candidates to incorrectly assume the acceleration as "g" rather than "3/5g" in use of suvat to find the time up the slope after the string had become slack.

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom