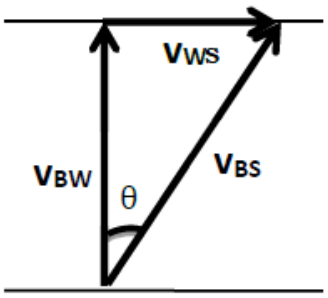
**SUVA SANGAM COLLEGE**

**YEAR 12**

**PHYSICS**

**WORKSHEET 5**

**STRAND 1 MECHANICS**

| NO. | **CONCEPT IN BRIEF: VECTORS**<br>**RELATIVE VELOCITY IN ONE DIMENSION**<br><br>$\boldsymbol{V_{AB} = V_{AC} + V_{CB}}$ |
|---|---|
| 1 | Tom walking along the road, heading west at 10km/h. A train runs parallel to the road and the train is passing by, travelling at 50km/h west. There is also a car driving by on the road, going 20km/h east.<br><br>Using a subscript Y for you, T for the train, and C for the car, we can resolve this using vector subtraction:<br><br>(i) How fast is the train travelling relative to you?<br>(ii) How fast is the car travelling relative to you?<br>(iii) How fast is the train travelling relative to the car? |
| | **CONCEPT IN BRIEF: VECTORS**<br>**RELATIVE VELOCITY IN TWO DIMENSIONS**<br><br>$\boldsymbol{V_{BS}{}^2 = V_{BW}{}^2 + V_{WS}{}^2}$<br><br>**CASE 1: BOAT PROBLEM**<br><br>• $V_{BW}$ → BOAT RELATIVE TO WATER<br>• $V_{WS}$ → WATER RELATIVE TO SHORE<br>• $V_{BS}$ → BOAT RELATIVE TO SHORE<br><br>  |

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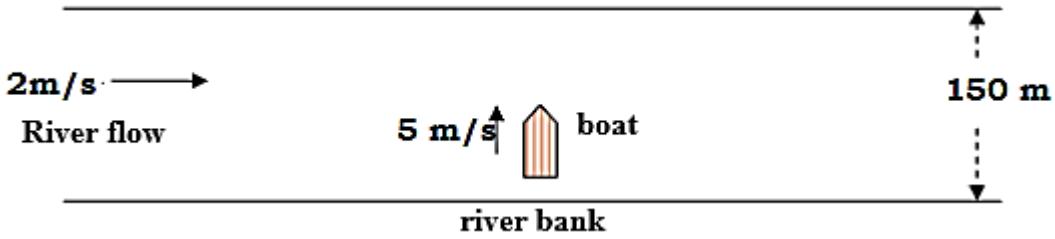
|---|---|
| 2 | A boat crosses a river at **5 m/s** relative to the water. The **150 m** wide river flows at **2m/s** as shown below<br>  <br><br>(i) What would be the velocity of the boat as observed by a stationary observer on the river bank from which the boat departed?<br>(ii) How long does the boat take to cross the river?<br>(iii) How far downstream is the boat taken by the river flow with reference to a point directly opposite where it started? |
| | **CONCEPT IN BRIEF: VECTORS**<br>**2. PLANE PROBLEM**<br><br>NOTE:<br>For aircraft, the true air speed (TAS) is the actual speed of the aircraft through the air (the speed of the aircraft relative to the air). The wind speed is usually measured relative to the ground. Groundspeed is the speed of the aircraft relative to the ground. The groundspeed of the aircraft is the vector sum of the true airspeed and the wind speed.<br><br>***Note:** if the angle between the two vectors being added together is other than 90°, **Cosine Rule** and **Sine Rule** can be used to solve the problem mathematically. Note also the use of the **compass** in the diagram to establish direction.* |
| 3 | The Auckland Airport in New Zealand is situated directly South of the Nadi International Airport in Fiji. A Pacific Airlines plane is flying with a velocity of 200 km/hr from Auckland Airport to Nadi International Airport.<br><br>(i) What is the velocity of the plane relative to a person standing at Auckland Airport watching the plane fly away?<br>(ii) What is the velocity of the plane relative to a passenger sitting on the plane? |