Review of two space and three space vectors   Date: _____
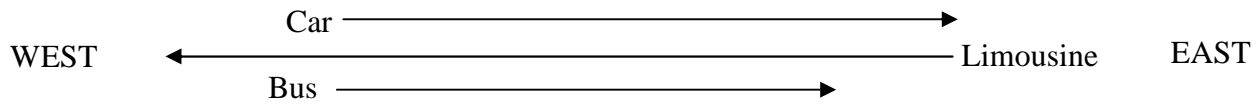
1. Consider the situation indicated in the diagram involving a car C travelling at 110 km/h, a bus B travelling at 95 km/h and a limousine L travelling at 125 km/h.

Car ⟶

WEST   ⟵

Bus ⟶   Limousine   EAST

   a) Find the velocity of the limousine relative to the bus.
   b) Find the velocity of the bus relative to the car.

2. The wind is blowing from $S80°E$ at a wind speed of 85 km/h. A plane's actual groundspeed is 480 km/h at a track of $S16°W$. Determine the airspeed and heading the pilot should take?

3. A ship is travelling at 22 knots in the direction $N15°W$. A submarine 12 nautical miles due north of the ship is travelling at 13 knots at $S35°W$. Find the velocity of the ship relative to the submarine? Does the ship pass in front of or behind the submarine?

4. Given $\vec{u} = (3,1)$ and $\vec{v} = (-2,-4)$, find the $Proj(\vec{u} \ onto \ \vec{v})$ as an algebraic vector.

5. Given vectors $\vec{u}$ and $\vec{v}$ as shown, find:
   a) $\vec{u} \times \vec{v}$ b) $Proj(\vec{u} \ onto \ \vec{v})$ (in terms of $\vec{v}$)
   c) $Proj(\vec{v} \ onto \ \vec{u})$ (in terms of $\hat{u}$) d) $(3\vec{u} + \vec{v}) \times (2\vec{u} - \vec{v})$

$40°$ $|\vec{u}| = 12, |\vec{v}| = 17$
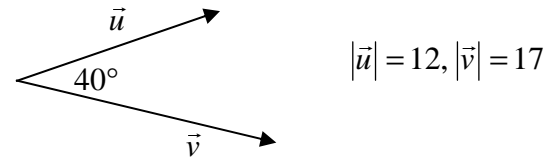
6. Given $\vec{x} = 2\hat{i} - \hat{j} + 5\hat{k}, \quad \vec{y} = (-1,2,2), \quad \vec{z} = (3,-2,4) \quad A(-1,3,4), \quad B(-3,2,7)$
   Find: a) $\vec{z} \times \vec{x}$ b) $(3\vec{x} - 2\vec{y}) \times (2\vec{x} + \vec{y})$

7. Find the work done if a force of 35 N in the direction of $\vec{r} = (4,-5,8)$ moves an object from G(1,7,-3) to H(5,3,-2).
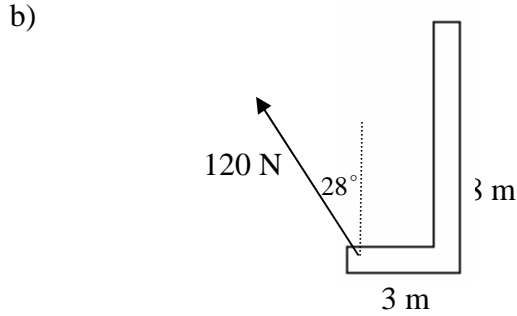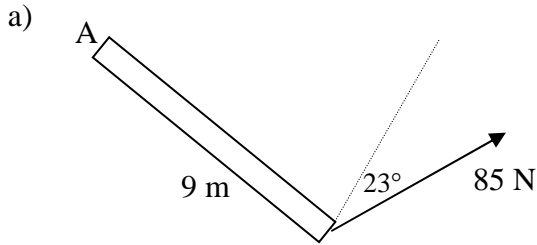
8. If $\vec{x} = (3t,-5,1)$ and $\vec{y} = (t+2,t+3,5)$, find all value(s) for t if $\vec{x} \times \vec{y} = (-29,-12,27)$.

9. Given $\vec{u} = (3,1,4)$ and $\vec{v} = (-2,-4,1)$, find the $Proj(\vec{u} \ onto \ \vec{v})$.

10. Find a unit vector $\perp$ to both $\vec{a} = (1,1,2)$ and $\vec{b} = (2,1,-2)$.

11. If $\overrightarrow{OA}, \overrightarrow{OB}, \text{ and } \overrightarrow{OC}$ are three edges of a parallelepiped where O is (0,0,0), A is (2,4,-3), B is (4,6,2), and C is (5,0,-2), find the volume of the parallelepiped.

12. Determine the magnitude of the moment of the force about the fixed point A for each of the following:

a)

9 m   23°   85 N

b)

120 N   28°   3 m

3 m