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MM04 Mechanics 4

Report on the Examination

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General

There was an excellent response from the majority of candidates. Many clear solutions were evident with good explanations. The great majority of candidates attempted all the questions. There were very few candidates with marks below 40, whilst four candidates scored full marks and several others were very close. Questions 1 to 4 proved to be the most successful with many candidates scoring full marks on several of these. Both questions 5 and 6 differentiated well. It was good to see so many varied and correct methods used for parts of these questions. The paper appeared to be the correct length and no candidate seemed to experience time trouble.

Question 1

Topic – Couples in $3\mathrm{D}$. There was a very good response to this question. Most candidates knew that the sum of forces must be zero and used it to find $\mathbf{F}$, clearly showing their reasoning. The most common error was to add the given two forces and give this as the answer. Showing that the magnitude of $\mathbf{F}$ was $3\sqrt{10}$ proved straightforward , although $\sqrt{90}$ had to be seen to secure both marks. Almost all candidates correctly used $\mathbf{r}\times\mathbf{F}$ although a common error was not to use all the necessary determinants. The most efficient solutions found $\overrightarrow{QP}$ and then used just one determinant.

Question 2

Topic – Centres of mass by integration. There was a very good response to this question with candidates showing sound knowledge of formulae and good integration skills. Part (a) was always correctly answered. A common error in part (b) was to lose a π symbol resulting in the wrong answer. Candidates showed good knowledge of suspension problems and even if errors were made in part (b) full recovery marks were available.

Question 3

Topic – Frameworks. There was an excellent response to this question. The most successful solutions included clear labelling of tensions or compressions in the framework, using $\mathrm{T_{AB}}$. The best solutions clearly indicated what they were doing thus making it easier to award marks even if minor errors occurred. A common error in part (a) was to evaluate $500/\sin 45$ as 354. Explanations in part (a)(ii) were good. No follow through marks were available here as the question could be answered with reference to the diagram.

Part (b) proved very discriminating with many candidates “resolving the whole system” to get the answer as $500\ \mathrm{N}$ – failing to understand the implication of a reaction force at point C. It was expected that candidates would use Newton’s third law at point D to get the correct answer of $1000\mathrm{N}$.

Question 4

Topic – Toppling and sliding. There was an excellent response to this question. Part (a) was almost universally correct; however when slips did occur it was because of the use of $W(4\mathrm{a})$ when taking moments.

Part (b) was rarely seen incorrect, however inequality signs sometimes lost a mark. Part (c) was answered very well with sound knowledge of cancelling, and trigonometrical identities. Once again a mark was sometimes lost because of an equality or greater than sign.

Question 5

Topic – MI and angular momentum. This was the question that proved to be most challenging. In part (a) a few candidates quoted results from the formulae book ignoring the request " by integration". It was pleasing to see methods using strips or particles being used correctly – explanations were also good with references to the mass of a strip, MI of rectangle etc.

Part (b) was probably the most difficult on the paper. A number of candidates tried to use energy methods to no avail. When candidates did attempt to use conservation of angular momentum they often made errors with the before scenario. For example using $\frac{1}{2}mu$ (no distance) or $\frac{1}{2}mu6a$ (wrong distance) or $\frac{3}{2}mu3a$ (wrong mass). Iw was correctly identified and used by nearly all candidates, but the momentum of the particle was again incorrect. Nevertheless, three marks were often easily scored (M0A0M1A0B1M1A0) by candidates who tried to use conservation of momentum.

Question 6

Topic – Rotational dynamics (connected particles). This was a challenging question although the structure helped. The majority of candidates successfully identified the KE of particles and the the disc to get the printed answer. Conservation of energy was often correctly used in part (a)(ii). Part (b) proved more discriminating. The method which involved differentiating the result in part (a)(ii) was least popular. Many types of errors were made – the worst of which was failing to use acceleration (ie velocity was used). Some candidates failed to appreciate how couple = inertia $\times$ angular acceleration could be used to form a third equation. Again, however, the mark scheme rewarded key understanding enabling all candidates to score marks somewhere.

Mark Ranges and Award of Grades

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