Examiners' Report

Summer 2015

Pearson Edexcel International Advanced Level
in Decision Mathematics D1
(WDM01/01)

Edexcel and BTEC Qualifications

Edexcel and BTEC qualifications are awarded by Pearson, the UK's largest awarding body. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information visit our qualifications websites at www.edexcel.com or www.btec.co.uk. Alternatively, you can get in touch with us using the details on our contact us page at www.edexcel.com/contactus.

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Summer 2015
Publications Code IA041218

Mathematics Unit Decision Mathematics 1
Specification WDM01/01

General Introduction

This paper proved accessible to the students. The questions differentiated well, with most giving rise to a good spread of marks. All questions contained marks available to the E grade students and there also seemed to be sufficient material to challenge the A grade students.

Students are reminded that they should not use methods of presentation that depend on colour, but are advised to complete diagrams in (dark) pencil.

Students are also reminded that this is a ‘methods’ paper. They need to make their method clear, ‘spotting’ the correct answer, with no working, rarely gains any credit.

Some students are using methods of presentation that are too time-consuming, this was particularly true in question 2(c), the bubble sort, where many students ran out of space (and possibly time) unnecessarily showing each comparison. The space provided in the answer book and the marks allotted to each section should assist students in determining the amount of working they need to show.

Some very poorly presented work was seen and some of the writing, particularly numbers, was very difficult to decipher.

Students should ensure that they use technical terms correctly. This was a particular problem in questions 2(a), 3(b) and 4(a).

Report on Individual Questions

Question 1

Part (a) was usually very well done with most students applying Dijkstra's algorithm correctly. The boxes at each node in part (a) were usually completed correctly. When errors were made it was either an order of labelling error (some students repeated the same labelling at two different nodes) or working values were either missing, not in the correct order or simply incorrect (usually these errors occurred at nodes E, G and/or H). The most common error tended to be a lack of 17 (which came from F) in the working values at E – likely forgotten because EF lies to the right of E on the diagram. The route from S to G was usually given correctly and most students realised that whatever their final value was at G this was therefore the value that they should give for the shortest distance. As noted in previous reports because the working values are so important in judging the student's proficiency at applying the algorithm it would be wise to avoid methods of presentation that require values to be crossed out.

Students who answered part (a) correctly usually went on to score both marks in part (b) for finding the shortest route and distance from S to H. However, earlier errors in applying the algorithm meant that sometimes only the mark for the shortest distance could be awarded (on the follow through) in this part.

Question 2

A lack of completeness and precision on the part of many students meant that scoring both marks was rare in part (a). Most responses, which were along the right track, were often too vague about comparing adjacent items in the list rather than specifying which items were being compared. To score any marks in this part it was vital that the student made it explicitly clear that in the first pass the first value in the list is being compared with the second value and the values are then swapped if the second is larger. Many students who scored the first mark did not score the second because their argument did not contain the salient points on how the first pass was completed. Even those students who did specify that the second value is then compared to the third value often did not explain that similar comparisons must continue to the end of the list.

Part (b) was more accessible than part (a) but equally challenging for some students. A significant number of students performed the first pass of the bubble sort in part (c) in order to inform their answers here and many stated an answer of 1 for the number which would be in the correct position after the first pass. Unfortunately many also stated an answer of 7 as this number happens to be in the correct position after the first pass for this particular list. Some students despite going on to undertake a correct bubble sort in part (c) gave incorrect answers here such as 'the largest'. A lack of precision also lost marks for some students in part (b) as they stated 'the end number' without unambiguously describing which item they were referring to. For the number of passes, the most common answers were n, $n + 1$, $n – 1$, $\log_2 n$, 6, 7 (the number of passes required to complete part (c)) and other seemingly random numbers.

In part (c) the majority of students knew how to carry out a bubble sort and nearly all did so correctly. Unfortunately, many students did not read the question carefully and either showed each comparison and swap during the first pass or during all subsequent passes. There were occasional errors including the loss of one item or the combining of two single digit numbers. A few students did not work consistently through the list of numbers. Finally, in this part, it was common for students to stop after a sixth pass due to the list appearing to be in the 'correct order'. With the bubble sort algorithm if the list finds itself ordered before the final two items in the list have been considered then either a suitable conclusion (that the list is sorted) or an additional pass is required.

