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| *Mathematics in Context - Ebola* | | | | | |
| Question | | Working | Answer | Mark | Notes |
| 1 | a |  |  | 1 | B1 oe |
|  | b | |  |  |  |  | | --- | --- | --- | --- | | **Number of new cases** | **Number of weeks (f)** | **Midpoint  (*x*)** | **f*x*** | | 1 - 40 | 2 | 20.5 | 41 | | 41 - 100 | 5 | 70.5 | 352.5 | | 101 - 200 | 7 | 150.5 | 1053.5 | | 201 - 500 | 6 | 350.5 | 2103 | | 501 - 800 | 4 | 650.5 | 2602 | |  | 24 |  | 6152 | |  |  | mean | 256 | | 256 | 3 | M1 for at least 4 products f*x* with *x* consistently within interval (including end points) M1 (dep) for use of at least 3 correct midpoints  M1 (dep on 1st M1) for Σf*x* ÷ Σf  A1 awrt 256–257 |
|  | c |  | Convincing reason | 1 | C1 for a convincing reason - e.g. the median will not be affected by the extreme values in 501+ |
| 2 | a |  | Correct cumulative frequency diagram  See below | 3 | M1 For a fully correct cumulative frequency table or for all cumulative frequencies at the correct height on the graph  M1 All points from the candidate's cumulative frequency table plotted correctly at the top end of the intervals  A1 Fully correct graph including scale and labels |

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|  | b |  | Correct box plot  See below | 3 | M1 for attempt to find Q1, Q2 and Q3 from the cumulative frequency graph or by interpolation  A1 for a box plot with the lower end in 1 - 20 and the upper end in 121 - 140  A1 for a fully correct box plot (ft cumulative frequency diagram) including a scale and a label of City B |
|  | c |  | Comment on medians Comment on IQR  Comment on symmetry | 3 | C1 The median in city B is, at 48, smaller than the median in city C, at 54. So typically the number of new cases per week is lower in city B.  C1 The IQR of city B, at 32, is smaller than the IQR of city C, at 42. So the spread of the middle 50% of cases is lower in B.  C1 The median in city B is halfway between the quartiles but there is a positive tail. The median in city C is closer to the upper quartile but there is a long positive tail (whisker). So City B has relatively more high new numbers than city C.  (NB the range is a poor choice because of the possible presence of outliers and the uncertainty of the least and greatest values.) |
| **3** | (a) | 10 × 1.0514 | 19.8 | 2 | M1  A1 19.8 - 20 |
|  | (b) |  | (About) 2 weeks | 1 | B1 oe |
|  | (c) | 100 × 1.0440 | 480 | 3 | M1  A1 |
|  | (d) |  | Convincing reason | 1 | C1 e.g. the disease will eventually run out of people to infect. |
| **4** |  | 75 × 1.0198132 = 998 | Correct comparison | 3 | M1  A1  C1 The model gives a value close to that on the graph. |
| **5** | (a) |  | Valid comment for each value in context | 2 | C2 for all of e.g. I1 = 1 means that a single individual has been infected **and** R1 =0 means that no one has had the disease and recovered **and** S1 = P − 1 as there is 1 person infected out of P.  (C1 for any one of these.) |

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| Question | | Working | Answer | Mark | Notes |
|  | (b) |  | Shown  Relevant comment on *a* | 3 | M1 for  C1 for a fully correct demonstration.  C1 Large values of *a* mean there will be large percentage decrease in the number of susceptibles. |
|  | (c) |  | Correct interpretation and comment on *b* | 2 | C1 The number recovering increased in a way proportional to the number of infectives.  C1 Large values of *b* mean that the increase in the number of recovered (or removed) is large, |
|  | (d)(i) | 15 00 000 − 5× 10-7 × 1 500 000 × 400 000 | 1200000 | 3 | M1  A1 |
|  | (ii) | 2 000 000 – 1 500 000 – 400 000 | 100000 | 1 | B1 |
| **6** | (a)i |  | 900 000  1 100 000 | 2 | B1 875 000 – 925 000  B1 1 050 000 – 1 150 000 |
|  | ii |  | Correct comment | 1 | B1 *S* must be 0 or *S* must be very small. |
|  | iii |  | A complete description | 3 | Award up to 3 C1 marks for :  The *In* graph: shows an initial slow growth until about day 20  then a very fast increase so that nearly all the population is infected in a few days.  then a slow decline.  The *Rn* graph  shows virtually no increase until about day 20  then is a steady climb, but with the rate slowing  NB for all 3 marks there must be comments for both graphs. |
|  | (b) |  | Correct graph  See below | 2 | M1 for a correct looking curve. A1 fully labelled with flat graph from (0,2) to (20,2) and then down to (30,0.05) approximately. |
|  | (c) | (2) *I*max = *I*max + *aSn I*max −b *I*max | Shown | 2 | M1 Correct substitution into equation (2).  A1 Correct manipulation to required result. |

2

5

10

15

20

25

30

35

20

40

60

80

100

120

140

160

Cumulative frequency

Number of new cases per week

20

40

60

80

100

120

140

City B

Number of new cases per week

6

Days

Population

(millions)

0.5

1

1.5

2

2.5

50

100

150

200

250

300

350