35 St. Andrew Square, Edinburge, 31st January 1936.

## The Honorary Editor, <br> The Faculty of Actuaries in Scotland, Edinburgh.

## Dear Sir,

## A1924-29 ULTIMATE TABLES $2 \frac{1}{2} \%$ INTEREST.

Having recently had occasion to use the Joint Life Annuity Values on this basis, given in the published Tables, I found it tedious to interpolate for the intermediate Values by inspection as suggested by the Joint Committee, and realising that interpolation by first differences gave rise roughly to an error of $\cdot 01$ in the Values, I formed a complete Table for all ages from 21 to 90 , using second forward differences in the interpolation. These Tables I now enclose with the hope that others may be saved the trouble of repeating the work.

Having drafted the form of the Tables and inserted the Values where each age was a multiple of three and where the ages were equal, interpolation was carried out for the older ages keeping the younger ages constant, the work being checked at each stage by summation. Thereafter in each perpendicular column interpolation was made for the younger age, and this work was not checked by summation, but, having based $u_{3 x+1}$ and $u_{3 x+2}$ on $u_{3 x}$ and its first and second differences, these were checked by ascertaining that $u_{3(x+1)}-u_{3 x+2}=\frac{1}{3} \Delta u_{3} x+\frac{1}{9} \Delta^{2} u_{3 x}$. In all the interpolations where at the end of each column the second difference adjustment was not available, it was found by extrapolation from the preceding Values.

As the published Values are given to three decimal places, as are the interpolated Values, the latter are, of course, suspect to the extent of -001.

