GCE EXAMINERS' REPORTS

GCE (NEW)
FURTHER MATHEMATICS
AS/Advanced

SUMMER 2018

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FURTHER MATHEMATICS

General Certificate of Education (New)

Summer 2018

Advanced Subsidiary/Advanced

FURTHER PURE MATHEMATICS A- AS UNIT 1

General comments

The candidates performed less well than expected and there were few excellent scripts. Many candidates began well before struggling with the middle section of the paper, only to collect many marks at the end of the paper.

Comments on Individual Questions

1. This question was answered well by many candidates. However, numerous candidates believed there was no inverse of $\mathbf{B}$ because the bottom-left and top-right values were equal. Some candidates ignored the 'hence' in part (*b*) and found simultaneous equations to solve, losing marks.

2. Questions on induction have appeared in the legacy qualification so it was disappointing that rarely were full marks awarded for this question. Candidates who undertook the proof by induction method often omitted elements and their conclusions were also lacking in detail. However, there were many candidates who used the expressions for $\sum r^2$ and $\sum r$ to derive the given result rather than provide a proof by induction.

3. In part (*a*), many candidates derived the quadratic equation satisfied by the values given in the question and then proceeded to solve correctly for α, β and γ, although some candidates cancelled through by x and as a result lost the value of 0 as one of their answers. Those candidates who realised one root must be 0 given $\alpha\beta\gamma = 0$, normally found the remaining roots quickly. Part (*b*) was answered well if part (*a*) was completed, although some errors with signs appeared when forming the equation.

4. This question was answered poorly with many candidates unaware that θ should be in radians and that the complex number was situated in the second quadrant of an Argand diagram. Many candidates began the question again with the conjugate rather than realising the modulus would be equal and the argument reflected in the Real axis. Few candidates seemed to know the relationship between moduli and arguments when multiplying complex numbers in part (*b*).

5. Part (*a*) was completed well, although some candidates used partial fractions to work in reverse despite partial fractions being outside of the specification – the mark was awarded if the method was fully correct. Part (*b*) was often started well with candidates beginning with values for $r = 2$, although some began with $r = 1$ and subsequently encountered difficulties. However, poor algebraic skills often resulted in errors, particularly with combining fractions and negative signs. Whilst part (*c*) was often answered well, some candidates stated that $\frac{4}{0} = \infty$, which was penalised.

6. Part (*a*) was often awarded 2 marks rather than the 3 available as candidates did not show a method for calculating $(1-2\mathrm{i})^3$ – it is imperative that sufficient mathematical working be shown to gain credit. In part (*b*), the majority of candidates noted the conjugate as another root and the candidates who found the final root most successfully were those who used the method of roots of polynomials rather than finding a quadratic factor from the complex roots.

7. Many candidates answered part (*a*) well. However, few noted that the locus was a perpendicular bisector between the points (4, 1) and (-2, 0). The responses seen most often pertained to the gradient and intercept of the line derived.

8. This question was answered very well, proving to be a boost to candidates' marks. However, some candidates multiplied in the wrong direction in part (*a*) and others were unable to identify T^{-1} having derived the identity matrix correctly.

9. Parts (*a*)(i) and (*b*) were answered very well, boosting candidates marks further. However, there were many errors in writing the Cartesian form of the equation of the line in part (*a*)(ii). Part (*c*) was answered very poorly and candidates seemed unsure of the method of finding a common perpendicular vector, often trying to use $|\mathbf{a}||\mathbf{b}|\cos\theta = \mathbf{a}.\mathbf{b}$.

MATHEMATICS

General Certificate of Education (New)

Summer 2018

Advanced Subsidiary/Advanced

FURTHER STATISTICS A - AS UNIT 2

General Comments

The new specification continues to give a wide spread in attainment over the course of the paper. Candidates were generally very good at performing calculations using formulae in the formula booklet; for example, calculating Spearman's rank correlation coefficient and the equation of a regression line. Many candidates struggled to form correct hypotheses for the three questions which required them. As expected, the questions which required interpretation in context were the least well answered.

Comments on individual questions

1. Although this question had a familiar feel to it, many candidates did not progress beyond part (*a*) and stating Var(X) and Var(Y). However, many others did perform well on this question, scoring full marks.

2. Parts (*a*) and (*b*) were generally well done with a handful of candidates multiplying by 3 instead of cubing their answer from part (a). Many candidates failed to score the final E1 in part (c) for not interpreting their calculations from the earlier part of the question. Although a considerable number of candidates were able to find the pdf in part (*d*), seldom did anyone write the limits and state explicitly that the pdf must be equal to 0 outside these limits; this was one of the most common omissions on the paper. Only a few candidates had the insight to successfully answer part (*f*).

3. This was by far the most poorly answered question on the paper. This is surprising because probability distributions have been assessed under the legacy specification and so should have been more familiar to candidates than some of the newer topics. Many candidates were unable to produce a probability distribution and, as a result, found it very difficult to answer part (*b*). Another prevalent error was using 0, 50 and 450 as the values of x, instead of -50, 50 and 450.

