Mixed Exercise - 1

1.

Phiz is standing on a moving walkway in an airport.
The walkway is moving at a steady velocity of 1.50 m s^{-1}.
a)   Phiz starts to walk forwards along the walkway at 2.00 m s^{-1}.
     What is his resultant velocity?

Phiz then decides he is going the wrong way. He turns round
and starts to run at 3.40 m s^{-1} in the opposite direction to the
motion of the walkway. What is his new resultant velocity?

2.

Two tugs are pulling a ship into harbour. One tug pulls in a SE
direction. The other pulls in a SW direction. Each tug pulls with
a force of 8.0×10^4 N.   What is the resultant force on the ship?

3.

A man tries to row directly across a river.
He rows at a velocity of 3.0 m s^{-1}.
The river has a current of velocity 4.0 m s^{-1} parallel to the banks.
Calculate the resultant velocity of the boat.

4.

A boy kicks a ball against a wall with a horizontal velocity of 4.5 m s⁻¹.
The ball rebounds horizontally at the same speed.
What is the ball's change in velocity?

5.

A tennis player hits a ball at 10 m s⁻¹ at an angle of 30°
to the ground.
What are the initial horizontal and vertical components
of velocity of the ball?

6.

A water-skier is pulled up a ramp
by the tension in the tow-rope.
This is a force of 300 N acting
horizontally. The ramp is angled
at 20.0° to the horizontal.
What are the components of the force
from the rope acting (a) parallel to,
and (b) perpendicular to the slope?
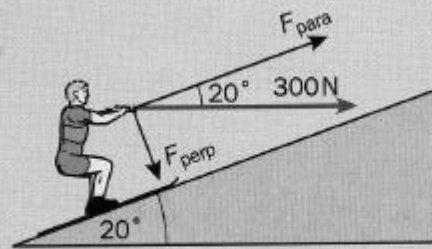
7.

1. Can you complete the following sentences?
   a) Measurements must be given as a number
      multiplied by a ....
   b) Seconds, metres and kilograms are all .... units.
      Units made up of combinations of base units are
      known as .... units.
   c) Vector quantities have both .... and ....
      Scalars have only ....
   d) The single vector that has the same effect as two
      vectors acting together is called the ....
   e) The effect of a vector in a given direction is called
      the .... in that direction.
   f) The .... of a vector in any direction is found by
      mutiplying the .... by the .... of the angle
      between the vector and the required direction.

2. a) What is the unit of force expressed in base units?
      What special name is given to this combination of
      base units?
   b) What is the unit of pressure expressed in base units?
      What special name is given to this combination of
      base units?

3. The drag force F, on a moving vehicle depends on its
   cross-sectional area A, its velocity v, and the density
   of the air ρ.
   a) What are the base units for each of these four
      variables?
   b) By checking for homogeneity, work out which of
      these equations correctly links the variables:
      i) $F = k \; A^2 \; \rho \; v$
      ii) $F = k \; A \; \rho^2 \; v$
      iii) $F = k \; A \; \rho \; v^2$
      (The constant k has no units.)

4. Rewrite each of the following quantities using a
   suitable prefix:
   a) 2 000 000 000 J
   b) 5900 g
   c) 0.005 s
   d) 345 000 N
   e) 0.000 02 m

5. In a tug-of-war one team pulls to the left with a force
   of 600 N. The other team pulls to the right with a
   force of 475 N.
   a) Draw a vector diagram to show these forces.
   b) What is the magnitude and direction of the
      resultant force?

6. Two ropes are tied to a large boulder. One rope
   is pulled with a force of 400 N due east. The other
   rope is pulled with a force of 300 N due south.
   a) Draw a vector diagram to show these forces.
   b) What is the magnitude and direction of the
      resultant force on the boulder?

7. A javelin is thrown at 20 m s⁻¹ at an angle of 45° to
   the horizontal.
   a) What is the vertical component of this velocity?
   b) What is the horizontal component of this velocity

8. A ball is kicked with a force of 120 N at 25° to the
   horizontal.
   a) Calculate the horizontal component of the force.
   b) Calculate the vertical component of the force.

8. The formula given below comes from the Newton's Law of Gravitation. In the formula F represents Force, m_1 and m_2 represent mass and r represents distance.

$$F = \frac{Gm_1m_2}{r^2}$$

Determine the SI unit of the quantity represented by the symbol G.