I am, Sir,
Yours faithfully,

## C. Keith Granger.

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| $a_{x y}$ |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $y$ |  |  |  |  |  |  | $\boldsymbol{x}$ |
| 28 | 29 | 30 | 31 | 32 | 33 | 34 |  |
| 23.070 | 22.853 | 22.624 | 22.383 | $22 \cdot 131$ | 21.869 | 21.595 | 21 |
| 22.971 | 22.760 | 22.536 | 22.301 | $22 \cdot 054$ | $21 \cdot 798$ | 21.528 | 22 |
| $22 \cdot 862$ | 22.657 | 22.439 | 22.210 | 21.968 | $21 \cdot 718$ | 21.453 | 23 |
| 22.744 | 22.545 | 22.333 | 22-109 | 21-874 | 21-628 | 21-370 | 24 |
| $22 \cdot 616$ | 22.423 | 22.218 | 22.001 | 21.771 | 21.532 | 21.280 | 25 |
| $22 \cdot 477$ | $22 \cdot 290$ | $22 \cdot 092$ | 21.882 | 21.658 | 21-426 | 21-180 | 26 |
| $22 \cdot 327$ | $22 \cdot 147$ | 21.956 | 21.752 | 21.536 | 21.309 | 21.069 | 27 |
| 22-166 | 21.993 | 21.808 | 21.612 | 21.401 | 21-183 | 20.950 | 28 |
| 28 | 21.828 | 21.649 | $21 \cdot 461$ | 21.256 | 21.046 | $20 \cdot 820$ | 29 |
|  | 29 | $21 \cdot 480$ | $\begin{aligned} & 21 \cdot 298 \\ & 21 \cdot 124 \end{aligned}$ | $\begin{aligned} & 21 \cdot 104 \\ & 20 \cdot 938 \\ & 20 \cdot 759 \end{aligned}$ | $\begin{aligned} & 20.899 \\ & 20.739 \\ & 20.568 \\ & 20.386 \end{aligned}$ | $20 \cdot 680$ | 30 |
|  |  | 30 |  |  |  | 20.528 | 31 |
|  |  | 30 | 31 |  |  | $20 \cdot 365$ | 32 |
|  |  |  | 31 | 32 |  | $20 \cdot 191$ | 33 34 |
|  |  |  |  |  | 33 |  | 34 |
|  |  |  |  |  |  | 34 |  |
| 83 |  |  |  |  |  |  |  |
| 1.869 | 82 | 81 |  |  |  |  |  |
| 1.942 | $\begin{aligned} & 2 \cdot 019 \\ & 2 \cdot 097 \end{aligned}$ |  | 80 |  |  |  |  |
| $\begin{aligned} & 2 \cdot 015 \\ & 2 \cdot 089 \end{aligned}$ |  | $2 \cdot 180$ |  | 79 |  |  |  |
|  | $2 \cdot 177$ | $2 \cdot 265$ | $2 \cdot 353$ |  | 78 |  |  |
| $2 \cdot 162$ | $2 \cdot 255$ | $2 \cdot 349$ | $2 \cdot 443$ | $2 \cdot 538$ |  | 77 |  |
| $2 \cdot 234$ | $2 \cdot 332$ | $2 \cdot 432$ | 2.533 | $2 \cdot 634$ | 2.736 |  | 177 |
| $2 \cdot 305$ | $2 \cdot 409$ | $2 \cdot 514$ | $2 \cdot 622$ | $2 \cdot 729$ | $2 \cdot 841$ | $2 \cdot 946$ |  |
| $2 \cdot 376$ | $2 \cdot 485$ | $2 \cdot 596$ | $2 \cdot 709$ | $2 \cdot 823$ | 2.941 | $3 \cdot 054$ | 76 |
| $2 \cdot 446$ | $2 \cdot 560$ | $2 \cdot 677$ | $2 \cdot 795$ | 2.916 | 3.039 | $3 \cdot 161$ | 75 |
| $2 \cdot 514$ | $2 \cdot 633$ | 2.755 | $2 \cdot 879$ | $3 \cdot 007$ | $3 \cdot 136$ | $3 \cdot 268$ | 74 |
| $2 \cdot 579$ | $2 \cdot 704$ | $2 \cdot 832$ | 2.963 | $3 \cdot 097$ | $3 \cdot 233$ | $3 \cdot 272$ | 73 |
| $2 \cdot 642$ | $2 \cdot 773$ | 2.908 | $3 \cdot 046$ | $3 \cdot 186$ | $3 \cdot 329$ | $3 \cdot 473$ | 72 |
| $2 \cdot 704$ | $2 \cdot 841$ | $2 \cdot 981$ | $3 \cdot 126$ | $3 \cdot 272$ | $3 \cdot 422$ | $3 \cdot 574$ | 71 |
| $2 \cdot 764$ | $2 \cdot 906$ | 3-052 | $3 \cdot 203$ | $3 \cdot 356$ | $3 \cdot 513$ | 3.672 | 70 |
| $2 \cdot 822$ | $2 \cdot 969$ | $3 \cdot 121$ | $3 \cdot 278$ | $3 \cdot 438$ | $3 \cdot 602$ | $3 \cdot 768$ | 69 |
| $2 \cdot 876$ | $3 \cdot 029$ | $3 \cdot 187$ | $3 \cdot 349$ | $3 \cdot 516$ | $3 \cdot 687$ | $3 \cdot 860$ | 68 |
| $2 \cdot 929$ | $3 \cdot 087$ | $3 \cdot 250$ | $3 \cdot 418$ | $3 \cdot 591$ | $3 \cdot 769$ | $3 \cdot 949$ | 67 |
| 2.980 | 3•142 | $3 \cdot 310$ | $3 \cdot 484$ | 3-663 | $3 \cdot 848$ | $4 \cdot 035$ | 66 |
| $3 \cdot 026$ | 3-192 | $3 \cdot 366$ | 3-544 | $3 \cdot 730$ | 3.922 | $4 \cdot 115$ | 65 |
| $3 \cdot 068$ | 3.239 | $3 \cdot 417$ | $3 \cdot 601$ | $3 \cdot 792$ | 3.990 | $4 \cdot 190$ | 64 |
| $3 \cdot 107$ | $3 \cdot 282$ | $3 \cdot 464$ | $3 \cdot 654$ | $3 \cdot 850$ | $4 \cdot 053$ | $4 \cdot 260$ | 63 |
| $3 \cdot 142$ | $3 \cdot 322$ | $3 \cdot 506$ | $3 \cdot 703$ | $3 \cdot 903$ | $4 \cdot 112$ | $4 \cdot 325$ | 62 |
| $3 \cdot 175$ | 3-358 | $3 \cdot 546$ | $3 \cdot 747$ | 3.952 | $4 \cdot 167$ | $4 \cdot 386$ | 61 |
| $3 \cdot 205$ | $3 \cdot 391$ | $3 \cdot 585$ | $3 \cdot 787$ | $3 \cdot 998$ | $4 \cdot 217$ | $4 \cdot 442$ | 60 |
| 83 | 82 | 81 | 80 | 79 | 78 | 77 |  |


