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| **Guidance on the use of codes for this mark scheme** | |
| M | Method mark |
| A | Accuracy mark |
| B | Working mark |
| C | Communication mark |
| P | Process. proof or justification mark |
| cao | Correct answer only |
| oe | Or equivalent |
| ft | Follow through |

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| **Question** | **Working** | **Answer** | **Mark** | **AO** | **Notes** | **Grade** |
| **1** | 79 298 – 78 987 = 311 kWh used.  80 kWh × 20.95 pence = 1676 pence  = £16.76  311 – 80 = 231  231 × 10.80 pence = 2494.80 pence  = £24.948  Total bill = £16.76 + £24.948 = £41. 708  Assumption that if you average consumption over the year April will be representative. | £41.71  Yes | M1  B1  B1  B1  A1  C1 | 2 | M1 for subtracting the given readings to find the amount of electricity used  B1 multiplying 80 by 20.95 or for writing down £16.76  B1 for subtracting 80 from 311 and then finding the cost of the remainder used by multiplying by 10.80 or for writing down £24.948  B1 for adding the two amounts found together or writing down £41.708  A1 for converting to pounds correctly  C1 for assumption made such as that given or showing that the standing order is higher than the cost of electricity used in April  oe assumptions stated | B |
| **6** |

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| **2** | Assuming dates are inclusive and not a leap year:  27 August to 30 December  = 4 + 30 + 31 + 30 + 30 = 125 days  31 December to 9 April  = 1 + 31 + 28 + 31 + 9  = 100  Total number of days = 125 + 100 = 225  Total amount of electricity used  = 55 916 – 53 480 = 2436 kWh  Current supplier:  225 × 13.99 pence = 3147.75 pence  = £31.4775  2436 × 15.09 pence = 36 759.24 pence  = £367.5924  Total= £31.4775 + £367.5924 = £399.07  New supplier:  225 × 23.818 pence = 5359.05 = pence  = £53.5905  2436 × 14.37 pence = 35005.38 pence  = £350.0538  Total= £53.5905 + £350.0538 = £403.64 | He should stay with his current supplier assuming that electricity use continues at the same level. The summary does not include the summer months when use is likely to be less. The difference is likely to be greater for the summer months. | M1  C1  M1  B2  M1  B2  A1  C2 | 2 | M1 for showing how many days from each month are used and added together  C1 For stating the assumptions about inclusive days, that this is not a leap year and for calculating number of days correctly  M1 for showing how to find the difference of the readings  B2 for showing how to calculate each part of the total cost  B1 if the conversion to pounds and correct rounding has not been done  M1 for showing how the cost is derived for the new supplier with same data as before  B2 for finding the total cost and correctly rounding into money units  B1 if the correct amount has been calculated but not rounded or changed to correct monetary units  A1 for correctly stating he should stay with current supplier  C2 for clarity of answer, including any assumptions given. | B |
| **11** |
| **3 a**  **b**  **c**  **d**  **e** |  | 175 ÷ 8 = 21.875  Round up to the nearest integer, 22, as tables are needed for everybody and you can’t have part of a table.  175 ÷ 8 = £21.875  If all the guests pay the same amount of £21.88 or more there is enough to cover the bill.  175 ÷ 8 = 21.875  Cannot have a fraction of a box, so only 21 boxes can be filled.  