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| Figure S1. The experimental and correlated binodal curves of PEG 300,400 and 600 + Magnesium sulfate + water ATPSs. The solid line calculated from equation (3). |

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| Figure S2. The experimental and correlated binodal curves of PEG 300,400 and 600 + Aluminum sulfate + water ATPSs. The solid line calculated from equation (3). |

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| **Table S1.** Density, *ρ*, and Refractive Index,$n\_{D}$, for the binary and ternary of PEG (p) + tri-potassium citrate (s)+ water system at 298.15 Ka and 0.1 MPab at various mass fractions of polymer, $w\_{p}$and salt, $w\_{s}$. |
| $w\_{p}$*c* |  | $w\_{s}$*c* |  | $$\frac{ρ(\pm 0.0001 )}{kg.m^{-3}}$$ |  | $n\_{D}$ *(*$\pm 0.0001 )$ |
| **PEG300** |  | **Zinc sulfate** |  |  |  |  |
| 0.05 | 0.10 | 1.1899 | 1.4388 |
| 0.10 |  | 0.10 |  | 1.2885 |  | 1.4466 |
| 0.15 |  | 0.10 |  | 1.3588 |  | 1.4496 |
| 0.20 |  | 0.10 |  | 1.3855 |  | 1.4533 |
| 0.25 |  | 0.10 |  | 1.5577 |  | 1.4630 |
| 0.00 |  | 0.05 |  | 1.0255 |  | 1.3383 |
| 0.00 |  | 0.10 |  | 1.055 |  | 1.3442 |
| 0.00 |  | 0.15 |  | 1.0852 |  | 1.3501 |
| 0.00 |  | 0.20 |  | 1.1149 |  | 1.3558 |
| 0.00 |  | 0.25 |  | 1.1492 |  | 1.3623 |
| 0.00 |  | 0.30 |  | 1.1822 |  | 1.3687 |
| 0.00 |  | 0.00 |  | 0.9970 |  | 1.3327 |
| 0.05 |  | 0.00 |  | 1.0046 |  | 1.3385 |
| 0.10 |  | 0.00 |  | 1.0128 |  | 1.3455 |
| 0.15 |  | 0.00 |  | 1.0205 |  | 1.3521 |
| 0.20 |  | 0.00 |  | 1.0354 |  | 1.3585 |
| 0.25 |  | 0.00 |  | 1.0374 |  | 1.3658 |
| 0.30 |  | 0.00 |  | 1.0457 |  | 1.3734 |
| 1.00 |  | 0.00 |  | 1.1219 |  | 1.4650 |
| PEG300 |  | Magnesium sulfate |  |  |  |  |
| 0.00 |  | 0.05 |  | 1.0216 |  | 1.337 |
| 0.00 |  | 0.10 |  | 1.0473 |  | 1.3421 |
| 0.00 |  | 0.15 |  | 1.0728 |  | 1.3472 |
| 0.00 |  | 0.20 |  | 1.099 |  | 1.3524 |
| 0.00 |  | 0.25 |  | 1.1256 |  | 1.3568 |
| 0.00 |  | 0.30 |  | 1.1531 |  | 1.3613 |
| 0.05 |  | 0.15 |  | 1.1455 |  | 1.3421 |
| 0.10 |  | 0.15 |  | 1.1566 |  | 1.3472 |
| 0.15 |  | 0.15 |  | 1.2685 |  | 1.3524 |
| 0.20 |  | 0.15 |  | 1.3325 |  | 1.3568 |
| 0.25 |  | 0.10 |  | 1.4565 |  | 1.3613 |
| PEG300 |  | Aluminum sulfate |  |  |  |  |
| 0.00 |  | 0.05 |  | 1.0255 |  | 1.3383 |
| 0.00 |  | 0.10 |  | 1.055 |  | 1.3442 |
| 0.00 |  | 0.15 |  | 1.0852 |  | 1.3501 |
| 0.00 |  | 0.20 |  | 1.1149 |  | 1.3558 |
| 0.00 |  | 0.25 |  | 1.1492 |  | 1.3623 |
| 0.00 |  | 0.30 |  | 1.1822 |  | 1.3687 |
| 0.05 |  | 0.10 |  | 1.1899 |  | 1.4388 |
| 0.10 |  | 0.10 |  | 1.2885 |  | 1.4466 |
| 0.15 |  | 0.10 |  | 1.3588 |  | 1.4496 |
| 0.20 |  | 0.10 |  | 1.3855 |  | 1.4533 |
| 0.25 |  | 0.10 |  | 1.5577 |  | 1.4630 |

a $298.15\pm 0.0$5 K, b $100\pm $0.05 kPa,c %mass $\pm 0.001$