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| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| A1924-29 ultimate $2 \frac{1}{2} \%$ |  |  |  |  |  |  |  |
| $\alpha_{x y}$ |  |  |  |  |  |  |  |
| $x$ | $y$ |  |  |  |  |  |  |
|  | 35 | 36 | 37 | 38 | 39 | 40 | 41 |
| 21 | 21.311 | 21.016 | 20.711 | 20.397 | 20.075 | 19.743 | 19.402 |
| 22 | 21.249 | 20.959 | $20 \cdot 657$ | 20.348 | 20.029 | 19.701 | 19.364 |
| 23 | 21-179 | $20 \cdot 894$ | 20.596 | 20.292 | 19.977 | 19.653 | 19.320 |
| 24 | 21-101 | 20.821 | 20.529 | 20.228 | 19.919 | 19.600 | 19.271 |
| 25 | 21.016 | 20.742 | 20.456 | $20 \cdot 161$ | 19.856 | 19.542 | 19.216 |
| 26 | 20.922 | 20.654 | 20.374 | 20.085 | 19.785 | 19.476 | 19.154 |
| 27 | 20.818 | 20.557 | 20.283 | 19.999 | 19.706 | 19-401 | 19.086 |
| 28 | 20.706 | $20 \cdot 452$ | 20.185 | 19.907 | 19.620 | 19.321 | 19.012 |
| 29 | 20.583 | $20 \cdot 436$ | 20.076 | 19.805 | 19.524 | $19 \cdot 232$ | 18.929 |
| 30 | 20-450 | 20.210 | 19.957 | 19.693 | 19.419 | 19-133 | 18.836 |
| 31 | $20 \cdot 307$ | 20.073 | 19.828 | 19.571 | $19 \cdot 305$ | 19.026 | $18 \cdot 736$ |
| 32 | 20.152 | 19.925 | 19.688 | 19.439 | $19 \cdot 180$ | 18.909 | 18.626 |
| 33 | 19.985 | 19.767 | 19.537 | 19-296 | 19.045 | 18.782 | 18.507 |
| 34 | 19.808 | 19.598 | 19.377 | 19•143 | 18.900 | 18.644 | 18.378 |
| 35 | 19.618 | $19 \cdot 417$ | 19.205 | 18.979 | 18.744 | 18.496 | 18.238 |
|  | 35 | 36 | 19.020 | 18.804 | 18.576 | 18.338 | 18.088 |
|  |  |  | 18.824 | 18.618 18.419 | 18.398 18.208 | $18 \cdot 170$ 17.990 | 17.928 17.757 |
|  |  |  | 37 | 38 | $18 \cdot 009$ | 17.798 | 17.574 |
|  |  |  |  |  | 39 | 17.594 | 17.381 |
|  |  |  |  |  |  | 40 | 17. |
|  |  |  |  |  |  |  | 41 |
|  | 76 | 75 |  |  |  |  |  |
| 7675 | $3 \cdot 169$ |  |  |  |  |  |  |
|  | 3.283 | $3 \cdot 406$ | 74 | 73 |  |  |  |
| 74 | $3 \cdot 396$ | 3.529 | $3 \cdot 656$ |  | 72 |  |  |
| 73 | 3.508 | $3 \cdot 648$ | 3.783 | 3.9204.054 |  | 71 | 70 |
| 72 | $3 \cdot 618$ | $3 \cdot 765$ | 3.909 |  | $4 \cdot 199$4.342 |  |  |
| 71 | $3 \cdot 726$ | 3.981 | 4.035 | $4 \cdot 188$ |  | 4.4934.641 |  |
| 70 | 3.832 | 3.995 | $4 \cdot 158$ | $4 \cdot 320$ | $4 \cdot 483$ |  | 4.803 |
| 69 | 3.936 | $4 \cdot 107$ | 4.278 | $4 \cdot 449$ | 4.621 | $4 \cdot 791$ | 4.961 |
| 68 | 4.036 | $4 \cdot 216$ | $4 \cdot 394$ | 4.574 | $4 \cdot 756$ | $4 \cdot 937$ | $5 \cdot 117$ |
| 67 | $4 \cdot 133$ | 4.321 | 4.508 | 4.697 | 4.888 | $5 \cdot 079$ | $5 \cdot 269$ |
| 66 | $4 \cdot 227$ | $4 \cdot 423$ | 4.619 | $4 \cdot 817$ | 5.017 | $5 \cdot 216$ | 5.416 |
| 65 | $4 \cdot 314$ | $4 \cdot 517$ | 4.722 | 4.929 | 5.139 | $5 \cdot 347$ | $5 \cdot 557$ |
| 64 | $4 \cdot 396$ | $4 \cdot 607$ | 4.819 | 5.035 | 5.254 | $5 \cdot 472$ | $5 \cdot 692$ |
| 63 | $4 \cdot 473$ | $4 \cdot 692$ | 4.911 | $5 \cdot 135$ | $5 \cdot 363$ | 5.591 | $5 \cdot 821$ |
| 62 | 4.544 | 4.771 | 4.997 | 5.230 | $5 \cdot 466$ | $5 \cdot 703$ | $5 \cdot 943$ |
| 61 | 4.611 | 4.844 | 5.078 | $5 \cdot 318$ | $5 \cdot 562$ | 5.808 | $6 \cdot 057$ |
| 60 | $4 \cdot 673$ | 4.911 | $5 \cdot 153$ | $5 \cdot 400$ | $5 \cdot 652$ | 5.907 | 6.164 |
|  | 76 | 75 | 74 | 73 | 72 | 71 | 70 |


