Solutions:

1. $\frac{1}{1+i}\bullet\frac{1-i}{1-i}=\frac{1-i}{2}$ D

2. When you solve for y you see this is exponential so y-axis!! $y=10^x$ B

3. Use sum of roots and product of roots. Imaginary roots come in conjugate pairs.

$2\pm i\sqrt{3}\rightarrow\frac{-b}{a}=4\rightarrow\frac{c}{a}=7\rightarrow 7-4=3$ C

4. $x+y=1\rightarrow\frac{x}{y}=\frac{1}{\sqrt{2}}\rightarrow y=x\sqrt{2}\rightarrow x+x\sqrt{2}=1\rightarrow x=\frac{1}{1+\sqrt{2}}=\frac{1-\sqrt{2}}{-1}=\sqrt{2}-1$ D

$\sqrt{2}\left(\sqrt{2}-1\right)=2-\sqrt{2}$

5. $5=A\left(3x^2-7\right)-\left(x-2\right)\left(Bx+C\right)\rightarrow 5A=5\rightarrow A=1$

$5=3x^2-7-Bx^2-xC+2Bx+2C\rightarrow B=3\rightarrow 2C=12\rightarrow C=6$ B

$1+3-6=-2$

6. We are looking for the y-coordinate of the vertex. The x-coordinate is –b/2a. Plug it in and solve for y!! $a\left(\frac{-b}{2a}\right)^2+b\left(\frac{-b}{2a}\right)+c=\frac{b^2-2b^2+4ac}{4a}=\frac{-b^2+4ac}{4a}\rightarrow D$

7. $\frac{1}{1-\frac{2}{9}}=\frac{9}{7}$ D

8. $x=\frac{y+3}{-2}\rightarrow 2\left(\frac{y+3}{-2}\right)^2+6\left(\frac{y+3}{-2}\right)+5y+1=0$

$\frac{y^2+6y+9}{2}-3y-9+5y+1=0$ C

$y^2+6y+9-6y-18+10y+2=0\rightarrow y^2+10y-7=0$

9. $\left(a^2-25b^2\right)^4$ so 4+1=5 terms B

10. $4-n=\sqrt{n-2}\rightarrow 16-8n+n^2=n-2\rightarrow n^2-9n+18=0$
$(n-3)(n-6)=0\rightarrow n=3$ 6 is extraneous!! A

11. $\frac{3-\sqrt{2}}{4+\sqrt{2}}\bullet\frac{4-\sqrt{2}}{4-\sqrt{2}}=\frac{12-7\sqrt{2}+2}{14}=\frac{14-7\sqrt{2}}{14}=\frac{2-\sqrt{2}}{2}$ A

12. Draw a picture. Draw a radius from the center to the tangent point. This creates similar triangles. This creates a ½ ratio so radius of smaller circle is 6. The radius of larger circle is 18 B

13. $\frac{xy(x+y^{-1})}{xy(x^{-1}+y)}=13\rightarrow\frac{x^2y+x}{y+xy^2}=13\rightarrow\frac{x(xy+1)}{y(1+xy)}=13\rightarrow x=13y$
$14y\le 100\rightarrow 0<y\le 7$

Therefore 7 solutions: C

14. $\frac{1}{i^{2017}}=\frac{i^3}{i^{2020}}=-i$ B

15. $\frac{4^{-2}a^3b^{-3}}{2^3\left(ab^{-2}\right)^2}\bullet\frac{\left(a^3b^3\right)^{-1}}{(8a)^{-3}}=\frac{ab}{2^7}\bullet\frac{2^9}{b^3}=\frac{4a}{b^2}$ D

16. Draw a picture!! ZW=MU=MZ. We now see that triangle MWZ is equilateral. This makes the angle we are looking for equal to 90-60=30 degrees. Answer C

17. Since the coefficient of y equal 1, the factors of k must be one apart. So (1,2), (2,3)…(9,10). We stop here because (10, 11) violates the limits on k. So 9 possibilities. Answer C