21 × 8 = 168 rolls  hence 7 rolls left over  Average speed = distance ÷ time  165 ÷ 8 = 21.875 km/h  You do not need to round this figure off as the speed can be given with this accuracy. | M1  A1  C1  B1  A1  C1  B1  P1  A1  B1  A1  M1  A1  C1  C2 | 2  3 | M1 for dividing guests by number at a table  A1 for the rounded, correct integer  C1 for explaining the need to round up to the nearest integer  B1 for dividing bill by the number at the table  A1 for a correct monetary amount higher than £21.875 and less than £22 unless a tip is mentioned  C1 for stating the need to round up in order to create a total higher than the bill if they all pay the same  B1 for correctly dividing number of bread rolls by number in each box or the number 21.875  P1 for stating the need to truncate the amount  A1 for the correct truncation  B1 for calculating the number of boxes multiplied by 8 or the total 168  A1  M1 for stating formula for calculating speed  A1 for the correct answer with correct units  C1 for stating no need to round off answer  C1 for an answer  C1 for describing what is the same and different about each context  C2 for quality of questions and explanations in mark scheme | B |
| **16** |
| **4 a i**    **ii**  **iii**  **iv**  **b** | 4.6 × 40 = 4.6 × 10 × 4  = 46 × 4  = 184  24 × 72 = 1728  1728 ÷100 = 17.28 | 184  50 × 40 = 200  Two correct calculations e.g. 1156 ÷ 34 = 34  Multiplying both by ten  11.56 ÷ 0.34 = 34 Dividing both by ten  Two correct calculations, e.g. 2.4 × 7.2 = 17.28  Divide both by 10  24 × 0.72 = 17.28  Divide one of the numbers by 100  Suitable question using concepts introduced in part a. | M1  A1  C1  B2  B2  C2  C2  B2  C2 | 3 | M1 for knowing and using the links  A1 for correctly using the links to get to 184  C1 for correctly showing rounded figures to show the answer is reasonable  B1 for each correct statement  B1 for each correct explanation of the relationships between the calculations  C1 for each correct statement  C1 for each correct explanation of the relationships between the calculations  B1 for each set of questions, but the second must be harder than the first  C2 Explanation marks for correct explanation of the relationships between the calculations and identification of progression in difficulty | B |
| **9** |
| **5** |  | 2484 and 3426 are both even and so are divisible by 2.  17 625 ends in a 5 so is divisible by 5.  Therefore none are prime numbers as they have factors other than one and themselves. | B2  C2 | 2  3 | oe  B1 for each reason why the numbers cannot be prime  C2 for quality of explanation and communication | B |
| **4** |
| **6** | 17 × a = 629  a =  Therefore:  a = 37 | 37 | M1  A1  C2 | 3 | M1 for dividing 629 by 17  A1 for 37  C1 for clarity of communication  C1 for use of mathematical connectives | B |
| **4** |
| **7**  **i**  **ii**  **iii** | 4.75 ≤ space < 4.85  4.25 ≤ car < 4.75 | A – Yes, the car is always smaller than the smallest possible space.  B – No, the smallest space is the same size as the largest car length.  C – No, because the car is always smaller than the minimum size of the space, you can always say it will fit. | B1  B1  C1  C1  C1 | 3 | B1 for stating upper and lower bounds of space  B1 for stating upper and lower bounds of car  C1 for correct explanation of why this is definitely true oe  C1 for correct explanation of why this is definitely not true oe  C1 for correct explanation of why this is definitely not true oe | B |
| **5** |
| **8** | 14.5 cm ≤ Brick < 15.5 cm | The maximum length for 20 identical bricks is:  20 × 15.5 = 310 cm | M1  A1 | 3 | M1 for identifying the upper bound of the length of one brick and multiplying this by 20  A1 for correct answer only | B |
| **2** |
