MSMA KO 20-21 Explanations

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1. C
57 + 88 = 145

2. E
71 - 38 = 33

3. D
47 * 53 = 2491
(note: can use $50^2 - 3^2$ for speed)

4. D
1003 / 17 = 57

5. A
Hexagon has 6 sides, Square has 4 sides. Two sides will not be counted since they are not part of the perimeter.
Total of 8 sides exposed, each 7cm long. Total perimeter is 56

6. D
1cm = 10mm, 156cm = 1560mm

7. B
20% can be translated to 0.2
46 * 0.20 = 9.2
(note: can also use 46 / 5)

8. E
2 + 4 + 6 + 8 + 10 = 30
(note: can also use 2(1 + 2 + 3 + 4 + 5))

9. C
The only variable is a, so add all of a's coefficients together to receive the final answer
6 + 12 - 9 - 3 + 17 = 23
23a

10. C
Roman Numerals
I=1
V=5
X=10

L=50
C=100

D=500
M=1000

Special rules: when adding I in front of a number (V or X), subtract 1 from that number (ex:IV=4)
when adding I behind a number (V or X), add 1 to that number (ex: VI=6)
when adding X in front of a number (L or C), subtract 10 from that number (etc)
XIV would is 10, 1, 5
But since the I is in front of V, it becomes a 4
So the answer is 14

11. B
Only way to solve this problem is to divide each one separately
452 / 8 = 56 remainder 4

12. B
Median means middle number when in sorted order,
(If 2 numbers in the middle average them)

In order: 11, 26, 33, 35, 35, 87, 91, 91, 91
Middle number: ~~11, 26, 33, 35~~, *35*, ~~87, 91, 91, 91~~

13. E
Each term adds 16
2 + 16 = 18,
18 + 16 = 34
34 + 16 = 50
….
98 + 16 = 114

14. A
57811 / 9 = 6423 remainder 4
(note: for remainder with 9 you can add up the digits (5 + 7 + 8 + 1 + 1 = 22) then take the remainder of that with 9 (22 / 9 = 2 remainder 4)

15. C
Complement is equal to 90°. (Supplement is 180°)
The complement of an angle measuring 73 would be 90 - 73 = 17.

16. D
X-coordinate is on the horizontal axis
Y-coordinate is on the vertical axis
Ordered pairs are (x, y)
A (-3,2)
B (2,-4)

Asking for A's x-coordinate + B's y-coordinate
-3 + (-4) = -7

17. E
GCF = Greatest Common Factor = Largest number that evenly divides both numbers

4:	156 / 4 = 39	36 / 4 = 9	✔
36:	156 / 36 = 4.33	36 / 36 = 1	✘
5615:	156 / 5616 = .027	36 / 5616 = .0006	✘
8:	156 / 8 = 19.5	36 / 8 = 4.5	✘
12:	156 / 12 = 13	36 / 12 = 3	✔

Largest number that works is 12

18. D
Prime factorization is the grouping of smallest prime numbers multiplied together to make the original number

In this case, the expression is already in prime factored form, so multiply all numbers together to find the original number
$2 * 3^3 * 11 = 2 * 27 * 11 = 54 * 11 = 594$

19. D
The || symbol means absolute value, which makes all numbers inside of it to become positive. If h = -23
|h * 17| - 3 = ?
|-23 * 17| - 3 = ?
|-391| - 3 = ?
391 - 3 = 388

20. B
Hour = 60 minutes. 1.4 hours = (60 * 1.4) minutes = 84 minutes.

21. C
Circumference = πd
Circumference = 3*4.5 = 13.5in

22. C

Numbers that are highlighted are all numbers less than (and equal to) 7
○ = < or >
● = ≥ or ≤
The point on the number line is shaded in, facing left and on the number 7
Answer is n ≤ 7

23. E
Add all food item prices together and subtract that from the $10 bill
$3.35 + $1.50 + $1.99 = $6.84
$10.00 - $6.84 = $3.16
24. C
Percent increase/decrease

$$\frac{change}{original} = \frac{20-12}{20} = \frac{8}{20} = 0.4 = 40\%$$

25. A

In the problems it states
x■y = -7(x)(y)

