Examiners' Report
Principal Examiner Feedback

Summer 2025

Pearson Edexcel GCE

In A Level Further Mathematics (9FM0)

Paper 3C Mechanics 1

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General

Overall learners were able to access all eight questions on this paper and time did not appear to be a limiting factor. Learners were able to recall and use standard formulae and were familiar with the context given in all questions.

Although the presentation was generally good, learners are advised to present solutions vertically down the page, using all the space available, and to avoid using arrows to direct examiners around their solution. It was more common this year for learners to store values in their calculator memory and note in their solutions '$\rightarrow A$' or '$w = \sqrt{ANS^2 + \left(\frac{3\sqrt{3}}{2}\right)^2}$'. Whilst learners may find this a useful way to keep track of their calculator use, it should not replace conventional mathematical communication.

In Further Mechanics, a simple neat diagram can often provide clarity when problem-solving and learners are advised to annotate a Figure when one is provided in the question. The most successful learners in this paper are skilled working with vectors as well as magnitudes and directions and engage directly with the question in the form it is presented. Those who lack the flexibility to work with both are more prone to errors as they attempt to convert the information to their preferred form.

If there is a printed answer to show, as in 4(a), 5(a), 7(a) and 8(a), learners need to ensure that they show sufficient detail in their working to warrant being awarded all of the marks available and that they end up with **exactly** what is printed on the question paper with no errors in the working. It is evident that many understand these requirements, clearly establishing necessary equations, including at least one line of working and re-arranging their final answer, when necessary, to match the printed answer.

In all cases, as stated on the front of the question paper, learners should show sufficient working to make their methods clear to the examiner and correct answers without working may not score all, or indeed, any of the marks available.

If a learner runs out of space in which to give their answer then they are advised to use a supplementary sheet – if a centre is reluctant to supply extra paper then it is crucial for the learner to say whereabouts in the script the extra working is going to be done.

It is important at this level for learners to understand that *g* holds the units ms^{-2}. In calculations the numerical value of *g* which should be used is 9.8. Final answers should then be given to 2 (or 3) significant figures – more accurate answers will be penalised, including fractions but exact multiples of *g* are usually accepted.

Question 1

Providing an accessible start to the paper, this question was a good source of marks for most. Although solutions were usually fully correct, even high attainers made errors that could have been avoided with careful checking. When using $I = m(v - u)$ a small proportion did not use a correct mass which lost the method mark and others made sign errors which resulted in a loss of accuracy.

After drawing and labelling a clear diagram, it was common for learners at all levels to assume the format of the question and immediately write down a CLM equation. Most recognised that they could make no further progress in part (a) without knowing k and so formed a suitable Impulse equation and answered parts (a) and (b) simultaneously.

Unfortunately, the false start caused confusion for some learners who proceeded to make errors in their working or made v the subject instead of u. It is important for learners at all levels to process each question carefully before embarking on an approach.

Question 2

The vast majority were able to demonstrate an excellent understanding of the relationship between the power and the driving force of an engine. In both parts the most successful solutions established an equation of motion first, made D the subject, and then substituted D into the power equation. After forming and solving a quadratic equation, the negative value of V was either rejected or completely ignored.

Those with low attainment often had conceptual errors, confusing the force in the power equation with the resultant force in $F = ma$ and therefore losing crucial method marks. In general, learners remembered to resolve the weight force in part (b), rarely forgot g and even less showed any cos/sin confusion. However, accuracy marks were still lost by some who did not follow the instructions on the front of the paper and did not round to 2 or 3 significant figures after using 9.8ms^{-2} for g.

Question 3

In this question, it was common for learners to work with column vectors to first find an expression for the change in momentum and then apply Pythagoras to the components to form a quadratic equation in λ. Most chose to use their calculator to solve the quadratic equation, efficiently finding two values for λ.

There were many solutions with poor vector work and unconventional notation. Learners confused scalars and vectors, forming structurally incorrect equations such as $\mathbf{I} = m|\mathbf{v}| - m|\mathbf{u}|$ or $|\mathbf{I}| = m\mathbf{v} - m\mathbf{u}$. Due to the format of this question, many were able to make a full recovery but learners should take greater care when solving problems with impulse expressed as a vector.

It was rare for learners to use a vector triangle and the cosine rule to answer this question, but when seen it was usually correct. Sign errors or not using the mass in one or both of the terms caused marks to not be awarded.

Those who tried to convert velocity vectors into a speed and direction made very little progress at all.

Question 4

With the first ‘show that’ question on the paper, some solutions lacked the rigor required to earn all marks in part (a), scoring 2 out of the 3 available. Those who were well-rehearsed, understood the requirements of a ‘show that’ question and established a work-energy equation in terms of W. After showing clearly how the energy terms were formed, they subtracted to reach the expression for W as printed in the paper. The most common incomplete solutions either did not show how the energy terms combined or did not find an expression for W, simply stating $16 - 6.3 = 9.7$.