| **9 a**  **b**  **c**  **d** |  | How long will it take Barry to recover the money it cost him to convert the car?  Cost of 1 litre of LPG (CPLG)  Cost of 1 litre petrol (CP)  The distance he can travel per litre of each fuel (DPLG and DP)  How far does he travel in one month (D)  Cost of using LPG per month is;  A = CPLG × (D ÷ DPLG)  Cost of using Petrol per month is;  B = CP × (D ÷ DP)  The saving is B – A  Can now ask: ‘Is B – A more than £66.99?’ | C2  C4  M1  B1  M1  B1  B1  C2  C2 | 3 | oe  oe  M1 for trying to find first cost  B1 for correct method of finding this cost  M1 for trying to find second cost  B1 for correct method of finding this cost  B1 for finding this difference correctly  C2 for clarity of explanation throughout part c  C2 for clarity of explanation in linking part c with the new information | M |
| **12** |
| **10** | Assume the dolphin starts from the bottom. A complete cycle from top to bottom, back to top, takes 7 minutes.  Therefore in 90 minutes it completed the following cycles:  90 ÷ 7 = 12 .8571428 cycles.  It has therefore completed 12 cycles but is not back at the back at the bottom.  To work out which of the other options is correct calculate:  0.857 142 8 × 7 = 6 minutes.    Therefore if we assume that the time started by observing the dolphin at the surface, the 6 minutes of the cycle will be towards the end of the cycle, it is on its way up. | – on its way up. | M3  C2  A1 | 2 | M1 for adding the times to create a 7 minute cycle  M1 for dividing 90 by the time of one cycle  C1 for stating that the dolphin has completed 12 cycles  M1 for multiplying the fraction part of 12.8… by 7  C1 for finding this time and relating it to a part of the cycle  A1 for correct answer only | M |
| **6** |
| **11 a**  **b** | 26 letters × 25 numbers  So 26 × 25 = 650  5 flavours, 4 sizes, cone or tub.  5 × 4 × 2 = 40 | 650  40 | B1  M1  A1  B1  M1  A1 | 2  3 | B1 for knowing to use 26 and 25  M1 for 26 × 25  A1 correct answer only  B1 for identifying the need to use 5, 4 and 2  M1 for 5 × 4 × 2  A1 for correct answer only | M |
| **6** |
| **12 a**  **b**  **c** | |  |  |  | | --- | --- | --- | | **Planet** | **Distance from the Sun (million km)** | **Diameter (km)** | | Mercury | 5.8 × 101 | 4.878 × 103 | | Venus | 1.08 × 102 | 1.2104 × 104 | | Earth | 1.5 × 102 | 1.2756 × 104 | | Mars | 2.28 × 102 | 6.787 × 103 | | Jupiter | 7.78 × 102 | 1.42796 × 105 | | Saturn | 1.427 × 103 | 1.20660 × 105 | | Uranus | 2.871 × 103 | 5.1118 × 104 | | Neptune | 4.497 × 103 | 4.8600 × 104 | | Pluto | 5.913 × 103 | 2.274 × 103 |   i Jupiter  ii Pluto  iii Pluto  iv Jupiter  v Uranus  vi Earth and Venus  Diameter and mass increase with distance from the Sun until you reach Jupiter. Diameter and mass then decrease with distance from the Sun. | | B2  B6  C3 | 2 | B1 for correct distance column B1 for correct diameter column  B1 cao  B1 cao  B1 cao  B1 cao  B1 cao  B1 cao  C3 for clarity of explanation and of finding some trend within the data | M |
| **11** |
| **13 a**    **b**  **c**  **d** |  | Sometimes true – not true for fractions or negative numbers.  Always true (positive × positive = positive, Negative × negative = positive).  False – you can’t find the square root of a negative number using real numbers.  Always true –The cube root of a positive number is positive and the cube root of a negative number is negative. | B1  C1  B1  C1  B1  C1  B1  C1 | 2 | B1 for sometimes  C1 for correct explanation  B1 for always true  C1 for correct explanation  B1 for false  C1 for correct explanation  B1 for always true  C1 for correct explanation | M |
| **8** |