18. ${}_{26}C_2-{}_{13}C_2-13=325-78-13=234$ C

19. The slope of the segment is 264/45. If prime factor these you have only one common factor, which is 3. This leaves 88/15. So you had 15 to each x coordinate and 88 to each y coordinate. This gives 2 additional answers besides the endpoints (20,107) and (35,195). Answer B

20. Draw picture!! Extend LU and MZ to meet at X. Angle X will = 30 degrees so XL = 6 and XU = 10 so

MU = $\frac{10}{\sqrt{3}}$ D

21.
$$i = x^2 + 2xyi - y^2 \rightarrow x^2 - y^2 = 0 \rightarrow 2xy = 1 \rightarrow y = \frac{1}{2x}$$
$$x^2 - \frac{1}{4x^2} = 0 \rightarrow 4x^4 - 1 = 0 \rightarrow x^2 = \pm\frac{1}{2} \rightarrow y^2 = \pm\frac{1}{2}$$

They do have the same sign so 1/2 + ½ =1 B

22. For a matrix to not have an inverse its determinant must equal zero. Answer D

23. x- intercept is 5/3 and the y-intercept is 5. Add them together and you get 20/3 D

24. To make the vertex lie on the x-axis you need one double root so set the discriminate equal to zero and solve. $b^2 - 4ac = 0 \rightarrow 4n^2 - 4\left(n^2 - 9n + 9\right) = 0 \rightarrow 36n - 36 = 0 \rightarrow n = 1$ B

25. Factor as difference of squares
$$\left[\left(\frac{e^y + e^{-y}}{2}\right) - \left(\frac{e^y - e^{-y}}{2}\right)\right]\left[\left(\frac{e^y + e^{-y}}{2}\right) + \left(\frac{e^y - e^{-y}}{2}\right)\right] = e^{-y} \bullet e^y = 1 \quad \text{C}$$

26. Reorder the terms and then factor as difference of squares twice!!
$$a^2 - 2ac + c^2 - b^2 + 2bx - x^2 = \left(a - c\right)^2 - \left(b - x\right)^2 = \left(a - c + b - x\right)\left(a - c - b + x\right) \quad \text{A}$$

27. $e^3 = 6\left(12e\right)^2 \rightarrow e = 864$ D $e^3 = 6\left(12e\right)^2 \rightarrow e = 864$ D

28.Diagonals intersect at right angles. Use Pythagorean theorem with half the diagonal length as sides:
$$4^2 + \frac{x^2}{4} = 169 \rightarrow \frac{x^2}{4} = 153 \rightarrow x^2 = 612 \rightarrow 24 < x < 25 \quad \text{D}$$

29.
$$x^2 - 8x + 16 + y^2 = 65 \rightarrow \left(x - 4\right)^2 + y^2 = 81$$
$$x^2 - 16x + 64 + y^2 - 10y + 25 = -73 + 89 \rightarrow \left(x - 8\right)^2 + \left(y - 5\right)^2 = 16$$

The first is a circle with center (4,0) and radius 9. The second is a circle center at (8,5) and radius 4. If you graph them you see that the answer is 2. You could also solve the first equation for y-squared and substitute into the second. This will lead to a quadratic which also tells you there are 2 solutions. C

30. If the sum of the absolute values equals zero then each absolute value is zero. Solve the system and plug in!!
$$\begin{aligned} 2m + n &= -6 \\ 2m - n &= 14 \\ 4m = 8 \rightarrow m = 2 &\rightarrow n = -10 \rightarrow \left|2 - 10\right| = 8 \end{aligned}$$
C

Answers:

1. D
2. B
3. C
4. D
5. B
6. D
7. D
8. C
9. B
10. A
11. A
12. B
13. C
14. B
15. D
16. C
17. C
18. C
19. B
20. D
21. B
22. D
23. D
24. B
25. C
26. A
27. D
28. D
29. C
30. C