So -5■13 = -7(-5)(13) = 455

26. B
Base conversion from 10 to another number
Divide the base 10 number by the other number (in this case, 6) and write down the remainder and repeat process

76/6 = 12 remainder 4 (4 is units digit)
12/6 = 2 remainder 0 (0 is tens digit)
2/6 = 0 remainder 2 (2 is hundreds digit)
Answer: 204

27. D
The first number in scientific notation is always between 1 and 10 (in this case 3.4)

The power of 10 is how many times you have to move the decimal place to get to the original number to be between 1 and 10, moving the decimal to the right means a positive power of 10, to the left is negative

There are ten 10s after the 3.4 in this case so the answer would be
3.4 * 10^10

28. E

2ft x 3ft = 24in x 36in

Since each tile is 2inx2in that means the floor is
12tiles x 18tiles
So the total number of tiles is 216.

29. C
Since there are 2 pages the average page number is 97 / 2 = 48.5
Page numbers cannot be decimals or even
That means the pages are the nearest integers, 48 and 49
48 * 49 = 2352

30. B
Positive slope = Slanted up
Negative slope = Slanted down
Undefined slope = Straight up and down
Zero slope = Flat
Neutral slope = Not really a thing (might be the same as zero slope)

Since the line is slanted downward it has a negative slope

31. A
The sum of the interior angles of any polygon is 180 * (number of sides - 2)

So in this case 180 * (6 - 2) = 180 * 4 = 720

32. D
The degree of a monomial is all of the exponents added together
So in this case $24a^4b^2cd^3 \rightarrow 0 + 4 + 2 + 1 + 3 = 10$

33. D
The only numbers that satisfy x - 5 < 3 are 1, 2, 3, 4, 5, 6, 7
1 + 2 + 3 + 4 + 5 + 6 + 7 = 28
(numbers must be positive integer)
(8 doesn't work because 3 is not less than 3 it is equal)

34. E
Sum of angles in a triangle is 180.
The sum of the 3 numbers in the ratio given are 2 + 3 + 5 = 10
This means that the numbers given are 180/10 = 18 times smaller than the actual values
The smallest angle would be 2 * 18 = 36

35. E

$f(-6 + (-3)) = f(-9)$

$f(x) = -3x^2$ so plugging in -9 as x gives $-3(-9)^2 = -3(81) = -243$

36. D
Order of operations requires exponents first.
Square $3d^3$
3 squared is 9, d^3 squared is (3 from the original exponent * 2 from the squared) so d^6
$2(3d^3)^2 = 2 * 9d^2 = 18d^6$

37. A
Simplify the expression, using the distributive property it becomes
$4(x + 2) = -2(12 - 6x)$
$4(x) + 4(2) = -2(12) + (-2(-6x))$
$4x + 8 = -24 + 12x$

Solve for x by moving the variables
$4x + 8 = -24 + 12x$
(subtract 4x from both sides)
$8 = -24 + 8x$
(add 24 to both sides)
$32 = 8x$
$x = 4$

38. E
A right triangle can be determined by using the Pythagorean Theorem ($a^2 + b^2 = c^2$)

This describes the sum of the squares of two legs equaling the hypotenuse (diagonal side)

Triples of numbers that form right triangles are normally memorized, but you can also just check each set to see if they work (longest side is c)

In this case the answer is $8^2 + 15^2 = 17^2$ (64 + 225 = 289)
If your equation is valid, then the 3 numbers form a right triangle.