| **14 i      ii** | 56 ÷ 5-3 = 5(6 - -3) = 5or  =59  56 × 5-3 = 5(6+-3) = 53 or  == 53  27 × 48 = n4 × 2*c*  Using prime factors:  27 = 33  48 = 24 × 3  So 27 × 48 = 34 × 24 | The power represents the reciprocal of squaring so take the square root.  So *n* = 3 and c = 4 | M2  M2  C2  M2  B2  A2  C1 | 2 | M1 for showing subtraction of indices M1 for recognising 6 – –3 = 6 +3 or  M1 for showing each number as a product of factors M1 for combining them to give all the 5s as numerators  M1 for showing the indices are added  M1 for recognising 6 + –3 = 6 – 3 or  M1 for showing each number as a product of factors M1 for combining them to give all the 5s as numerators  C1 for showing square root C1 for clear explanation  M1 for finding the prime factors of each number M1 for stating each number as the product of the prime factors  B1 for 27 expressed as product of prime factors in index form B1 for 48 expressed as product of prime factors in index form  A1 for n = 23 cao A1 for c = 4 cao  C1 for clear communication of solution | M |
| **11** |
| **15 a**  **b**  **c**  **d** | = 10.66  8.298 × 102 ÷ 103 = 0.8298 km  20 ÷ 1 000 000 000 = 2 × 10-8  Area of eye = 9π × 10-6  Radius of eye =  =3 × 10-3 m  Diameter of eye = 2 × 3 × 10-3 m  = 6 × 10-3 m  Fraction =  = 3.333 333 × 10–6 | 10.66  0.8298 km  2 × 10-8 m    3.33 × 10–6 | M1  A1  M1  A1  M1  A1  M1  A1  M1  A1  C1 |  | M1 for dividing mountain height by skyscraper height  A1 accept 10.66…… or 10.7  M1 for dividing skyscraper height by 1000  A1 cao  M1 for dividing 2 by 1 000 000 000  A1 cao  M1 for connection between area of eye and π*r*2  A1 cao  M1 for setting up fraction with correct numbers  A1 cao  C1 for clear communication shown of methods | M |
| **11** |
| **16** |  |  | M1  B1 A1  M1  A1 | 2 | M1 for adding given fractions B1 for use of common denominator 63  A1 cao  M1 for subtracting fraction sum from 1  A1 ft from their first | M |
| **5** |
| **17** | So  of the residential land is used for services.  m2    = 13.75% | 13.75% of the total area is used for services. | C1  M1  A1  M1  A1 | 2  3 | C1 for recognising and stating  of residential development is used for the services  M1 for multiplying  by  A1 oe  M1 for finding above fraction of 15 and multiplying by 100  A1 accept 14 or 13.8 | M |
| **5** |
| **18 a**    **b i**    **ii**  **c** |  | The volume of the 2 cm cube is 2 × 2 × 2 = 8 cm3.  The volume of the 4 cm cube will be  4 × 4 × 4 = 64 cm3.  This is 8 times as much plastic as the  2 cm cube.  The 4 cm dice will use 64 – 8 = 56 cm3 more plastic.  (Or could say 8 times as much.)  The volume of the 3 cm cube is 3 × 3 × 3 = 27 cm3.  The volume of the 2 cm cube is 8 cm3  so will use 27 – 8 = 19 cm3 more plastic or 27 ÷ 8 = 3.375 times as much.  The volume of the 3 cm dice = 27 cm3.  The volume of the 4 cm dice = 43  = 64 cm3.  So it needs 64 – 27 = 37 cm3 less plastic.  A dice that has twice the volume will have volume ratio of 1 : 2.  Hence the length ratio will be  = 1 : 1.26.  Hence the length of the dice will be  2 × 1.26 = 2.52 cm.  The advice to give Siobhan is to make the cube with a side length just larger than 2.5 cm. | C2  B1  B1  B1  B1  B1  P2  B1  C1 | 3 | C1 for clear explanation showing how to find volumes of each cube  C1 for clear indication that the volume of the 4cm dice is not twice as much as the 2 cm  Or C2 for stating twice as large in dimensions will be 23 as large in volume  B1 for stating 56 cm3 more plastic  Or for stating 8 times as much  B1 for finding the volumes of both cubes  B1 for finding 19 cm3 more plastic or for stating 3.375 times as much  B1 for finding the volumes of both cubes  B1 for finding 37 cm3 less plastic  P1 for setting up ration as 1:2  P1 for finding and stating the cube root of ratio  B1 for calculation of 2 × cube root of 2  C1 for communicating the idea of making a cube just larger than 2.5 cm | M |
