GCE EXAMINERS' REPORTS

GCE (NEW)
MATHEMATICS
AS/Advanced

SUMMER 2018

Grade boundary information for this subject is available on the WJEC public website at:
https://www.wjecservices.co.uk/MarkToUMS/default.aspx?l=en

Online Results Analysis

WJEC provides information to examination centres via the WJEC secure website. This is restricted to centre staff only. Access is granted to centre staff by the Examinations Officer at the centre.

Annual Statistical Report

The annual Statistical Report (issued in the second half of the Autumn Term) gives overall outcomes of all examinations administered by WJEC.

MATHEMATICS

General Certificate of Education (New)

Summer 2018

Advanced Subsidiary/Advanced

PURE MATHEMATICS A – AS UNIT 1

General comments

This paper seemed to be about the correct standard and length, though there were some feelings among students that it might have been a touch too long. As the marking was done question by question, very few entire scripts were seen, so it was difficult to judge whether this was actually the case. Very good solutions to all questions were seen with perhaps only question 12, and question 17, particularly part (c), causing general difficulties to all except the most able candidates.

Candidates should familiarise themselves with the formula booklet before sitting mathematics examinations. It would appear that some candidates did not know the formula required in question 11, for example, when they might have looked it up in the formula booklet.

Comments on individual questions

1. Both parts of this question were generally well done with some errors on tidying up the final answers losing candidates the last mark in each part.

2. Part (a) was well done by almost all candidates. In part (b), candidates did not always explain clearly their method, nor indeed say in their solution, which ratio was being considered. Often the ratio 2:1 or 1:2 appeared with no accompanying explanation. Disappointingly, in part (c), many candidates thought that the line crossed the x-axis when $x = 0$ rather than $y = 0$. This affected the number of available marks in part (d). In part (d), some candidates got the incorrect angle as the right angle making their solution completely wrong. This kind of error can be eliminated by a clearly drawn diagram and candidates should be encouraged to draw a clearly labelled diagram with questions on this topic.

3. Most candidates did not have difficulties with this question though a variety of strange and interesting substitutions for $\cos^2\theta$ were seen. Some candidates got the signs the wrong way round when factorising the quadratic. However, full follow through was given for the resulting angles.

4. As usual with questions on basic differentiation and integration, candidates scored high marks for this question. Errors were usually with the manipulation of the fractional indices.

5. Responses to this question were disappointing as candidates did not take sufficient care to preserve the asymptotes when sketching the graphs and so the asymptotes were not clearly indicated in the resulting diagram. The concept of an asymptote does not seem to be generally well understood by many candidates. Few candidates managed to gain all 4 marks available in this question.

6. Both parts of this question were reasonably well done. In part (b), some candidates had the incorrect limits in spite of getting everything correct in part (a). In addition, many errors were made with the final calculation. Candidates who ended up with a negative answer seemed perfectly happy with their solution.

7. Most candidates had the correct idea as to the trigonometric manipulation required but the standard of presentation of their proof leaves a great deal to be desired. Some candidates multiplied both sides by $\cos\theta$ and then worked on both sides of the equation at the same time. These candidates were happy when they arrived at the point when the two sides became the same. This lost them the final mark in the question which was only awarded when the quality of the mathematical presentation was good.

8. Both available methods were seen equally. This question did not cause any difficulties for most candidates.

9. When solving trigonometric equations, candidates nearly always give both the acute and the obtuse angle as their solution. Not so in this question. Candidates who got both answers required by the question were definitely in the minority. Some candidates did a lot of extra work finding all the lengths and angles of the triangle, which lost them examination time.

10. A generally well done question though lots of candidates had difficulties with simplifying powers of $\sqrt{b}$. In part (b), many candidates made the mistake of subtracting the two brackets instead of adding them.

11. Part (a) was such a simple question, but unfortunately many candidates did not think so. Most candidates were able to find the modulus of a vector but then, bafflingly, they did not know how to proceed. The formula required for part (b) can be found in the formula booklet. This fact would appear to have escaped the notice of many candidates. However, the candidates who found the formula often had the values 2 and 3 the wrong way round; whereas the candidates who did it from scratch using vector methods often got the correct answer.

12. Many candidates knew this question required the use of the discriminant of a quadratic equation. However, the presence of a term involving the unknown m threw them and their discriminant often had sign errors or bits missing. Also, the resulting quadratic inequality caused difficulties. Few completely correct solutions were seen.

