WS5 Vector Algebra (Addition, Subtraction and Scalar Multiplication)

*Remember*: Physical quantities ***can only be added or subtracted if they have the same dimension***. That is you can add a length to a length, a mass to a mass, a force to a force but you cannot add a speed to an acceleration, you cannot subtract a time from an area and so on.

When you **multiply (or divide)** physical quantities the **dimensions are also multiplied or divided**. For example if you divide a distance by a time the result will have dimension of distance/time (and units like m/s or km/h or mi/h).

With any operation it is much simpler if you first **make sure that units for each dimension match**.

1. Consider the following physical quantities and perform the operations below. (Include units)

 **v**o=4.0m/s [22o above –x] **a**=2.0m/s2 [77o below –x] t=3.0s

 a. 2**v0** b. **v0**t c. ½**a**t2 d. –**v0**

 e. Find the final velocity f. Find **d**=**v**ot + ½**a**t2

2. Consider the following physical quantities and perform the operations below. (include units)

 **v0**=3.0m/s south **v**=4.0m/s east t=2.0s

 a. **v0**t b. –**v0**  c. **v**+(-**v0**) d. **v** – **v0**

 e. Δ**v**  f. Find the acceleration. g. Find the average velocity

3. Consider the following physical quantities and perform the operations below. (include units)

 **A**=16N **x** **B**=-12N **y** **C**=38m [56o above –x]

 **D**=8.0m/s [14o above +x] **E**=2.0m/s2 [37o below +x] t=2.0s

 a. **A** + **B**  b. **B** + **A**  c. **A** – **B** d. **B** – **A**

e. **C** + **D** f. **D** + **E**t g. 2**D** – 3**E** + **A** h. **C**t – **A**

 i. **C** + **D**t

4. Consider the following vectors and perform the operations below (if possible).

 **A**=25N [36o above +x] **B**= 4.4m/s [67o below +x] **C**= 0.830km [13o W of S]

 a. 2**A** b. 7**B** c. 5**A**+**C** d. -2.25**B**

e. -10.00**C**  f. (4**C**)/44sg. (-3**A**)/52kg

5. Consider the following physical quantities below and complete the questions below (if possible).

 **v1**=6.0m/s East **v2**= 8.00m/s South t1=2.00s t2=12.00s

 m1=1.00x103kg m2=1.0x105 g **a1**=4.0m/s2 West **a2**=0.80m/s2 South

 a. Find **v1** + **v2**. b. Find **v2** + **v1**. c. Find **v1** – **v2**.

 d. Find **v2** – **v1**. e. Find **v1**+ **a1**. f. Find **v1** + **a1**t1

 g. If a car has an initial velocity of **v1** and accelerates to a final velocity of **v2**, what is the change in

velocity, ∆**v**? What is the average velocity $\overbar{v}$?

 h. If a car has an initial velocity of **v2** and accelerates to a final velocity of **v1**, what is the change in

velocity, ∆**v**? What is the average velocity $\overbar{v}$?

 i. If a car has an initial velocity of **v1** and accelerates to a final velocity of **v2** in a time t2, what is the

acceleration, **a**? What is the average velocity $\overbar{v}$? What is the displacement?

 j. Find m1**v1** + m2**v2**. k. Find **v2**t1 + ½**a1**t1. l. Find **v2**t1 + ½**a1**t12.