| **11** |
| 1. **a**   **bi**    **ii**    **iii** |  | 0.8 is less than 1 so 68 ÷ 0.8 will be greater than 68 as dividing by a number less than 1 gives an answer greater than you started with.  75 × 20 = 1500 oe  The approximation will be smaller because each term has been rounded down  = 5 oe  The approximation will be smaller because the numerator has been rounded up and the denominator rounded down. Dividing a smaller number by a larger number will result in a smaller answer  22 × 7.5 = 30 oe  The approximation will be bigger because both numbers have been rounded up and so the estimation is larger than the real answer. | C1  M1  A1  P1  M1  A1  P1  M1  A1  P1 | 3 | C1 For greater with a correct explanation  M1 for a suitable rounding of each number A1 for correctly multiplying the rounded numbers  P1 for a correct justification  M1 for a suitable rounding of each number A1 for correctly dividing the rounded numbers  P1 for a correct justification  M1 for a suitable rounding of each number A1 for correctly multiplying the rounded numbers  P1 for a correct justification  In each case answer marks only if the estimation is one that could be done in your head. Award explanation marks only for a valid explanation but allow ft for a given approximation | M |
| **10** |
| 1. **a**   **b** |  | Three calculations that approximate to 75, e.g. 1.1 × 75.1 based on 1 × 75  24.7 × 3.2 based on 25 × 3  147 ÷ 1.9 based on 150 ÷ 2  9 ÷ 3 is a better approximation than  10 ÷ 3 because 9 ÷ 3 is easily worked out in your head with an integer answer whereas 10 ÷ 3 gives a decimal answer. | B3  C2  C2 | 2  3 | B1 for each example that approximates to 75  C1 for use of multiplication and division C1 for evidence of progression of complexity in the questions  oe  C2 for use of mathematical language and possibly connectives in answer | M |
| **7** |
| **21** | The minimum area would be:  14.5 × 18.5 = 268.25  The maximum area would be less than:  15.5 × 19.5 = 302.25  Given lengths are 2 sf, so it would be sensible to give area to 2 sf also.  Where area = 15 × 19 = 285  The sensible answer for the area is 290 m2. | 268.25  302.25  268.25 ≤ floor area < 302.25    290 m2 | M1  A1  M1  A1  A1  C1  B1 | 2 | M1 for multiplying the lower bounds  A1 cao  M1 for multiplying the upper bounds  A1 cao  A1 cao  C1 for explanation of why 2 sf should be used  B1 cao | M |
| **7** |
| **22**  **a**  **b**    **c** | Assume pallets are at maximum of 525 kg.  A 6-axle lorry can carry up to  44 ÷ 0.525 = 83.8  So a maximum of 83 pallets per trip.  A 5-axle lorry can carry up to  40 ÷ 0.525 = 76.2  So a maximum of 76 pallets per trip.  80 is less than 83 but more than 76, so choose the 6-axle lorry, as this can do it in one trip.  150 pallets can be split into two loads of 75, this is less than 76, sochoose 5-axle lorry to make two trips, as this works out cheaper per trip.  159 can be split into two loads, 76 + 83. So choose the 5-axle lorry to make one trip, as this is cheaper per trip, and 6-axle lorry to make one trip as this avoids the need for a third trip. | 6 axle max of 83 pallets  5 axle max of 76 pallets | B1  M1  A1  A1  C2  C2  C2 | 2  3 | B1 for stating maximum possible mass of pallet  M1 for dividing both load limits by maximum pallet mass  A1 cao  A1 cao  C2 for clear explanation of correct choice  C2 for clear explanation of correct choice  C2 for clear explanation of correct choice. | M |
| **10** |