In part (d) in which students now had to apply the first-fit decreasing algorithm to their ordered list from part (c) a significant number, who had sorted the numbers into ascending order earlier, then proceeded to attempt a “first fit increasing” method in this part. While the vast majority of students used the sorted list they had obtained in part (c) there were a minority of students who used the unsorted list. Otherwise, the most common errors were putting the 9 in bin 3 or putting the 1 in bin 4.

Question 3

Most students answered part (a) correctly although many gave elaborate (but acceptable) cycles that attempted to visit every vertex on the graph. Others gave answers which contained sub-cycles. It was also quite common to see answers which did not return to the start node.

In part (b) a significant number of students thought that P – Q – R – T – Q – S was a path because it ‘was a finite sequence of edges where the end vertex of one edge is the start vertex of the next’ but neglected to consider the fact that a vertex cannot appear more than once. Rather more worryingly some stated that it was a path because no vertex was visited more than once. Of those students who made a more successful attempt many gave an argument that was too general in their explanation stating either that ‘it contained a cycle’ or ‘a vertex was repeated’ – it was expected that the argument would be based on the network given in the question. Disappointingly many of those that did attempt to state the cycle did so incorrectly, for example, it was often stated that R – T – Q was a cycle.

Part (c) was generally well answered with the majority of students applying Prim’s algorithm correctly starting from vertex P. A few students attempted to construct a table to perform Prim, clearly believing that Prim can only be performed when expressed in matrix form. Finally, there is still a small minority of students who appear to be rejecting arcs when applying Prim’s algorithm so scoring only one of the three possible marks in this part.

Most students applied Kruskal’s algorithm correctly in part (d), but some did not demonstrate the correct handling of rejected arcs, which is essential for Kruskal’s algorithm. Students would be advised to list all the arcs (from the network) in ascending order and then state ‘add’ or ‘reject’ next to each arc (or some other clear indication of which arcs are being included/not included in the MST). Some students lost the final mark by omitting one or more rejected arcs while a small minority scored no marks in this part as they then failed to record any rejections.

If the student answered part (c) and/or (d) successfully then they typically answered part (e) correctly. A number of students were able to recover from mistakes in these earlier parts to draw the correct minimum spanning tree.

Part (f) discriminated extremely well. It was clear that many did not understand the term interval as many gave a single numerical answer. Others added up the weights of all the arcs (including x) and gave the sum as their answer. Very often however this part was left blank. Only the most able students were able to gain any marks here although it was usually only one mark as they frequently neglected the $x > 20$ or gave $x \leq 31$.

Question 4

Some students in part (a) gave fully correct complete definitions of an alternating path and others were nearly there, although some unfortunately let themselves down by confusing the terms ‘arcs’ and ‘nodes’. For most, however, this part was less accessible. The majority of students gave definitions which attempted to explain what an alternating path is used for rather than what it is and so stated ‘it is how you improve your matching’ or similar. Others gave answers whose imprecision failed to gain any marks and examiners commented that they saw many responses which were along the lines of ‘from an unmatched node in one set to another node’. Some students interspersed their answer with the terms ‘in’ and ‘not in’ but without referring explicitly to arcs.

Part (b), especially part (i), differentiated well. This style of question was quite unfamiliar and threw many weaker students and therefore it was often either left blank or students jumped straight in to stating the improved matching in part (ii).

Part (c) was answered extremely well but there was the usual loss of marks for some students due to not stating or showing the change of status, or for failing to state or draw the complete matching. In some cases students may have drawn the complete matching on a diagram which was not clear due to multiple arcs being drawn from individual vertices.