4. Along with question 7, this was very well answered overall. The most challenging part was commenting on the statement given in part (*c*), with more students thinking that it was a correct statement than otherwise. This showed a misunderstanding of what Spearman's rank correlation coefficient measures.

5. Candidates found forming the hypotheses and interpreting the parameters 6 and 0.6 the most challenging part of this question. Another common error was failing to combine groups where the expected frequencies were less than 5. Some candidates did manage to combine some of the groups together, but not all the ones that needed to be combined; solutions of this kind were treated in the same manner as those that did not combine groups at all.

6. Once again, forming the hypotheses proved challenging for many candidates, with the word “correlation” prevalent amongst incorrect answers. In part (*e*), very few candidates realised they had to comment on the *p*-value from the computer output, instead relying on the information in the table and making an intuitive comment.

7. This was by far the best answered question on the paper, with a vast majority of candidates getting full marks in part (*a*). In part (*b*), most candidates were only able to give one reason.

FURTHER MATHEMATICS

General Certificate of Education (New)

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FURTHER MECHANICS A - AS UNIT 3

General Comments

The standard of this paper compares favourably with previous legacy mechanics papers. Therefore, all questions should be accessible to candidates and many high-scoring scripts were seen.

Nevertheless, this turned out to be a challenging paper, mainly due to a lack of the necessary algebraic skills required for Further Mathematics. However, this was the first assessment of this unit in the new specification and was taken primarily by candidates at the end of the first year of a two year programme of study.

Comments on individual questions

1. This was by far the best received question on the paper and generally well done by almost all candidates.

   For part (*b*), sign errors were frequent in both the conservation of momentum and the restitution equations, but the most common error was not recognising that objects *A* and *B* have opposing velocities.

   Candidates who used the ratio method to find e, the coefficient of restitution, were less successful as sign errors were much more common.

   Parts (*c*), (*d*) and (*e*) were generally well answered. In particular, for part (*d*), some candidates who made earlier mistakes were content when their solutions indicated a gain in energy.

2. Very few candidates managed to achieve full marks on this question. One of the main problems was due to the resistance to motion being dependent upon velocity.

   Some common responses were:

   - writing $R = v^2$ leading to expressions such as

   $$\frac{P}{14} - 75g - 196 = 0 \quad \text{and} \quad \frac{P}{28} - 75g - 784 = 0;$$

   - using one common resistance so that

   $$\frac{P}{14} - 75g - R = 0 \quad \text{and} \quad \frac{P}{28} - 75g + R = 0;$$

   - not realising that the tractive force is dependent upon the velocity so that

   $$F - 75g - 196k = 0 \quad \text{and} \quad F - 75g + 784k = 0.$$

3. In part (*a*) of this question, most candidates were aware that conservation of energy was required to connect potential and elastic energy. Relatively few included an incorrect term involving a kinetic energy. Unfortunately, in many cases, candidates' points of reference were ambiguous.

   In part (*b*), overall, candidates correctly stated the necessary assumption, yet surprisingly many did not state the correct distance *AP*.

4. For part (*a*), almost all candidates recognised that differentiation was required to obtain an expression for the velocity vector. They also knew that this vector is zero when the particle is at rest. Disappointingly, very few candidates realised that for a vector to be zero, all its components must also be zero. Therefore, very few candidates were able to determine *any* values of t such that the particle is at rest. A few candidates decided to look at

$$v^2 = 34\cos^2 t + 64\sin^2 2t = 0\,.$$

   and hence were unable to solve the resulting equation as it involved a compound angle formula.

   For those who correctly identified that the individual components could simply be equated to zero, many gave responses in degrees.

   Parts (*b*) and (*c*) were generally done very well. Notably, few candidates spotted the fact that the required force in part (*c*) could have been obtained by differentiating their expression for momentum in part (*b*).

5. Responses to this question were either very good or extremely poor, possibly since it was in a purely algebraic setting. The main error was in establishing the potential energy component(s) for the energy equation in part (*a*).

   Many candidates worked relative to the base of the circle and hence initially obtained the equivalent correct response below

$$\frac{1}{2}mu^2 + mgl\left(1-\cos 60^\circ\right) = \frac{1}{2}mv^2 + mgl\left(1-\cos\theta\right).$$

   Sadly, sign errors were frequent when rearranging such equations and many interchanged u and v at various stages of their solutions.

   Some candidates treated the problem as if motion started at the bottom of the circular path instead of at 60° to the downward vertical.

   In parts (*b*) and (*c*), most candidates were aware of the concepts required. However, many candidates were unable to succinctly describe the motion of the particle after circular motion breaks down.

6. Efforts were generally disappointing in this question, especially since there was no tendency to sideslip.

For part (*a*), many candidates erroneously opted to resolve perpendicular to the plane or along the plane. Therefore, $R = 1200g\cos 60^{\circ}$ was frequently seen.

As expected, misconceptions in part (*a*) were mirrored in part (*b*). However, once the radius was found, candidates were generally able to find the angular speed, correctly stating its units.

Overall for part (*c*), candidates were able to recognise that, without appropriate assumptions, the radius would differ. However, many candidates were unable to provide an assumption, other than 'no friction'.

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