13. Parts (a) and (b) of this question were well done generally. Some misunderstandings were apparent with candidates who mistakenly calculated $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$ to be zero claiming that the point under consideration to be a point of inflection. Many strange and incorrect statements were seen in part (c).

14. Part (a) was reasonably well done. However, in part (b), many candidates thought that showing that statement B is true for a particular pair of values for c and d was a sufficient proof that statement B is true for all values of c and d.

15. Most candidates were able to use the values given to obtain two equations for A and k. However, many did not know what to do with the resulting pair of equations and many did not know that $\mathrm{e}^0 = 1$.

16. Candidates who had an idea how to use the gradient function generally went on to gain full marks as the resulting calculations were simple. Candidates who used the discriminant method were mostly successful, but many made mistakes with the discriminant, particularly with the signs in the constant term.

17. This question proved to be the most difficult one on the paper for the candidates. This may be because it was the penultimate question on a long paper and candidates were under time pressure. Not many correct solutions were seen to all parts. In part (b), candidates tried to invert without first dividing by 2. In part (c), candidates were not able to write $4^x - 10 \times 2^x$ as $y^2 - 10y$; many candidates ended up with an incorrect linear expression in y which made the last 4 marks inaccessible.

18. Part (a) was well done by candidates using a variety of methods. In part (b), candidates who did not spot that *BC* is the diameter of the circle had some difficulties. This is another question where a carefully drawn diagram with points clearly labelled would have helped candidates towards a correct solution and to avoid mistakes.

MATHEMATICS

General Certificate of Education (New)

Summer 2018

Advanced Subsidiary/Advanced

APPLIED MATHEMATICS A – AS UNIT 2 SECTION A

General Comments

The new specification gave a wide spread in attainment over the course of the paper. Some calculations were generally well done, such as the calculations for outliers and using the equation of the regression line. Many candidates found themselves out of their depth at this level, with the increase in challenge from GCSE to AS a step too far. Questions requiring interpretation or insight were not well answered.

Comments on individual questions

1. This question clearly stated that candidates must show the calculation required. Despite this, many candidates did not show their working and therefore scored no marks.

2. In part (a), many candidates did not give their answer in context. Of those that answered in context, some did not understand that $M \cap D'$ did not refer to the *number* of students studying mathematics and not drama, or to the *probability* of studying mathematics and not drama.

   In part (b), a common error was to ignore the 4 students who studied mathematics and drama, thus arriving at an answer of $\frac{25}{40}$.

   Part (c) was tackled with a variety of methods. The most successful candidates were those who set out their solution in a similar manner to questions of this kind in legacy statistics papers.

3. This question was not generally very well answered. Many candidates were unable to interpret the situation as being modelled by the Poisson distribution, with most of those that could, using Po(0.25). Even fewer candidates were able to use their answer for part (a) with a binomial distribution to answer part (b).

4. This question was by far the most poorly answered question on the paper. Almost all candidates formed the correct hypotheses, but very few candidates understood the concept of a test statistic.

   Part (b) was relatively well done. The most common errors were to find $P(X = 4)$ and $P(X = 5)$ and to form a critical region based on these probabilities. This was not awarded any marks.

A disappointing proportion of candidates failed to give the answer to part (c) in context. In part (d), most candidates did not use their answer to part (b), which would have been the obvious approach to take. Teachers and students should note that "accept H_0" is not a reasonable conclusion to come to, having conducted a hypothesis test. The correct terminology should be "do not reject H_0". With regards to the conclusion reached, the evidence did not suggest that the proportion was 0.2, it suggested that there was not enough evidence to say that Edward had improved.

5. This question was reasonably well answered, with the most common omission being the words "on average" for describing the gradient in part (b)(i). Most candidates realised that the reliability of the estimate found in (b)(ii) was not very high. Some thought that it was reliable due to the strong nature of the linear relationship.

6. Performing the calculations to determine the relative position of the outliers was done well by the vast majority of candidates, but the nuanced answer of "40 is an outlier, but there may be others" was only eluded to by a very small number of candidates. An even smaller number of candidates were able to correctly identify what would happen to the median if the outlier was removed.

   Part (d) showed that very few candidates had advanced their analytical skills from GCSE, with a large number of candidates simply stating facts such as "The range is bigger for Dafydd", or "Basel's median is higher". This did not score any marks.

