Answers to Unit 1 Assignments

Activity 2

1. a. $\overrightarrow{AF} = \frac{\overrightarrow{AB}}{2}$ b. $\overrightarrow{AE} = \frac{\overrightarrow{AB}+\overrightarrow{BC}}{2}$ c. $\overrightarrow{BC} = 2(\overrightarrow{EC} - \overrightarrow{AF})$
2. a. 6N[W4°N] b. 5.8m/s 45°
3. a. 10.8m/s [N35°E] b. 5.1N [24°Wof S]
4. 492 km/h 205°
5. 9N [-26°to the resultant]

Activity 4

1. $\left(\frac{2}{7}, \frac{4}{7}, \frac{6}{7}\right)$ 2. k=+2 or -2 3. 1515 N 4. 1.5 m^2

5. to give some perspective if $\vec{b}$ were the x-axis then the "projection" of $\vec{a}$ onto $\vec{b}$ would be $|\vec{a}|\cos\theta$

Now in general if we're given $\vec{a}$ *and* $\vec{b}$ (but not an angle) then we could compute the dot product between them – ie. $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}|\cos\theta$, which we can rearrange to have $|\vec{a}|\cos\theta = \frac{\vec{a}\cdot\vec{b}}{|\vec{b}|}$ This gives the correct magnitude. For the correct direction we need to multiply the "unit vector" in the direction of $\vec{b}$ which is $\frac{\vec{b}}{|\vec{b}|}$ (sometimes referred to as $\hat{b}$).

So the projection of $\vec{a}$ *onto* $\vec{b}$ will be $\frac{\vec{a}\cdot\vec{b}}{|\vec{b}|}\,\frac{\vec{b}}{|\vec{b}|} = \left(\frac{\vec{a}\cdot\vec{b}}{|\vec{b}|^2}\right)\vec{b} = \left(\frac{\vec{a}\cdot\vec{b}}{\vec{b}\cdot\vec{b}}\right)\vec{b}$

Activity 5

1. (-49, -42, 29)
2. The result would be 0.
   The first term is $a_2b_3 - a_3b_2$ which becomes $a_2a_3 - a_3a_2 = 0$. It would be similar for each term
3. The result of the cross product returns a vector this is perpendicular to te two vectors being multiplied so we need three dimensions.
4. 1.28x10-13 N [up]

Activity 6

1. a) the dot product yields a scalar and the dot product is defined for use with two vectors. So it is not possible

   b) example $\vec{a} = (1,2,3)$, $\vec{b} = (2,3,4)$, $\vec{c} = (3,4,5)$

   so $\vec{b} \cdot \vec{c}$ is (6,12,20) and $\vec{a} + (\vec{b} \cdot \vec{c})$ is (7,14,23)

   where $\vec{a} + \vec{b}$ is (3,5,7) and $\vec{a} + \vec{c}$ is (4,6,8) so their dot product is (12,30,56). (this is because the first case is $a_1+b_1c_1$ and the latter is $a_1b_1+a_1c_1$)
2. In the first case the first term is $a_2(b_3c_2 - b_2c_3) - a_3(b_2c_3 - b_3c_2)$ versus $(a_2b_3 - a_3b_2)c_3 - (a_3b_2 - b_3a_2)c_2$ which are not equivalent.
3. Given $\vec{a} = (a_1, a_2, a_3)$, and $\vec{b} = (b_1, b_2, b_3)$

   Then $\vec{a} + \vec{b} = (a_1+b_1,\ a_2+b_2,\ a_3+b_3)$ and $\vec{a} - \vec{b} = (a_1-b_1,\ a_2-b_2,\ a_3-b_3)$

   And the first term of their cross product would be

   $(a_2a_3 - a_2b_3 + b_2a_3 - b_2b_3) - (a_3a_2 - a_3b_2 + b_3a_2 - b_3b_2) = (-\ 2a_2b_3 + 2\ b_2a_3)$

   And the first term of $\vec{b} \times \vec{a}$ is $(b_2a_3 - a_2b_3)$ and the rest will be similar.
4. The first terms are as follows and show the equivalence

   $k(\vec{a} \times \vec{b}) = k(a_2b_3 - b_2a_3) = ka_2b_3 - kb_2a_3$

   $(k\vec{a} \times \vec{b}) = (ka_2b_3 - b_2(ka_3)) = ka_2b_3 - kb_2a_3$

   $(\vec{a} \times k\vec{b}) = (a_2(kb_3) - kb_2a_3) = ka_2b_3 - kb_2a_3$
5. (See Activity 5, number 2) The vectors must be parallel (or equivalent)
6. a) (9, 60, 7) b) the dot product is a scalar

Activity 7

1. 18.28 2. 22.2N 3. a) 141N*m b) 90° c)150N*m

Activity 9

1. 175m [N28°E] 2. a) 35N*m b) 50N*m, @ 90° 3. S 4.17°E
5. a) true. A1(b1+c1) and a1b1 +a1c1

b) true (a2(b3+c3) – a3(b2+c2)) and (a2b3 –a3b2 +a2c3 – a3c2)

c) can’t cross a vector with a scalar

5. 186 cubic units

6. 56° rope 25.2N, 45°rope 19.9N