Question 5

Part (a) was generally answered well by most students with the vast majority stating the correct three distinct pairings of the correct four odd nodes. There were a few students who only gave two pairings of the four odd nodes or who gave several pairings but not three distinct pairings. There were however many instances where the totals were incorrect. It was fairly common to see 33 for the AE and HG pairing and sometimes 38 for the other two pairings. There were also some instances where no totals were given which lost students a significant number of marks. Students should be advised to be thorough when checking the shortest route between each odd pairing. Many students did not explicitly state the arcs that should be repeated instead stating that AE and HG should be repeated instead of the correct arcs AB, BC, CE, HF, FG. Furthermore, a number of students did not state the length of a shortest inspection route.

Only a minority of students were able to answer part (b) correctly with the majority stating that F would appear 8 times (8 was the order of vertex F once the two additional arcs were added) rather than the correct answer of 4.

In part (c) many students identified AE, EG and AG as the paths that needed to be considered, although they often missed stating the fact that EG was the shortest path that did not include vertex H. Many students, even with the correct selection of arcs, did not state that the finishing point should be vertex A. Some students misunderstood the reasoning altogether and focused on the fact that AH had the greatest weight of the previous pairings and therefore should be avoided and so EG should be repeated. Others said that ‘EG is the least therefore the finishing point should be at either E or G’. Those who did state EG usually went on to score the mark for stating the length of a shortest inspection route.

Question 6

Parts (a) and (b) were generally well answered with many students scoring full marks in both these parts. The most common error in part (b) was to have incorrect values at the end of activity B. Most students were confident in calculating the float in part (c) and the majority of students gave the calculation in full. Equally successful was the lower bound calculation in part (d) and there were relatively few students who calculated 42/17 or similar. For part (e) quite a few students drew a Gantt chart instead of a scheduling diagram, and so scored no marks. There were also quite a few instances of this part being left blank. For students who knew what a scheduling diagram was this part was generally well answered, although students should be reminded to check that they include all the activities in the network and that the activities have the correct lengths. In this part many students did not include all 11 new activities, or they scheduled using five workers rather than the correct four. Some students made a good attempt but failed to fully check the precedences for each activity. The most common errors arose out of the precedence of activity I on activity E and also from the precedence of activities E and F on activity C. There were some good solutions seen to this part, with a number of different but valid solutions seen.

Question 7

This question proved to be quite challenging for the majority of students. In part (a) many students were quite successful in obtaining the two required inequalities although the second inequality was sometimes given incorrectly as $5x + 8y \geq 160$. Part (b) was far more challenging and in fact this part was sometimes omitted altogether. Examiners noted that it was almost as common to see the coefficients of x and y interchanged and/or the inequality sign reversed as it was to see the correct answer of $2y \geq x$.

Most students were able to draw the required lines correctly in part (c) although some were unable to draw lines sufficiently accurately (some drew lines without a ruler) or sufficiently long enough. As stated in previous reports the following general principle should always be adopted by students:

- lines should always be drawn which cover the entire graph paper supplied in the answer book and therefore,

- lines with negative gradient should always be drawn from axis to axis.

The rationale behind this is that until all the lines are drawn (and shaded accordingly) it is unclear which lines (or parts of lines) will define the boundary of the feasible region. If students only draw the line segments that they believe define the boundary of the feasible region then examiners are unaware of the order in which the lines were drawn and therefore it is unclear to examiners why some parts of the lines have been omitted. In general the lines $12x + 7y = 168$ and $5x + 8y = 160$ were correctly drawn. The most common error was with the line $2y = x$, either because of a previous error with part (b) or incorrectly drawing the line $y = 2x$. Furthermore, a significant number of students were unable to select the correct feasible region in this part.

In part (d)(i) reciprocal gradient objective lines were drawn by a significant number of students, which of course usually meant choosing the wrong vertex. Of those students who had both a correct feasible region and objective line many did not label the optimal vertex on their graph as requested. In part (ii) many students attempted to read the coordinates from their graph and it was rare to see students finding the coordinates of the optimal vertex using simultaneous equations. A number of students who made errors with the method in this part, or did not show a method at all, were still able to pick up the final two marks in part (e) for identifying the correct number of hardbacks and paperbacks and the corresponding profit.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:
http://www.edexcel.com/iwantto/Pages/grade-boundaries

Pearson Education Limited. Registered company number 872828
with its registered office at 80 Strand, London, WC2R 0RL, United Kingdom