MATHEMATICS

General Certificate of Education (New)

Summer 2018

Advanced Subsidiary/Advanced

APPLIED MATHEMATICS A – AS UNIT 2 SECTION B

General Comments

All questions appeared to be accessible to most candidates and it was clear that they were able to finish section B of the paper.

The most challenging questions were notably 8(b) and 11(c).

Comments on individual questions

7. This question provided a gentle start to section B of the paper. Almost all candidates recognised that integration was required in order to obtain an expression for the displacement. Remarkably, many candidates did not go beyond $x = 2t^3 - 4t^2 - 5t + C$ and hence forfeited the final A1 mark. Of those candidates who attempted to find the constant C, many were unsuccessful as they struggled to deal with the initial conditions.

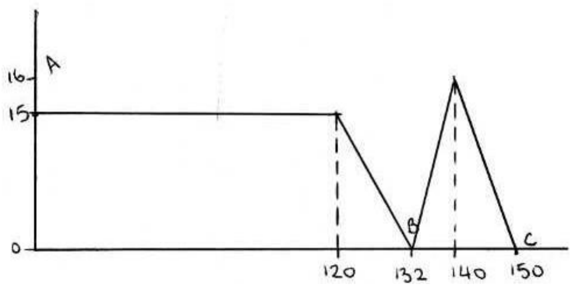
8. This 'standard pulley' question was generally well done. However, possibly due to its simplicity, many candidates incorrectly applied N2L to particle *A* since there was no force opposing T. In particular, the weight of the particle $(3g)$ on the horizontal surface, which acts in a perpendicular direction to the direction of motion, was often erroneously included in the equation of motion, i.e. $T - 3g = 3a$ was considered instead of $T = 3a$. Disappointingly, very few candidates were successful in answering part (b) concerning the effect of a rough pulley. The most frequent incorrect response was *"Tension is constant throughout the string."*

9. Candidates were very successful in answering this question. Nevertheless, many candidates did not do enough to secure the final mark for the direction of the resultant. Candidates were generally comfortable in dealing with the necessary trigonometry, yet were unconvincing with the direction.
Some common ambiguous responses were:
   - $\theta = 77^{\circ}$ below the axis
   - $\theta = 77^{\circ}$ below the horizontal

   A few candidates decided to work out the magnitude and direction of the individual forces $\mathbf{L}$, $\mathbf{M}$ and $\mathbf{N}$.

10. This 'standard lift' question was answered very well in general. Since the lift was decelerating, some candidates struggled with the fact that the net upwards force was negative. As a result, these such candidates either dealt with $836g - T = 836a$ or decided to simply drop the negative sign in the answer. A small number of candidates missed out the mass for the person in the lift in part (a). Part (b) was well answered, mainly by those candidates who were comfortable with part (a). Part (c) was also relatively well done as most candidates were able to correctly isolate the forces acting on the person and the floor of the lift.

11. Candidates were very successful in answering parts (a) and (b). For the sketch in part (c), few candidates were able to gain full marks since they mainly struggled with the concept of negative velocity. Furthermore, axes were not labelled sufficiently in many cases. A frequent response is shown below.



In part (d), due to the confusion over negative velocity, *AC* = 1890 + 144 was frequently seen.

MATHEMATICS

General Certificate of Education (New)

Summer 2018

Advanced Subsidiary/Advanced

PURE MATHEMATICS B – A2 UNIT 3

General comments

This paper proved to be of an appropriate standard and was accessible to the majority of candidates. Many very good solutions were seen to all of the questions. Question 14(b) would seem to be the question that caused the candidates the most difficulties as many did not spot the correct trigonometric substitution, though most candidates did realise that a trigonometric substitution was required. The length of the paper would seem to be about right. I wish the quality of presentation of candidates' solutions could be improved, and I think all my assistant examiners would echo that sentiment.

Comments on individual questions

1. This question provided a good start to the paper. Both available methods were seen equally often and errors were mainly algebraic caused by carelessness.

2. This second accessible question should have thoroughly settled the candidates' examination nerves. Hardly any candidates got this question wrong.

3. Most candidates coped with this question well and the points were marked in clearly. In part (b), a minority of candidates did not realise that the graph is now a negative quadratic curve and got the wrong shape.

4. Candidates are well used to solving trigonometric equations of this type and this particular one is a simple example of its type. Not many candidates had difficulties.

5. As the form of the partial fractions was given in part (a) of the question, candidates were well able to find the required constants, either by substituting appropriate values for x, or by comparing coefficients. The integration was also reasonably well done with very few candidates missing the $\ln$ terms. There were some errors seen, particularly with candidates forgetting the minus sign when integrating $4(x-4)^{-2}$.