| **23 a**  **b**    **c**  **d**  **e** | 13.25 ≤ runner 1 < 13.35  13.295 ≤ runner 2 < 13.305 | 0.4 m is written to 1 dp so could have a value between 0.35 m and 0.449 999 m.  0.400 m is written to 3 dp so could have  a value between 0.3995 m and 0.400 499 9 m  If the answer is required to 3 dp, to provide all the information required, you need to include three places of decimals even if the last digits are 0.  425 cm ≤ length < 435 cm  Tenth of a metre or 10 cm.  Therefore runner 1’s fastest time could be less than that of runner 2.  But it is also true that the slowest time for runner 1 is more than the slowest time of runner 2.  If each person is measured to the nearest kg. They could all, for example, weigh 100.4 kg and 7 × 100.4 > 700 kg. | C2  C1  C1  C1  B1  B1  C2  B1  C2 | 2  3 | C2 for clear explanation showing the range of possible values each could have  C1 for clear explanation  C1 for communicating clearly this information  C1 for communicating clearly this information  B1 for runner 1 limits  B1 for runner 2 limits  C2 for clear explanation showing both possibilities  B1 for a given example  C2 for clear explanation | M |
| **12** |
| **24** | Maximum number of people turning up will be 104 (as 105 will round to 110).  Assume 5% of the 280 do not turn up.  0.05 × 280 = 14  Hence assume 266 seats already taken.  365 – 266 = 99 free seats | If the estimate of how many will fail to turn up is correct, 266 seats will be taken with advance sales. This leaves 99 seats free. If up to 99 extra people turn up, they all get seats. If 100–104 turn up, some will not get a seat. So it is possible they will all get seats. | B1  B1  B1  B1  C2 | 3 | B1 for stating maximum number of people that could turn up  B1 for finding the assumed number not turning up  B1 for finding assumed seats taken  B1 for finding assumed number of free seats  C2 for clear explanation using all the calculated data | M |
| **6** |
| **25** | 12.25 seconds ≤ time < 12.35 seconds  99.995 m ≤ distance < 100.005 m  Speed = distance ÷ time  Greatest speed is longest distance divided by shortest time  = 100.005 ÷ 12.25  = 8.163 67 m/s | 8.164 m/s | B1  B1  M1  C1  M1  A1 | 2 | B1 for time range  B1 for distance range  M1 for correct formula used for speed  C1 for explanation of longest distance used with shortest time  M1 for division  A1 for suitably rounded speed (4 or 5 sf) | M |
| 6 |
| **26** | 124.5 ≤ volume < 125.5  Take cube root for lengths of sides, giving:  4.993 324 4 ≤ length < 5.006 657 8  Area of side will be square of lengths, giving:  24.933 289 ≤ area < 25.066 622 | 24.93 cm2 ≤ area < 25.07 cm2 | B1  P1  A1  P1  A1 | 2 | B1 for stating limits of accuracy for volume  P1 for finding cube root to find length  A1 for un rounded limits to length  P1 for squaring unrounded length limits  A1 for rounded limits to 3 or 4 sf | M |
| 5 |
| **27 a i**  **ii**  **iii**  **b** | The maximum for which no grade is achieved by 5 students occurs when each grade is achieved by 4 students, which means 6 × 4 = 24 students. Hence, having one more student will guarantee that at least one grade is achieved by 5 students. | True. Whenn = k, each box contains 1 ball. So when n > k at least one box contains at least two balls.  False, for example if n = 5 and  k = 2,  = = 2.5  As you cannot have half a ball, the statement is false.  False, as a normal year has 365 days there are 366 people, there must be at least two people who share a birthday.  OR this could be possible in a leap year, but then not necessarily so.  At least 25 students | C1  C1  C1  C1  C1  C1  M1  M1  A1 | 2 | C1 for explaining how it is true: can use example or diagram to show this  C1 for clear communication  C1 for explaining how it is true  C1 for clear communication  C1 for explaining how it is true  C for clear communication  M1 for least number with no grade with 5 students  M1 for adding one more student  A1 cao | M |
