Examiners' Report

October 2016

Pearson Edexcel International Advanced Level in Mechanics M2 (WME02/01)

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

October 2016
Publications Code WME02_01_1610_ER

Mathematics Unit Mechanics 2

Specification WME02/01

General Introduction

The majority of students offered solutions to all eight questions on this paper. Many students made a confident start with correct solutions to the first three questions. Much of the work was clearly set out and accompanied by diagrams. Students demonstrated a good understanding of the topics tested and a good standard of mathematical communication.

Students should read the questions carefully to ensure that their answer meets the requirement of the question, both in terms of what they find, and the accuracy of their answer. In particular, Q4 on this paper asked for the magnitude of the acceleration, Q7 asked for answers accurate to 2 significant figures, and Q8 asked for the speed of a particle (which must have a positive value). The rubric on this paper is very clear about the value that students should use if they need to substitute a value for g, and the accuracy that is expected after this substitution. However there are still students who lose accuracy marks by using the substitution $g = 9.81$ or by leaving their final answer with more significant figures than are justified.

Some students are confident when working with vectors, but some are not clear about the distinction between scalars and vectors. This was a particular problem in Q2 where some students tried to equate vectors to scalars and consequently were able to score no marks.

Report on Individual Questions

Question 1

The majority of students found this a straight forward question to start with. They wrote down the two moments equations and solved them with no difficulty. Most errors involved dimensionally incorrect equations, with a distance or a mass missing from one of the terms. Some students used a total mass of 3 (the number of particles) in place of $(5+k)m$.

Question 2

Students who started this question by expressing the final velocity as a vector were usually successful in finding the two possible values of λ. The most direct approach, of expressing the components of the velocity in terms of λ and then applying Pythagoras' theorem to form a quadratic in λ, was the most popular. Some students expressed the velocity as $a\mathbf{i}+b\mathbf{j}$, formed an equation in *a* or *b*, and worked from there.
Several students formed an equation which was a mixture of velocity and speed (usually $12-6\mathbf{i}=\lambda(\mathbf{i}-2\mathbf{j})$) and made no useful progress. It is important for students to ensure that they understand the difference between speed and velocity so that they can avoid forming dimensionally incorrect statements.

Question 3

The given answer to part (a) ensured that most students who knew about energy were able to reach the correct conclusion. Some students preferred to form the equation of motion for the particle, find the force due to friction, and hence the work done.
Part (b) required students to use the work-energy principle, so alternative approaches were not accepted. The most common error in the equations was to omit the work done against friction. Although it has been mentioned in many previous reports, there are still students who double count the change in gravitational potential energy by also including the work done against the weight of the particle.

Question 4

They key to success in this question was to understand that it is the velocity of the particle, not its position vector, which determines the direction of motion. Students who used this correctly often gained full marks for the question provided that they worked all the way through to find the magnitude of the acceleration.
The large number of students who started by making the position vector parallel to $-\mathbf{i}-\mathbf{j}$ were able to score marks in part (b) for using their value of *T* correctly.

Question 5

The given answer for part (a) helped the majority of students to make a confident start to this question. However, nearly 10% of students made no progress at all in a question which was not unusually difficult.
For the majority of students the process of resolving forces and taking moments was well understood. Some students made errors in the trigonometry, but the most common

error was for students to have friction acting in the wrong direction at *P*, or to omit the friction at *P* altogether. A carefully labelled diagram of forces, with some thought about which way the rod will move if it does slip, would help students to include all the forces correctly.

Question 6

Although both parts of this question use *R* as their point of reference, many students preferred to used *O* or *P* instead, which added to the work required in part (a) and introduced unnecessary errors in part (b).
The given answer in part (a) helped all but a small number of students to reach the required distance.
Students tried a variety of approaches to part (b) and provided that they had a clear understanding of where each mass was placed they were often successful. The most popular approach was the first alternative on the mark scheme, although many students chose to apply this by considering distances from *O* or from *P*. Success depended on translating this correctly into distances from *R* to use $\arctan\left(\frac{1}{4}\right)$.

Question 7

Many students made a correct start to their solution by writing down an equation about the kinetic energy of *P*. In addition, they also needed to use the information about the vertical component of the velocity in order to be able to find the time taken for the journey from *O* to *A*. Although this is a standard task for a projectile question, several students overlooked it and made no further progress. Students who found the position vector of *A* did not always follow the instruction to give their final answers to 2 significant figures.

Question 8

Many students scored most of the marks available in this question. They started with correct equations for the conservation of linear momentum and for the impact law. Part (a) asks for the speed of *A,* so students need to ensure that their answer is positive by using the modulus of the value found – very few students remembered to do this.
Most students were able to form a correct inequality for the speed of *A* in order for *A* and *B* to be moving in the same direction, and they usually reached $k < 6$. Some of them went on to do further work which gave them the incorrect final answer $-4 < k < 6$. As *km* is the mass of *B*, *k* cannot possibly take a negative value.
Students who formed the impact equations correctly in part (a) usually went on to write down correct equations in part (c). If they substituted their expression for the speed of *B* in terms of *u* early in the process this usually led to simpler equations which were more straight forward to solve. Many students reached the given conclusion by comparison of correct values for the speeds of *A* and *B*.

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

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