6. The responses to this question were a little disappointing. Some candidates were not able to deal efficiently with the negative fractional index in the binomial expansion. Some candidates substituted $x=\frac{1}{13}$ into the expanded side of the equation only and were therefore not able to find the required approximate value for $\sqrt{13}$.

7. This was a generally well done question with some candidates substituting the incorrect expression, $1+\frac{x^2}{2}$, for $\cos x$, which, sadly, lost them all the available marks in this question.

8. This proved to be a very simple question for many candidates. Some did the question without using the usual equations for an arithmetic progression. Quite a few solutions were seen where there was no working at all. Almost all but the weakest candidates obtained full marks in this question.

9. This question proved to be reasonably challenging. In part (a), many candidates made perfectly correct statements about the divergence of the series when $|r| > 1$, but omitted to say anything about its convergence. However, it is statements about the convergence that carried the mark. In part (b), candidates were generally not able to explain why the series W is a geometric one. However, they simply assumed that the series is geometric and were able to form the correct equation from the information provided in the question and went on to find the value of r correctly. In part (c), candidates who realised that the sum to 20 terms of a geometric series was required usually went on to obtain the correct answer. A proportion of these candidates were out by a factor of (1.03).

10. Candidates did not find this question easy. In part (a), many candidates realised that θ needed to be eliminated, but they used a variety of inappropriate methods where θ was eliminated but where there were still trigonometric functions present in the equation. Part (b) was reasonably well done with all the methods equally used by the candidates, including first finding the coordinates of *P* and *Q* and then verifying that these points lie on the line. In part (c), many candidates did not know how to deal with an infinite gradient and simply assumed that the gradient was 0.

11. A lot of candidates were able to gain the first 3 marks, but they were not able to gain the last mark. Although they all knew that there had to be a contradiction, many were not able to say where the contradiction occurred.

12. Part (a) was not well done giving the impression that the work on functions was not generally well understood. Part (b) had better quality responses except for the required sketch of the graph. Many sketches were very carelessly drawn. Asymptotes were not generally drawn in the sketch. These were required as no marks were awarded for a graph without its accompanying asymptotes.

13. Parts (a) and (b) of this question were well done. In part (c), some very strange answers were seen. Many candidates seemed to have forgotten the 17.

14. Part (a) was well done though solutions were riddled with careless mistakes. Part (b) depended on candidates spotting the correct substitution, either $2\sin\theta$ or $2\cos\theta$. Many candidates tried $\sin\theta$ or $\cos\theta$ which was not helpful. Candidates who presented perfectly correct answers, presumably obtained from their calculators, without any supporting working were awarded no marks at all.

15. Some candidates did not manage to separate the variables correctly. This was a costly mistake as all available marks were lost.

16. This question is similar to the ones that appeared in the 'C' papers in the legacy qualification and are therefore generally well done by many candidates. Errors were usually careless algebraic ones or with the arithmetic when calculating the gradient of the tangent.

17. This last question also did not cause many difficulties. Some candidates were not able to draw a convincing graph. Usually, the cosine curve was correct, but the point of intersection with the straight line was not between 0 and $\frac{\pi}{2}$. This usually lost candidates the first mark in the question. The Newton-Raphson method seemed to be well understood.

MATHEMATICS

General Certificate of Education (New)

Summer 2018

Advanced Subsidiary/Advanced

APPLIED MATHEMATICS B – A2 UNIT 4 SECTION A

General Comments

Section A was generally very well answered. As this was the first assessment in the new specification, all the candidates sitting this paper were those who were completing the full A level in Mathematics in one year. The cohort sitting this paper was of a particularly high standard with very few weak candidates. Question 3 proved to be the most challenging question. In general, the conditional probability questions were not well answered.

Comments on individual questions

1. Parts (a) and (b) were generally very well answered. The algebraic solution and the alternative, Venn diagram solution were both widely used with those candidates drawing a Venn diagram generally more successful. Part (c) was not as well answered, with 0.3 being the elusive part of the solution. Many varying, incorrect numerators were given.

2. Forming and solving the quadratic equation in part (a) was generally well done. Solutions to part (b) were often disappointing, with many candidates failing to recognise either $\frac{9}{22}$ or $\frac{12}{32}$ as the probabilities required to answer this part successfully.