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| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| A1924-29 ultimate $2 \frac{1}{2} \%$ |  |  |  |  |  |  |  |
| $a_{x y}$ |  |  |  |  |  |  |  |
| $y$ |  |  |  |  |  |  |  |
| 42 | 43 | 44 | 45 | 46 | 47 | 48 |  |
| 19.052 | 18.693 | 18.325 | 17.947 | 17.560 | 17.166 | 16.765 | 21 |
| 19.018 | 18.661 | 18.296 | 17.921 | 17.536 | $17 \cdot 145$ | 16.746 | 22 |
| 18.978 | 18.624 | 18.262 | 17.890 | 17.508 | 17-120 | 16.723 | 23 |
| 18.932 | 18.582 | 18.223 | 17.855 | 17-477 | 17.091 | 16.696 | 24 |
| 18.882 | 18.537 | 18.181 | 17.817 | 17-442 | 17.059 | 16.667 | 25 |
| 18.825 | 18.485 | 18.133 | 17.773 | $17 \cdot 401$ | 17.022 | 16.633 | 26 |
| 18.762 | $18 \cdot 426$ | 18.080 | 17.723 | $17 \cdot 355$ | 16.979 | 16.594 | 27 |
| 18.692 | 18.362 | 18.021 | 17.668 | $17 \cdot 304$ | 16.932 | 16.552 | 28 |
| 18.614 | 18.290 | 17.954 | 17.606 | $17 \cdot 247$ | 16.879 | 16.504 | 29 |
| 18.528 | 18.209 | 17.879 | 17.537 | 17.183 | 16.820 | 16.449 | 30 |
| 18.435 | $18 \cdot 121$ | 17.797 | 17.462 | 17-114 | 16.757 | 16.390 | 31 |
| 18.332 | 18.024 | 17.707 | 17.378 | 17.037 | 16.686 | 16.324 | 32 |
| 18.219 | 17.919 | $17 \cdot 608$ | 17.286 | 16.951 | 16.606 | 16.250 | 33 |
| 18.097 | 17.805 | 17.502 | 17-186 | 16.859 | 16.520 | 16.170 | 34 |
| 17.965 | 17.681 | 17.386 | 17.079 | 16.758 | 16.426 | 16.082 | 35 |
| 17.824 | 17.548 | $17 \cdot 260$ | 16.960 | 16.647 | 16.323 | 15.987 | 36 |
| 17.673 | 17.404 | 17-125 | 16.834 | 16.529 | 16.212 | $15 \cdot 885$ | 37 |
| 17.511 | 17.250 | 16.980 | 16.698 | 16.501 | 16.092 | 15.774 | 38 |
| $17 \cdot 337$ | 17.087 | 16.825 | 16.552 | 16.264 | 15-964 | 15.653 | 39 |
| $17 \cdot 153$ | 16.913 | 16.661 | 16.397 | 16.118 | 15.827 | 15.525 | 40 |
| 16.957 | 16.727 | 16.485 | 16.230 | 15.961 | 15.679 | 15.386 | 41 |
| 16.750 | 16.530 | 16.297 | 16.052 | 15.792 | 15.520 | $15 \cdot 236$ | 42 |
| 42 | 16.321 | 16.097 | 15.863 | 15.613 | 15.350 | 15.076 | 43 |
|  | 43 | $15 \cdot 886$ | 15.661 | $15 \cdot 421$ | $15 \cdot 168$ | 14.904 | 44 |
|  |  | 44 | $15 \cdot 446$ | 15.217 | 14.975 | 14.721 | 45 |
|  |  |  | 45 | $15 \cdot 000$ | 14.769 14.550 | $14.524$ $14 \cdot 315$ | 46 47 |
|  |  |  |  | 43 |  | 14.095 | 48 |
|  |  |  |  |  |  | 48 |  |
| 69 | 68 |  |  |  |  |  |  |
| $5 \cdot 130$ |  | 67 |  |  |  |  |  |
| $5 \cdot 308$ | $5 \cdot 473$ |  | 66 |  |  |  |  |
| $5 \cdot 470$ | $5 \cdot 647$ | 5.831 |  | 65 |  |  |  |
| $\begin{array}{r} 5 \cdot 617 \\ 5 \cdot 769 \end{array}$ | 5.815 | 6.010 | 6.203 |  |  |  |  |
|  | 5.978 | 6.183 | $6.388^{\circ}$ | 6.586 | 64 | 63 | 63 |
| 5.914 | $6 \cdot 133$ | 6.350 | 6.567 | 6.775 | $6 \cdot 979$ |  |  |
| 6.053 | 6.281 | 6.510 | 6.739 | 6.957 | $7 \cdot 171$ | 7.380 |  |
| 6.183 | 6.423 | 6.661 | 6.903 | $7 \cdot 131$ | 7.359 | 7.580 | 62 |
| $6 \cdot 307$ | 6.557 | $6 \cdot 806$ | $7 \cdot 058$ | 7.298 | 7.537 | 7.770 | 61 |
| 6.424 | 6.684 | 6.944 | $7 \cdot 205$ | $7 \cdot 457$ | 7.706 | $7 \cdot 951$ | 60 |
| 69 | 68 | 67 | 66 | 65 | 64 | 63 |  |