| **9** |
| **28 a**  **b**  **c**  **d** | Length of A4 paper = 297mm  = 2.97 × 102 mm  1 mm = 1 × 10-6 km  Area A4 paper = 2.97 × 102 × 1 × 10 -6 km  =2.97 × 10(2-6) = 2.97 × 10-4 km  or  297 ÷ 1 000 000 = 0.000297  =2.97 × 10-4 km  3–3 = 3 =  – 9 = –8  The two numbers are not equal.  162 = (2 × 8)2 = (21 × 23)2 =( 2(1 + 3))2 = (24)2 = 2(4 × 2) = 28  4 × 3= 4 × × 3 ×  = 4 × 3 × ×  = 12 × 3 = 36    = =  Is = 36?  We know that = 20 so will be less than 20 and therefore not 36.  Or    =  ==36  7=  =  But 1296 ≠ 343  So: | False  False  True  False | M1  A1  C1  C2  C2  C2 | 2 | M1 for getting units into mm the convert to m  A1 for finding correct length of A4  C1 for effective use of SI in calculation  Can also use an approximation of the length of A4 paper  C2 for clear explanation and stating false  C2 for clear explanation and stating true  C2 for clear explanation and stating false | H |
| **9** |
| **29 a**  **b**  **c**  **iv** | So  42= 16  52 = 25  So is between 4 and 5    So not less but equal to    =  Consider 0.6  =  Hence  > 0.6 | False  True  False  True | M1  A1  M1  A1  M1  A1  C1  M1  A1  C1 | 2 | M1 for finding a suitable comparison  A1 for showing it is false and stating such  M1 for showing the square of the limits  A1 for showing it is true and stating such  M1 for showing  A1 for showing it is false and stating such  C1 for explaining they are in fact equal.  M1 for showing both in similar comparable terms  A1 for showing it is true and stating such  C1 for clear concise communication of method | H |
| **10** |
| **30** |  | Odd one out is . | M3  A1 | 2 | M1 for showing 27(-) =  M1 for showing 25(-) =  M1 for showing 3-1 =  A1 cao | H |
| **4** |
| **31** | x= y  =  Square both sides:  =  Hence √x = y  Hence x2 = y | Any example where x is the square of y,  e.g. x = 1, y = 1  x = 4, y = 2  x = 9, y = 3 | M2  A1  C1 | 2 | M1 for squaring both sides to make information clearer M1 for considering only the denominator  A1 for a correct example  C1 for clear progression through the solution | H |
| **4** |
| **32** | 2.5 × 103 = 2500 Too small  2.5 × 104 = 25 000  2.5 × 105 = 250 000 Too big | n = 4 | M1  A1 | 2 | M1 for using trial and improvement  A1 for correct answer | H |
| **2** |
| **33 a**  **b**  **c**  **d**  **e**  **f**  **g**  **h**  **i**  **j** |  | 0.6  0.9  1.3  0.3  0.1  1.2  1.5  1.4  2.1  3.5 | B1  B1  B1  B1  B1  B1  B1  B1  B1  B1 | 2 | cao  cao  cao  cao  cao  cao  cao  cao  cao  cao | H |
| **10** |
| **34** | Try a = 3, b = 4  = = = 5  a + b = 7 | Statement is false. | M1  A1  C1 | 2 | M1 for finding an example which disproves the statement  A1 for stating it is false  C1 for clear communication of the solution | H |
| **3** |
| **35** |  | For example: 2÷  =  The cancels from numerator and denominator leaving 2, an integer. | B1  P1  C1 | 2 | B1 for a correct division of two surds  P1 for showing how the surds will leave an integer answer  C1 for clear communicating of method used | H |
| **3** |
| **36 a**  **b** |  | For example: 3 + and 3 –  For example: and | B1  B1 | 2 | B1 for a correct possible pair of surds  B1 for a correct possible pair of surds | H |
| **2** |
| **37** |  | is more than 1 and less than 2, since = 1 and = 2.  So 1 + is more than 2 and less than 3. | C1  C1 | 2 | C1 for explaining the integer range for  C1 for explaining how this relates to the 2 and 3 metres | H |
| **2** |