Confidently resolving forces on a slope, the vast majority used the work-energy principle in part (b) to form an equation in μ. It was rare for learners to confuse sin and cos and most correctly rounded the answer to 2 or 3 significant figures, following the use of $9.8\,\mathrm{ms}^{-2}$ for g.

Question 5

Candidates across the grades made a confident start to this question on successive direct collisions with most gaining the first 6 marks in a few lines of neat working.

Forming a CLM equation in part (a) was very straightforward with few sign errors seen and the modulus taken, if necessary, to give the speed of A after the first collision. Using the impact law in part (b) brought almost the same level of success with any errors deriving from incorrect signs.

In part (c), the second collision caused a significant challenge for less able learners who were required to find the speed of B and compare it with the speed of A, to find the full range of values for the coefficient of restitution. Attempts at CLM and NEL were prone to sign errors and occasionally learners did not pair the correct mass with the relevant speed. It is important to read the information given in a question carefully; in this case several learners overlooked the projected speed of C, assuming that it remained at rest. This assumption over-simplified the problem and became a costly error. Some found a correct expression for the velocity of B but solved $v_B < 0$ which did not consider the direction of A and so no further marks were available. Those who established the correct inequality almost always completed the question in full by combining with $0 \leqslant f \leqslant 1$.

Question 6

The 'show that' part (a) provided a very accessible opening to this question on elastic potential energy and the work-energy principle. Learners at all levels demonstrated their confidence and accuracy in part (a) using Hooke's Law with success to obtain the given answer. Some learners produced an incomplete solution and were not awarded the final mark for not giving an expression for AB as required in the question.

The scaffolding provided by part (a) supported a strong entry into part (b) with many fully correct solutions. When using the EPE formula, it was more common to see errors in the extension than the denominator, using the distance from A instead of the extension.

The final part of the question required use of the principle of conservation of mechanical energy and no marks were available for use of *suvat*. Well-rehearsed learners completed part (c) with ease, using their answer to part (b) and "Energy Loss = Energy Gain" to find an expression for EPE in just a few lines. Others chose to start again with separate energy terms and were just as successful using "Initial Energy = Final Energy".

Given that a and m both contain units, it was not appropriate to replace g with 9.8 in parts (b) or (c).

Question 7

This oblique impact question was one of the most challenging on the paper and distinguished between high and low attainers.

Those who prepared well for the topic, stated that components perpendicular to the line of centres are unchanged to establish an equation in v for part (a). With the requirements of a given answer, learners usually included a trivial rearrangement to show how v is obtained and earned all available marks. A few rushed straight into CLM along the line of centres and produced several pages of working and re-starts before abandoning the question completely.

Although the 7 marks available in part (b) involved fairly routine bookwork, it required following the directions indicated in the given figure and careful labelling of components. High achievers produced fluent solutions by forming two equations which were solved to find w and θ. Those who failed to use components or forgot either mass made very little progress.

In part (c), a follow through mark on the values for w and θ resulted in many learners scoring at least 2 out of the 3 marks available and rewarded those who understood how to use the impact law for oblique impact.

Question 8

As expected, the final question on the paper brought with it a significant level of challenge to stretch the most able and there were several blank responses. The information was given in vector form and those who were confident working with vectors were far more successful. Those who insisted on changing all vectors to speeds and directions made the process far more complicated and often introduced sign errors or was working with unnecessarily complicated algebra.

Part (a) awarded 6 marks for showing the kinetic energy lost by B. However, since the answer was given in the question, clear reasoning with sufficient working was required to earn all 6 available marks. Those who clearly labelled the diagram and used vectors usually scored higher than those who did not. For example, learners who used speeds and angles rarely stated that the component parallel to the surface is unchanged. Learners should use the number of marks available for questions to ensure they show sufficient workings. In this question, some learners treated the instructions as 'find' rather than 'show that'.

In part (b), it was very clear that many learners had prepared well for this topic as they immediately defined $\mathbf{w} = x\mathbf{i} + y\mathbf{j}$. Efficient solutions used the first method in the mark scheme to set up two simultaneous equations that were solved in just a few neat lines. The second most successful approach used the second method in the mark scheme, identifying the impulse direction and using $\mathbf{w} = p(3\mathbf{i} + 4\mathbf{j}) + q(-4\mathbf{i} + 3\mathbf{j})$. Both sets of learners proceeded to find **w** and, whilst using column vectors in their working, remembered to give the final answer in terms of **i** and **j**.

Those who attempted to use speeds and angles rarely progressed to a fully correct solution, making multiple re-starts before abandoning the question completely. Learners are reminded to present all of their workings clearly.

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