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$\alpha_{x y}$


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| $a_{x y}$ |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $y$ |  |  |  |  |  |  | $\boldsymbol{x}$ |
| 56 | 57 | 58 | 59 | 60 | 61 | 62 |  |
| 13.333 | 12.889 | $12 \cdot 443$ | 11.999 | 11.556 | $11 \cdot 115$ | 10.677 | 21 |
| $13 \cdot 325$ | 12.882 | $12 \cdot 437$ | 11.994 | 11.551 | $11 \cdot 111$ | 10.673 | 22 |
| $13 \cdot 315$ | 12.873 | $12 \cdot 429$ | 11.987 | 11.545 | 11-106 | 10.669 | 23 |
| $13 \cdot 303$ | 12.863 | $12 \cdot 420$ | 11.979 | 11.539 | $11 \cdot 100$ | $10 \cdot 664$ | 24 |
| 13.291 | 12.852 | 12.410 | 11.970 | 11.531 | 11.093 | 10.658 | 25 |
| 13.276 | 12.839 | $12 \cdot 398$ | 11.959 | 11.521 | 11.085 | 10.650 | 26 |
| $13 \cdot 259$ | 12.823 | $12 \cdot 383$ | 11.945 | $11 \cdot 510$ | 11.074 | 10.641 | 27 |
| $13 \cdot 239$ | 12.805 | $12 \cdot 367$ | 11.931 | 11.497 | 11.062 | 10.631 | 28 |
| $13 \cdot 216$ | $12 \cdot 784$ | 12.348 | 11.914 | $11 \cdot 482$ | $11 \cdot 048$ | 10.619 | 29 |
| $13 \cdot 189$ | $12 \cdot 760$ | $12 \cdot 327$ | 11.895 | 11.465 | 11.033 | 10.604 | 30 |
| $13 \cdot 159$ | 12.734 | $12 \cdot 303$ | 11.873 | 11.445 | $11 \cdot 015$ | 10.588 | 31 |
| $13 \cdot 125$ | $12 \cdot 704$ | $12 \cdot 276$ | 11.848 | 11.422 | 10.995 | 10.570 | 32 |
| $13 \cdot 088$ | $12 \cdot 669$ | $12 \cdot 245$ | 11.821 | $11 \cdot 397$ | 10.972 | 10.549 | 33 |
| 13.047 | 12.632 | $12 \cdot 211$ | 11.790 | $11 \cdot 369$ | 10.947 | 10.527 | 34 |
| 13.002 | 12.591 | $12 \cdot 173$ | 11.756 | 11.338 | 10.919 | 10.502 | 35 |
| 12.953 | 12.546 | $12 \cdot 132$ | 11.718 | 11.304 | $10 \cdot 889$ | 10.475 | 36 |
| 12.901 | 12.498 | $12 \cdot 088$ | 11.678 | 11.268 | $10 \cdot 856$ | $10 \cdot 445$ | 37 |
| 12.843 | 12.445 | 12.039 | 11.634 | 11.228 | 10.819 | $10 \cdot 412$ | 38 |
| $12 \cdot 779$ | 12.386 | 11.986 | $11 \cdot 585$ | $11 \cdot 183$ | 10.779 | 10.375 | 39 |
| 12.710 | $12 \cdot 324$ | 11.929 | 11.533 | $11 \cdot 137$ | 10.736 | 10.335 | 40 |
| $12 \cdot 634$ | 12.255 | 11.866 | 11.475 | 11.085 | $10 \cdot 688$ | $10 \cdot 291$ | 41 |
| 12.552 | $12 \cdot 178$ | 11.796 | 11.412 | 11.026 | $10 \cdot 635$ | $10 \cdot 244$ | 42 |
| $12 \cdot 463$ | 12.097 | 11.721 | $11 \cdot 344$ | 10.964 | $10 \cdot 579$ | $10 \cdot 194$ | 43 |
| $12 \cdot 365$ | $12 \cdot 007$ | 11-638 | $11 \cdot 268$ | 10.895 | $10 \cdot 516$ | 10.137 | 44 |
| 12.258 | 11.908 | 11.548 | $11 \cdot 185$ | 10.818 | $10 \cdot 447$ | 10.074 | 45 |
| $12 \cdot 143$ | 11.802 | 11.450 | 11.095 | $10 \cdot 736$ | $10 \cdot 372$ | 10.005 | 46 |
| 12.018 | 11.686 | 11.343 | 10.996 | 10.645 | $10 \cdot 289$ | 9.929 | 47 |
| 11.882 | 11.559 | 11.226 | 10.888 | 10.546 | 10-197 | $9 \cdot 845$ | 48 |
| 11.737 | 11.424 | $11 \cdot 100$ | $10 \cdot 772$ | $10 \cdot 438$ | 10.097 | 9.754 | 49 |
| 11.581 | 11.278 | 10.964 | $10 \cdot 646$ | 10.321 | 9.989 | $9 \cdot 655$ | 50 |
| 11.413 | 11-121 | 10.819 | 10.511 | $10 \cdot 196$ | $9 \cdot 874$ | $9 \cdot 548$ | 51 |
| 11.234 | 10.954 | 10.663 | $10 \cdot 365$ | $10 \cdot 061$ | $9 \cdot 749$ | $9 \cdot 433$ | 52 |
| 11.044 | 10.776 | $10 \cdot 496$ | $10 \cdot 209$ | $9 \cdot 916$ | $9 \cdot 615$ | $9 \cdot 309$ | 53 |
| $10 \cdot 842$ | 10.586 | 10.318 | 10.043 | $9 \cdot 762$ | $9 \cdot 471$ | $9 \cdot 175$ | 54 |
| 10.631 | 10.385 | 10.129 | $9 \cdot 865$ | $9 \cdot 596$ | $9 \cdot 317$ | 9.032 | 55 |
| 10.408 | 10.174 | 9.930 | $9 \cdot 678$ | $9 \cdot 421$ | $9 \cdot 154$ | $8 \cdot 880$ | 56 |
| 56 | 9.953 | $9 \cdot 722$ | $9 \cdot 483$ | $9 \cdot 237$ | 8.982 | $8 \cdot 720$ | 57 |
|  | 57 | $9 \cdot 505$ | $9 \cdot 278$ | $9 \cdot 045$ | $8 \cdot 802$ | $8 \cdot 551$ | 58 |
|  |  | 58 | $9 \cdot 063$ | $8 \cdot 843$ | $8 \cdot 612$ | $8 \cdot 373$ | 59 |
|  |  |  | 59 | $8 \cdot 630$ | $8 \cdot 411$ | $8 \cdot 185$ | 60 |
|  |  |  |  |  | $8 \cdot 206$ | $7 \cdot 992$ | 61 |
|  |  |  |  | 60 | 61 | $7 \cdot 789$ | 62 |
|  |  |  |  |  |  | 62 |  |

