Examiners' Report/
Principal Examiner Feedback

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Pearson Edexcel International A Level
in Mechanics M1 (WME01)
Paper 01

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General introduction

The vast majority of candidates seemed to find the paper to be of a suitable length, with no evidence of candidates running out of time, although question 8(d) was very demanding so it wasn't always clear whether candidates were running out of time or of ideas. Candidates found some aspects of the paper challenging, in particular question 5 (simultaneous *suvat* equations), question 7(b) (vectors) and questions 8(c) and 8(d) (velocity-time graphs). However, there were some parts of all questions which were accessible to the majority. The questions on simple vectors, equilibrium on an inclined plane and collisions were generally well understood and full marks for these questions were commonly seen. Although most candidates understood the techniques required to solve the first two parts of the velocity-time graph question, some had difficulty in interpreting the extra information in the final two parts. The paper discriminated well at all levels including at the top end, and there were some impressive, fully correct solutions seen to all questions.

Generally, candidates who used large and clearly labelled diagrams and who employed clear, systematic and concise methods were the most successful. In calculations the numerical value of g which should be used is 9.8, as advised on the front of the question paper. Final answers should then be given to 2 (or 3) significant figures, as advised on the front of the question paper – more accurate answers will be penalised, including fractions. If there is a printed answer to show then candidates need to ensure that they show sufficient detail in their working to warrant being awarded all of the marks available.

In all cases, as stated on the front of the question paper, candidates should show sufficient working to make their methods clear to the Examiner.

Question 1

Most candidates were able to make a good attempt at this first question, with the occasional slip in signs. Some candidates appeared to be unaware of the difference between speed and velocity and thus lost the final mark in part (a). Some candidates scored zero when different velocities were used for the motion after impact of each particle.

In the second part, most candidates made use of the change in momenta for the impulse, again often making sign errors and on occasions forgetting to give the magnitude as a final answer. A diagram showing the direction of the impulse would have helped in many cases.

Question 2

Part (a) proved to be very successful for the vast majority of candidates. The use of a simple diagram was extremely beneficial and only a few obtained a wrong answer. In the second part, most knew how the vectors were combined to reach the required answer but some lost marks through careless arithmetic and others lost marks by failing to realise the significance of the fact that ($\mathbf{i}$ + 4$\mathbf{j}$) was the final position vector. Occasional errors in giving the final answer in an appropriate form were rare. Other common errors included multiplying the position vector by 4 or using the magnitudes of vectors in *suvat* equations.

Question 3

This was a good question for many candidates. Some candidates used a direct method and took moments about the other man's position which led immediately to the required answer. However, the majority employed a two step process by resolving vertically to obtain the man's mass as 80 kg and then used this in an appropriate moments equation. This led to an equation in a single unknown length which is when candidates could begin to score marks. Candidates took moments about various points on the beam and did not always define their 'x'. Finally the candidates needed to find the length AG. Some left their answers as their 'x' which often was not AG. Common errors included dimensionally wrong equations, omission of a force or distance, omission of 'g' and careless arithmetic.

Question 4

This question was all about resolving forces and very few candidates mixed up cos and sin. All candidates who were successful resolved along the plane and perpendicular to the plane to produce two equations. Most candidates used the correct values for sin α and cos α but there are still those who confuse themselves by writing $\sin\frac{3}{5}$ or $\cos\frac{4}{5}$. There were a few who made sign errors and some who seem to believe that R always equals $mg\cos\alpha$. Many errors occurred through poor algebraic skills and often the final form of many answers was unconventional, for example $\left(\frac{\frac{N}{5}+\mu\frac{4}{5}}{\frac{4}{5}+\mu\frac{N}{5}}\right)$ rather than $\frac{3+4\mu}{4+3\mu}$. Some candidates failed to answer the question and found μ in terms of k rather than k in terms of μ.

Question 5

The majority of candidates used $s = ut + \frac{1}{2}at^2$ from P to Q and from P to R to form two equations in u and a. However, a significant proportion used the information from Q to R without adjusting the value of the initial velocity and thus produced an invalid equation. (A few of these did appreciate that $v_Q = u + 3a$ and were able to produce a correct resulting equation). Those who produced the correct simultaneous equations in u and a were usually able to produce a fully correct solution. There were a number of alternative methods employed, often quite successfully; simultaneous equations in v_Q and a were formed; three simultaneous equations were formed in u, v_Q and v_R, either using $s = \frac{1}{2}(u + v)t$ or using a speed-time graph.