3. The vast majority of candidates were able to identify the distribution, the mean and the variance, with a small number of candidates stating incorrectly that it was the normal distribution or the Poisson distribution. Finding the probabilities $\frac{1}{4}$ and $\frac{7}{12}$ from the uniform distribution proved too challenging for most candidates. A common incorrect probability seen was $\frac{1}{3}$. Fewer still realised that they had to multiply the correct probabilities of $\frac{1}{4}$ and $\frac{7}{12}$ by 0.88 and 0.12 respectively. Candidates who attempted part (b)(i) and who were awarded method marks in part (b)(i) were often able to go on and answer part (b)(ii).

4. This question was generally well answered. Many candidates were able to give good explanations in parts (a), (c) and particularly (d). In part (b), some candidates only found the probabilities, which made comparing predicted and actual values in part (c), impossible.

5. This question proved to be accessible to most candidates. There was some confusion regarding the two-tailed hypothesis test, with some candidates concluding that there was evidence of a positive correlation. Similarly, there were candidates using a one-tailed test who failed to conclude that the evidence pointed towards a positive correlation. The most common error was in part (a), which was to compare the p-value with the product moment correlation coefficient in order to conclude that there was no correlation. They should, of course, have compared the p-value with 0.05 as the standard 5% significance level.

MATHEMATICS

General Certificate of Education (New)

Summer 2018

Advanced Subsidiary/Advanced

APPLIED MATHEMATICS B – A2 UNIT 4 SECTION B

General Comments

All questions appeared to be accessible to most candidates and it was clear that they were able to finish section B of the paper.

The most challenging questions were notably 7(b), 8(b) and 9(b).

Comments on individual questions

6. This was the most successful question on the paper. Most candidates took moments about the pivot, meaning that there was no need to resolve vertically. It was encouraging to see candidates giving algebraic solutions in terms of g and showing that the end result is independent of g. Many candidates found the distance from *D* to the central pivot. Unfortunately, a small proportion of these candidates did not perform the final calculation to find *AD*, the required distance, and so lost the final A1 mark.

7. This was the most challenging question on the paper. Part (a) caused the least number of problems with many candidates correctly establishing the resistive force as $0.4v$. In part (b), many struggled to legitimately separate the variables, meaning that no further credit could be awarded. For those whose were successful in separating the variables, almost all of them recognised that the resulting integral was a logarithm. There were a small number of candidates who failed to see the importance of the modulus, and hence wrote incorrect expressions such as

$$\ln(-9.8-0.8v)=-0.8t+C\,.$$

For those candidates who attempted part (c), almost all of them recognised that $v=0$ at the highest point of motion.

8. Overall, efforts were generally disappointing in this question. Part (a) was well received. As expected, almost all candidates correctly resolved the weight of the object parallel and perpendicular to the inclined plane. Consequently, almost all candidates achieved the first two marks for writing down the normal reaction and the maximum friction.

   N2L was generally applied with the correct number of forces, although there were frequent sign errors meaning that the final two A1 marks were often sacrificed. Efforts in part (b) were relatively disappointing with many candidates failing to provide a convincing argument. It was evident that that many candidates did not fully appreciate the idea of limiting friction. Many considered $F_{\max}$ as a constant force acting down the plane, thus giving a negative net force. Some deemed this to be sufficient to justify that the object does not move up the plane, with a few using this fact to deduce movement down the plane.

9. Many candidates scored full marks in part (a) of this question on projectiles. A few candidates simply stated the formulae for the range of a projectile, namely $R = \frac{V^2}{g}\sin 2\theta$. However, as indicated in 2.4.8 of the specification, such responses unfortunately gain no credit. For part (b), many candidates were aware of the necessary methods, with some equating heights and others equating the appropriate horizontal distances. However, marks were often lost because of poor algebraic skills.

10. Overall, this question was relatively successful. In part (a), a small number of candidates only found the acceleration vector and hence forfeited the final A1 mark. In part (b), many candidates did not take advantage of the fact that the acceleration vector was constant. Therefore, many used repeated integration which led to unwieldy solutions. Nevertheless, many candidates achieved at least 2 of the 3 marks available with the omission of $\mathbf{r}_0$, the position vector of the particle at $t = 0$, being the main culprit for loss of the final A1.

WJEC
245 Western Avenue
Cardiff CF5 2YX
Tel No 029 2026 5000
Fax 029 2057 5994
E-mail: exams@wjec.co.uk
website: www.wjec.co.uk