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$2 \frac{1}{2} \%$
$\alpha_{x y}$

| $\boldsymbol{x}$ | $y$ |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | 63 | 64 | 65 | 66 | 67 | 68 | 69 |
| 21 | $10 \cdot 243$ | 9.808 | 9.380 | 8.959 | 8.541 | 8.134 | 7.739 |
| 22 | $10 \cdot 240$ | 9.805 | $9 \cdot 377$ | 8.957 | 8.539 | $8 \cdot 133$ | $7 \cdot 738$ |
| 23 | 10.236 | 9.802 | 9.374 | 8.955 | 8.537 | 8.131 | 7.736 |
| 24 | 10.232 | 9.798 | 9.371 | 8.952 | $8 \cdot 535$ | 8.129 | 7.734 |
| 25 | 10.227 | 9.793 | $9 \cdot 367$ | 8.948 | 8.532 | 8.127 | 7.732 |
| 26 | $10 \cdot 220$ | 9.787 | $9 \cdot 362$ | 8.943 | $8 \cdot 528$ | $8 \cdot 124$ | 7.729 |
| 27 | 10.212 | 9.780 | $9 \cdot 355$ | 8.938 | 8.523 | 8.119 | 7.725 |
| 28 | $10 \cdot 203$ | 9.771 | $9 \cdot 348$ | 8.931 | $8 \cdot 517$ | 8.114 | 7.721 |
| 29 | $10 \cdot 192$ | 9.761 | $9 \cdot 340$ | 8.923 | $8 \cdot 510$ | 8.108 | 7.716 |
| 30 | $10 \cdot 178$ | 9.751 | $9 \cdot 330$ | 8.915 | 8.502 | $8 \cdot 100$ | 7.709 |
| 31 | 10.163 | 9.738 | $9 \cdot 318$ | 8.904 | $8 \cdot 492$ | 8.091 | 7.701 |
| 32 | $10 \cdot 146$ | 9.723 | $9 \cdot 304$ | 8.892 | $8 \cdot 481$ | 8.081 | $7 \cdot 692$ |
| 33 | $10 \cdot 128$ | 9.706 | $9 \cdot 290$ | 8.879 | 8.469 | 8.070 | $7 \cdot 683$ |
| 34 | 10.109 | 9.687 | $9 \cdot 273$ | 8.864 | $8 \cdot 456$ | 8.059 | $7 \cdot 672$ |
| 35 | 10.087 | 9.666 | 9.254 | $8 \cdot 847$ | $8 \cdot 441$ | 8.046 | $7 \cdot 660$ |
| 36 | 10.061 | $9 \cdot 644$ | 9.233 | 8.829 | 8.425 | 8.031 | $7 \cdot 647$ |
| 37 | 10.034 | $9 \cdot 620$ | 9.211 | 8.809 | $8 \cdot 407$ | 8.015 | 7.632 |
| 38 | 10.004 | 9.593 | 9.187 | 8.787 | $8 \cdot 387$ | $7 \cdot 997$ | $7 \cdot 616$ |
| 39 | 9.971 | 9.563 | 9.160 | 8.763 | $8 \cdot 365$ | 7.977 | $7 \cdot 599$ |
| 40 | 9.936 | 9.531 | $9 \cdot 131$ | 8.738 | $8 \cdot 343$ | 7.957 | 7.581 |
| 41 | 9.897 | $9 \cdot 496$ | 9.099 | 8.710 | 8.318 | $7 \cdot 934$ | 7.561 |
| 42 | 9.853 | $9 \cdot 457$ | 9.065 | 8.678 | $8 \cdot 289$ | $7 \cdot 909$ | 7.538 |
| 43 | 9.807 | $9 \cdot 416$ | 9.028 | $8 \cdot 644$ | $8 \cdot 259$ | 7.882 | $7 \cdot 514$ |
| 44 | 9.755 | $9 \cdot 369$ | 8.986 | 8.606 | 8.225 | 7.851 | $7 \cdot 487$ |
| 45 | 9.698 | 9.317 | 8.939 | 8.563 | 8.186 | 7.817 | $7 \cdot 456$ |
| 46 | 9.638 | 9.260 | 8.887 | 8.516 | 8.144 | 7.780 | $7 \cdot 422$ |
| 47 | 9.569 | 9-197 | 8.829 | $8 \cdot 464$ | 8.097 | 7.738 | 7.384 |
| 48 | $9 \cdot 490$ | 9-127 | 8.766 | $8 \cdot 408$ | $8 \cdot 046$ | 7.691 | 7.343 |
| 49 | $9 \cdot 408$ | 9.053 | 8.700 | $8 \cdot 348$ | $7 \cdot 990$ | $7 \cdot 641$ | 7-297 |
| 50 | 9.318 | 8.971 | 8.626 | $8 \cdot 280$ | 7.928 | 7.585 | 7.246 |
| 51 | $9 \cdot 219$ | 8.881 | 8.543 | $8 \cdot 204$ | $7 \cdot 860$ | 7.522 | 7-191 |
| 52 | $9 \cdot 113$ | 8.783 | 8.454 | $8 \cdot 123$ | 7.787 | 7.456 | $7 \cdot 130$ |
| 53 | 8.998 | 8.677 | $8 \cdot 357$ | 8.035 | 7.707 | $7 \cdot 383$ | $7 \cdot 063$ |
| 54 | 8.875 | 8.564 | 8.252 | 7.939 | $7 \cdot 619$ | 7.303 | 6.991 |
| 55 | 8.742 | $8 \cdot 441$ | 8.139 | 7.836 | 7.525 | $7 \cdot 216$ | 6.912 |
| 56 | 8.601 | 8.310 | 8.118 | 7.725 | $7 \cdot 423$ | $7 \cdot 123$ | 6.827 |
| 57 | $8 \cdot 451$ | $8 \cdot 172$ | 7.890 | $7 \cdot 606$ | $7 \cdot 313$ | 7.023 | 6.736 |
| 58 | 8.292 | 8.025 | 7.753 | $7 \cdot 479$ | 7-197 | 6.917 | 6.639 |
| 59 | $8 \cdot 125$ | $7 \cdot 870$ | $7 \cdot 609$ | $7 \cdot 445$ | $7 \cdot 074$ | 6.804 | 6.535 |
|  | 63 | 64 | 65 | 66 | 67 | 68 | 69 |