A surprisingly large number of candidates calculated (usually two of) $\frac{48}{3}$, $\frac{48}{3}$ and $\frac{248}{8}$ and then claimed these to be the actual speeds at P, Q or R. Most common was to calculate $\frac{48}{3} = 16$ and $\frac{48}{3} = 40$ then attempt to find the acceleration by dividing (40 – 16) by 8 or 5. A correct attempt at the average speed method was extremely rare.

A significant number of candidates assumed $u = 0$. Some then used the interval PR to find a, followed by using the interval PQ to find the (now non-zero) value of u. A clearly labelled diagram would have helped many candidates.

Question 6

In part (a) the majority of candidates realised the need to find the acceleration, and most did so successfully, but surprisingly many failed to see that this was the required approach and struggled as a result. Finding the tension was less successful with common errors in the equation of motion being T and $mg \sin \theta$ reversed, an extra friction force, mg not resolved and a mass of 0.5g used. Those who formed a correct equation generally found the value of the tension correctly.

In part (b) there were many correct solutions and even those candidates whose tension was incorrect from part (a), usually lost only the final A1. A significant minority of candidates wrote $F = \mu R$ for P but then used for R the normal reaction on Q. Other common errors in the equation of motion included extra forces such as 0.1g included, T and μR reversed and confusion over the value of the mass. Those who tried to produce an equation of motion for the entire system often missed out forces and were rarely successful.

Question 7

Part (a) was well answered and often supported by a diagram. Most formed a correct tangent ratio and found the correct answer but a significant number gave the complementary angle. Some used sine or cosine and a few gave wrongly rounded answers. Use of radians was allowed but rare.

Part (b) was more problematic with many candidates having no idea how to approach the problem. Many candidates failed to appreciate the fact that **P** and **Q** were scalar multiples of the given vectors and thus were unable to progress. Of those who did, a significant number used the same multiple and also got nowhere. There were a whole variety of different approaches adopted, mostly unsuccessfully, and relatively few used the method on the mark scheme which led to a quick and straightforward solution.

Question 8

The later parts of this question proved to be very discriminating.

In part (a) the vast majority of candidates were able to sketch the isosceles trapezium but a significant number thought that B should have the same acceleration or maximum velocity as A and this produced an incorrect v-t diagram for B. Labels were usually correct but key points such as $t = 90$ or $t = 150$ were sometimes missing. Candidates generally fell into four main groups: those with a correct triangle; those whose triangle shared the sloping sides of the trapezium (i.e. the same acceleration for A and B); those who had the $t = 90$ vertex of the triangle at $v = 20$; those whose triangle had only the $t = 0$ and $t = 180$ points in common with the trapezium.

Candidates were generally successful in part (b) but a significant number failed to realise that the key piece of information was that both A and B travelled the same distance. Many of the difficulties were caused by an incorrect v-t diagram for B and the key importance of setting up the given information in problems of this type cannot be overstressed. Those who took v_{max} as 20 m s^{-1} or acceleration as $\frac{2}{3}$ m s^{-2} were unable to make any progress. Candidates who were working from a correct diagram for B were often successful in finding the acceleration although there were some careless arithmetic errors that marred correct methods. In part (c) there were fewer correct answers, with many candidates appearing to think that when the trains were moving at the same speed they would have travelled equal distances. A number found $t = 54$ s but then added 90 s to find the second value and a number failed to find 54 s but scored the last A1 for subtracting their value from 180 s.

In the final part almost all serious candidates found 1620 m for the distance travelled by A. Most of those who got this far found $v_{\text{B}} = \dfrac{100}{3}$ m s^{-1} at $t = 90$ s and a pleasing number made a decent attempt at B's distance, some by using $s = ut + at^2$ for 6 seconds and others by first finding B's speed at $t = 96$ s. Predictably there were a few candidates who tried using a single *suvat* formula to deal with the whole 96 seconds. A few considered the section between $t = 96$ s and $t = 180$ s and so did not need to find the maximum speed.

Grade Boundaries

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