39. B
The y-intercept describes the point at which x = 0 (0,y)

To find the y intercept you can plugin 0 for x, and find what y value is necessary to satisfy the equation

-7x - 4y = 12
-7(0) - 4y = 12
0 - 4y = 12
(divide both sides by 4)
0 - y = 3
y = -3

40. C
The square root of -1 is the “imaginary” number *i*

41. C
Adding numbers in base 5 is exactly the same as with base 10, except you have to carry for any number greater than 5
So in this case:

$$\begin{array}{r} {}^{1} \\ 0\ 3\ 3 \\ 0\ 4\ 1 \\ \hline 1\ 2\ 4 \end{array}$$

(7 is greater than 5 so you carry a 1 and subtract 5)

You can
42. D
Basic rules of transformation include:
f(x) + d is vertical translation up d units
f(x) - d is vertical translation down d units
f(x + d) is horizontal translation left d units
f(x - d) is horizontal translation right d units

So in this case it would be a translation right 5 units
43. A
Volume of a rectangular prism is: L*W*H (length * width * height)
So in this case: 13 * 4 * 17 = 364

44. E

There are multiple ways of solving a system of equations, including substitution, addition/subtraction or matrices. The easiest way to solve in this case is adding away one variable to solve for the other

Decide which variable to solve for first (x or y). In this case, I will demonstrate solving for x by removing y.

Equation : x - y = 17

3x + 2y = -14

Multiply the first equation by two 2(x - y = 17). Multiplying an equation does not change the value of the variables, only makes it easier to work with

2x - 2y = 34

Now add this equation to the second and see that the y values will now cancel out (2 - 2 = 0)

(2x - 2y = 34) + (3x + 2y = -14). Corresponding values must add to each other (x can ONLY add to x, y can ONLY add to y)

(2+3)x + (2-2)y = (34-14)

So 5x = 20

x = 4

Now solve for y by inserting x back into an original equation

original: x - y =17

4 - y =17

subtract 4 from both sides

-y = 13

multiply both sides by -1

y = 13

The question is asking for x + y (x = 4, y = -13)

x + y = -9

45. C

Simple interest is calculated using the formula P*r*t (Principal times rate times time)

Principal is the amount of original money

Rate is the annual interest rate

Time is in years

1500 * .04 * 3 = $180

46. B

In order to add the 2 numbers, the number inside the square roots must be the same.

You can do this because $8\sqrt{24}$ is the same thing as $8\sqrt{6 \times 2^2}$

$8\sqrt{6 \times 2^2} = 2 \times 8\sqrt{6} = 16\sqrt{6}$ so A + B = $2\sqrt{6} + 16\sqrt{6} = 18\sqrt{6}$

47. A
C is the midpoint of line AB

A is (14,11)
B is unknown
C is (8,-3)

The distance between the midpoint and point A has to be the same as the distance between the midpoint and point B

The distance between A and C is 8 - 14 = -6 on the X axis and -3 - 11 = -14 on the Y axis
Since point B is the same distance away it can be found by doing
8 + (-6) = 2 on the X axis and -3 + (-14) = -17 on the Y axis so (2, -17)

48. E
The quadratic equation in the problem is in the form $ax^2 + bx + c = y$
x-coordinate of vertex of parabola is found with formula $\frac{-b}{2a}$

The equation in the problem is $2x^2 + (-8x) + 1 = y$
So a = 2, b = -8, c = 1

Plugging a and b into the formula from before gives $\frac{-(-8)}{2(2)} = \frac{8}{4} = 2$, this means the x coordinate of the vertex is 2

To find the y value, we simply plugin 2 as the value for x, and see what y value that gives us
So in this case $2(2)^2 - 8(2) + 1 = 8 - 16 + 1 = -7$, so the y value is -7

Putting the two values into an ordered pair gives (2, -7)

49. D
Work backwards in this problem
If she had an average of 82 after 6 tests, her total score was 82 * 6 = 492

After removing lowest scores, average is 87 * 4 = 348
Subtract the two totals and you find how much was removed after removing the bottom two scores
492 - 348 = 144

Since they are two equal scores, divide by two to find one score
144/2 = 72

50. B

Addition of matrices

Simply add each corresponding number in the matrices (top left + top left ect.)

In this case

$$\begin{bmatrix} -3 & -5 \\ -2 & 4 \end{bmatrix} + \begin{bmatrix} 6 & -3 \\ 10 & 5 \end{bmatrix} = \begin{bmatrix} -3+6 & -5+(-3) \\ -2+10 & 4+5 \end{bmatrix} = \begin{bmatrix} 3 & -8 \\ 8 & 9 \end{bmatrix}$$