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| A1924-29 ultimate |  |  |  |  |  |  | $2 \frac{1}{2}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\alpha_{x y}$ |  |  |  |  |  |  |  |
| $\boldsymbol{x}$ | $y$ |  |  |  |  |  |  |
|  | 77 | 78 | 79 | 80 | 81 | 82 | 83 |
| 21 | $5 \cdot 011$ | $4 \cdot 726$ | 4.454 | 4-195 | 3.950 | $3 \cdot 718$ | $3 \cdot 497$ |
| 22 | 5.011 | $4 \cdot 726$ | $4 \cdot 454$ | 4-195 | 3.950 | 3.718 | $3 \cdot 497$ |
| 23 | $5 \cdot 010$ | $4 \cdot 725$ | $4 \cdot 453$ | 4-194 | 3.949 | 3.717 | $3 \cdot 496$ |
| 24 | $5 \cdot 009$ | $4 \cdot 725$ | $4 \cdot 453$ | 4-194 | 3.949 | $3 \cdot 717$ | $3 \cdot 496$ |
| 25 | 5-008 | $4 \cdot 724$ | $4 \cdot 453$ | 4-194 | 3.949 | $3 \cdot 717$ | $3 \cdot 496$ |
| 26 | 5.008 | $4 \cdot 724$ | $4 \cdot 452$ | $4 \cdot 194$ | $3 \cdot 948$ | $3 \cdot 717$ | $3 \cdot 496$ |
| 27 | $5 \cdot 007$ | $4 \cdot 723$ | $4 \cdot 452$ | $4 \cdot 194$ | 3.948 | $3 \cdot 717$ | $3 \cdot 496$ |
| 28 | $5 \cdot 005$ | 4.722 | $4 \cdot 451$ | $4 \cdot 193$ | 3.947 | $3 \cdot 716$ | $3 \cdot 496$ |
| 29 | 5.003 | $4 \cdot 720$ | $4 \cdot 450$ | $4 \cdot 192$ | $3 \cdot 946$ | $3 \cdot 715$ | $3 \cdot 495$ |
| 30 | $5 \cdot 000$ | $4 \cdot 718$ | 4.448 | $4 \cdot 190$ | $3 \cdot 945$ | $3 \cdot 714$ | $3 \cdot 494$ |
| 31 | 4.998 | 4.715 | $4 \cdot 446$ | $4 \cdot 188$ | 3.943 | 3.712 | $3 \cdot 492$ |
| 32 | 4.995 | $4 \cdot 712$ | 4.443 | $4 \cdot 186$ | $3 \cdot 941$ | $3 \cdot 710$ | $3 \cdot 490$ |
| 33 | 4.992 | 4.709 | $4 \cdot 440$ | $4 \cdot 183$ | 3.938 | $3 \cdot 707$ | $3 \cdot 487$ |
| 34 | 4.987 | 4.705 | $4 \cdot 436$ | $4 \cdot 180$ | $3 \cdot 935$ | $3 \cdot 705$ | $3 \cdot 485$ |
| 35 | 4.982 | $4 \cdot 701$ | $4 \cdot 432$ | $4 \cdot 176$ | 3.932 | 3.702 | $3 \cdot 483$ |
| 36 | $4 \cdot 977$ | $4 \cdot 696$ | $4 \cdot 428$ | $4 \cdot 172$ | 3.929 | $3 \cdot 699$ | $3 \cdot 480$ |
| 37 | 4.971 | $4 \cdot 690$ | $4 \cdot 423$ | $4 \cdot 168$ | 3.925 | 3.696 | $3 \cdot 477$ |
| 38 | 4.964 | $4 \cdot 684$ | $4 \cdot 418$ | $4 \cdot 163$ | $3 \cdot 921$ | $3 \cdot 692$ | $3 \cdot 474$ |
| 39 | $4 \cdot 957$ | $4 \cdot 678$ | 4.412 | $4 \cdot 158$ | $3 \cdot 916$ | $\mathbf{3} 688$ | $3 \cdot 471$ |