| **38 a**  **b** | Earth diameter = 1.2756 × 104 km  So radius = 6.378 × 103  Population = 7.185004 × 109  Surface area sphere = 4πr2  Surface area of the earth  =4 x π x(6.378 x 103)2  = 5.1118593 x 108 km2  Per person  =   =0.07114622 km2 | 0.07 km2  It reduces the total surface area by 30% of the total. Multiply the area per person by 0.3.  The revised answer is 0.021 km2. | M1  A1  M1  M1  A1  M1  A1  C1  C2 | 2 | M1 for halving diameter  A1 for correct radius  M1 for applying correct formula  M1 for using correct formula with correct data  cao not rounded  Correct division of surface area by population  A1 correct answer rounded to 1 or 2 sf  C1 for a clear communication of solution  C2 for a clear explanation of how the percentage makes a difference | H |
| **10** |
| **39 a**  **b**    **c** |  | True.All terminating decimals can also be written as fractions, for example:  0.456 =  True. For example:  a = 0.4242…….  100a = 42.42…….  100a –a = 42.42…..-0.42…  Therefore  99a =42  a =  For the recurring decimal with n repeating digits, replace the 100 above by 10n and this will make it possible to follow the same procedure and find the fraction.  False. Irrational numbers cannot be expressed in the form *a*/*b* where *a* and *b* are integers; for example, π and  are irrational numbers. | B1  C1  B1  C1  C2  C2 | 2 | True followed by a clear example  C1 clear explanation  B1 for work showing how you change a recurring decimal to fraction  C1 for clear explanation  C2 for clear explanation showing how all recurring decimals can be treated in this way to get to a fraction  C2 Clear explanation showing definition of rational numbers and at least one example | H |
| **8** |
| **40 a**  **b**  **c**  **d**  **e** |  | If the prime factors of the denominator of a fraction in its simplest form are only 2 and/or 5 its decimal will terminate. So the following are terminating:  ,,  is non-terminating because the prime factors of 6 are 2 and 3. Any multiple of  where the numerator is not a factor or a multiple of 6 will also be recurring.  == 2 × 0.166 666….  =  = × =0.1666…. ÷ 10  Easy to convert are 0.027 272 7… and 0.272 727…..  Since after multiplying by 100 in each case, you can eliminate the infinite recurrence to be left with a simple fraction  The hardest to convert are 2.727 272 and 27.272 727 only because the result will give an improper fraction.  But any decimal with n recurring digits can be changed to a fraction by multiplying by 10n and eliminating the infinite part.  a = 2.727 272…..  100a = 272.7272…….  100a – a = 270  99a = 270  a =  a = 27.27272…..  100a = 2727.272…….  100a – a = 2700  99a = 2700  a =  which is  × 10 | C2  B1  C2  C1  C1  C1  C1  C1  M1  A1  A1  C1 | 2 | C2 for clarity of explanation  B1 for the 3 correct fractions  C2 for clear explanation  C1 for clear communication of method  C1 for clear communication of method  C1 for clear explanation of easy  C1 for clear explanation of more difficult  C1 for clear explanation for any recurring decimal  M1 for correct method of converting recurring decimal to fraction  cao  cao  C1 clear communication of full answer. | H |
| **11** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **41** | Using the sine rule:  =  sin *B* = 35 ×  To maximise the angle we need to maximise this calculation by using the upper bound of sin 61° and 35 cm and the lower bound of 42 cm:  sin *B* = 35.5 ×  sin *B* = 0.751 759 2  *B* = sin-1 0.751 759 2  *B* = 48.742 997° | B = 48.7 (3sf) | M2  B1  C1  B1  B1  B1 | 2 | M2 showing how the sine rule is applied in this situation  B1 for setting the equation with sinB as subject  C1 for clear explanation of how we maximise the calculation  B1 for calculation used with correct bounds  B1 for correct value not rounded  B1 for correct answer to 2 or 3 sf | H |
| **7** |