1.

a) $\vec{A} = 2\hat{a}_x - 2\hat{a}_y + \hat{a}_z$ $\quad \sqrt{2^2 + (-2)^2 + 1^2} \quad \sqrt{4+4+1} = \sqrt{9} = \boxed{3}$

$\vec{B} = \hat{a}_x + 8\hat{a}_y - 4\hat{a}_z$ $\quad \sqrt{1^2 + 8^2 + (-4)^2} \quad \sqrt{1+64+16} = \sqrt{81} = \boxed{9}$

$\vec{C} = 12\hat{a}_x - 4\hat{a}_y - 3\hat{a}_z$ $\quad \sqrt{12^2 - 4^2 - 3^2} \quad 144+16+9 = \sqrt{169} = \boxed{13}$

$\cancel{L = \sqrt{(2+1+12)^2 + (8-4-2)^2 + (1-4-3)^2}}$

$\cancel{= \sqrt{15^2 + 2^2 + (-6)^2}}$

$\cancel{= \sqrt{225 + 4 + 36}}$

$\cancel{=}$

$\vec{A} \times \vec{B} = \left((-2)(-4) - (1)(8)\right)\hat{a}_x + \left((1)(1) - (2)(-4)\right)\hat{a}_y + \left((2)(8) - (1)(-2)\right)\hat{a}_z$

$= \boxed{0\hat{a}_x + 9\hat{a}_y + 18\hat{a}_z}$

$\vec{A} \times \vec{C} = \left((-2)(-3) - (1)(-4)\right)\hat{a}_x + \left((1)(12) - (2)(-3)\right)\hat{a}_y + \left((2)(-4) - (12)(-2)\right)\hat{a}_z$

$= \boxed{10\hat{a}_x + 18\hat{a}_y + 16\hat{a}_z}$

Scalar Projection of $\vec{C}$ on $\vec{B}$: $\dfrac{\vec{C} \cdot \vec{B}}{|\vec{B}|} = \dfrac{(12)(1) + (-4)(8) + (-3)(-4)}{\sqrt{1^2 + 8^2 + (-4)^2}}$

$= \dfrac{12 - 32 + 12}{1 + 64 + 16} = \dfrac{-8}{\sqrt{81}} = \boxed{\dfrac{-8}{9}}$

b) $\vec{A} = 2\hat{a}_x - 3\hat{a}_y + 6\hat{a}_z$ $\quad \sqrt{2^2 + (-3)^2 + 6^2} = \sqrt{4+9+36} = \sqrt{49} = \boxed{7}$

$\vec{B} = 10\hat{a}_x + 2\hat{a}_y + 11\hat{a}_z$ $\quad \sqrt{10^2 + 2^2 + 11^2} = \sqrt{100+4+121} = \sqrt{225} = \boxed{15}$

$\vec{C} = 2\hat{a}_x - 9\hat{a}_y - 6\hat{a}_z$ $\quad \sqrt{2^2 + (-9)^2 + (-6)^2} = 4+81+36 = \sqrt{121} = \boxed{11}$

$\vec{A} \times \vec{B} = \left((-3)(11) - (6)(2)\right)\hat{a}_x + \left((6)(10) - (2)(10)\right)\hat{a}_y + \left((2)(2) - (-3)(10)\right)\hat{a}_z$

$= \boxed{-45\hat{a}_x + 40\hat{a}_y + 34\hat{a}_z}$

$\vec{A} \times \vec{C} = \left((-3)(-6) - (6)(-9)\right)\hat{a}_x + \left((6)(2) - (2)(-6)\right)\hat{a}_y + \left((2)(-9) - (-3)(10)\right)\hat{a}_z$

$= \boxed{-36\hat{a}_x + 24\hat{a}_y + 12\hat{a}_z}$

Scalar projection of $\vec{C}$ on $\vec{B}$: $\dfrac{\vec{C} \cdot \vec{B}}{|\vec{B}|} = \dfrac{(10)(2) + (2)(-9) + (11)(-6)}{15}$

$= \dfrac{20 - 18 - 66}{15} = \boxed{\dfrac{-64}{15}}$

c) $\vec{A} = 10\hat{a}_x + 10\hat{a}_y + 5\hat{a}_z$ $\quad \sqrt{10^2 + 10^2 + 5^2} = \sqrt{225} = 15$

$\vec{B} = 5\hat{a}_x - 2\hat{a}_y - 14\hat{a}_z$ $\quad \sqrt{5^2 + (-2)^2 + (-14)^2} = \sqrt{225} = 15$

$\vec{C} = 4\hat{a}_x + 7\hat{a}_y - 4\hat{a}_z$ $\quad \sqrt{4^2 + 7^2 + (-4)^2} = \sqrt{81} = 9$

$$\vec{A} \times \vec{B} = \overset{-130}{\left((10)(-14) - (5)(-2)\right)}\hat{a}_x + \overset{165}{\left((5)(5) - (10)(-14)\right)}\hat{a}_y + \overset{-30}{\left((10)(-2) - (10)(5)\right)}\hat{a}_z$$

$$= \boxed{-130\hat{a}_x + 165\hat{a}_y - 30\hat{a}_z}$$

$$\vec{A} \times \vec{C} = \overset{-75}{\left((10)(-4) - (5)(7)\right)}\hat{a}_x + \overset{60}{\left((5)(4) - (10)(-4)\right)}\hat{a}_y + \overset{30}{\left((10)(7) - (10)(4)\right)}\hat{a}_z$$

$$= \boxed{-75\hat{a}_x + 60\hat{a}_y + 30\hat{a}_z}$$

scalar projection $\vec{C}$ on $\vec{B}$: $\dfrac{\vec{C} \cdot \vec{B}}{|\vec{B}|}$ $\quad \dfrac{(5)(4) + (-2)(7) + (-14)(-4)}{15} = \boxed{\dfrac{62}{15}}$