| 40 | 4.949 | 4-672 | $4 \cdot 407$ | $4 \cdot 153$ | $3 \cdot 912$ | $3 \cdot 684$ | $3 \cdot 467$ |
| 41 | 4.941 | $4 \cdot 665$ | $4 \cdot 401$ | $4 \cdot 147$ | $3 \cdot 907$ | $3 \cdot 679$ | $3 \cdot 463$ |
| 42 | 4.932 | 4.657 | $4 \cdot 393$ | $4 \cdot 141$ | $3 \cdot 901$ | $3 \cdot 674$ | $3 \cdot 458$ |
| 43 | 4.922 | $4 \cdot 648$ | $4 \cdot 385$ | $4 \cdot 134$ | $3 \cdot 895$ | $3 \cdot 669$ | $3 \cdot 454$ |
| 44 | $4 \cdot 911$ | $4 \cdot 638$ | $4 \cdot 376$ | $4 \cdot 126$ | $3 \cdot 888$ | $3 \cdot 663$ | $3 \cdot 449$ |
| 45 | $4 \cdot 899$ | $4 \cdot 627$ | $4 \cdot 366$ | $4 \cdot 117$ | 3.881 | $3 \cdot 656$ | $3 \cdot 442$ |
| 46 | 4.885 | $4 \cdot 616$ | $4 \cdot 355$ | $4 \cdot 109$ | $3 \cdot 872$ | $3 \cdot 649$ | $3 \cdot 436$ |
| 47 | 4.870 | $4 \cdot 603$ | $4 \cdot 343$ | 4.099 | $3 \cdot 862$ | $3 \cdot 641$ | $3 \cdot 429$ |
| 48 | 4.854 | $4 \cdot 587$ | $4 \cdot 33 \mathrm{I}$ | $4 \cdot 086$ | $3 \cdot 852$ | $3 \cdot 631$ | $3 \cdot 420$ |
| 49 | $4 \cdot 834$ | $4 \cdot 569$ | $4 \cdot 316$ | $4 \cdot 073$ | 3.841 | $3 \cdot 620$ | $3 \cdot 409$ |
| 50 | 4.813 | $4 \cdot 550$ | $4 \cdot 299$ | $4 \cdot 058$ | 3.828 | $3 \cdot 608$ | $3 \cdot 398$ |
| 51 | $4 \cdot 789$ | $4 \cdot 530$ | $4 \cdot 280$ | $4 \cdot 041$ | $3 \cdot 812$ | 3.595 | $3 \cdot 388$ |
| 52 | 4.764 | 4.509 | $4 \cdot 261$ | $4 \cdot 022$ | $3 \cdot 795$ | $3 \cdot 580$ | $3 \cdot 375$ |
| 53 | $4 \cdot 735$ | $4 \cdot 483$ | $4 \cdot 238$ | 4.001 | $3 \cdot 778$ | $3 \cdot 563$ | $3 \cdot 360$ |
| 54 | $4 \cdot 703$ | $\mathbf{4} \cdot \mathbf{4 5 4}$ | $4 \cdot 211$ | 3.979 | 3.757 | $3 \cdot 545$ | $3 \cdot 343$ |
| 55 | $4 \cdot 668$ | $4 \cdot 421$ | $4 \cdot 183$ | 3.954 | 3-734 | $3 \cdot 525$ | $3 \cdot 325$ |
| 56 | $4 \cdot 630$ | $4 \cdot 386$ | $4 \cdot 152$ | $3 \cdot 926$ | $3 \cdot 709$ | $3 \cdot 503$ | $3 \cdot 305$ |
| 57 | $4 \cdot 588$ | $4 \cdot 349$ | $4 \cdot 118$ | $3 \cdot 896$ | $\mathbf{3} 682$ | $3 \cdot 478$ | 3-283 |
| 58 | $4 \cdot 543$ | 4-309 | 4.081 | $3 \cdot 863$ | 3 652 | 3.451 | $3 \cdot 259$ |
| 59 | $4 \cdot 494$ | $4 \cdot 266$ | 4.041 | 3.827 | $3 \cdot 619$ | $3 \cdot 422$ | $3 \cdot 233$ |
|  | 779 | 78 | 79 | 80 | 81 | 82 | 83 |



