YEAR 12

PHYSICS (STAGE 3)

VECTORS TEST

Student's Name: _____ Tutorial Group: _____

Teacher's Name: _____ Date: _____

- A **scalar quantity** has magnitude only.
- A **vector quantity** has both magnitude and direction.

1. For each physical quantity listed in TABLE 1, can you indicate which quantity is a vector, and which is a scalar by printing either **V** for a vector or **S** for a scalar in the appropriate cell in the table?

TABLE 1: Which are Scalars? Which are Vectors?			
	Physical Quantity	**Scalar**	**Vector**
1	mass		
2	weight		
3	time		
4	temperature		
5	distance		
6	displacement		
7	speed		
8	velocity		
9	acceleration		
10	force		
11	kinetic energy		
12	potential energy		
13	momentum		
14	impulse		

[14 marks]

Suppose that you are a passenger, sitting at rest, on a school bus that is travelling West at 10.0 m s^{-1}.

2. What is your **speed** relative to the bus? _____ [1 mark]

3. What is your **speed** relative to the ground? _____ [1 mark]

4. What is your **velocity** relative the ground? _____ [2 marks]

- Graphically a vector is represented by an arrow, whose length gives the magnitude of the vector, and whose arrowhead gives the direction of the vector.

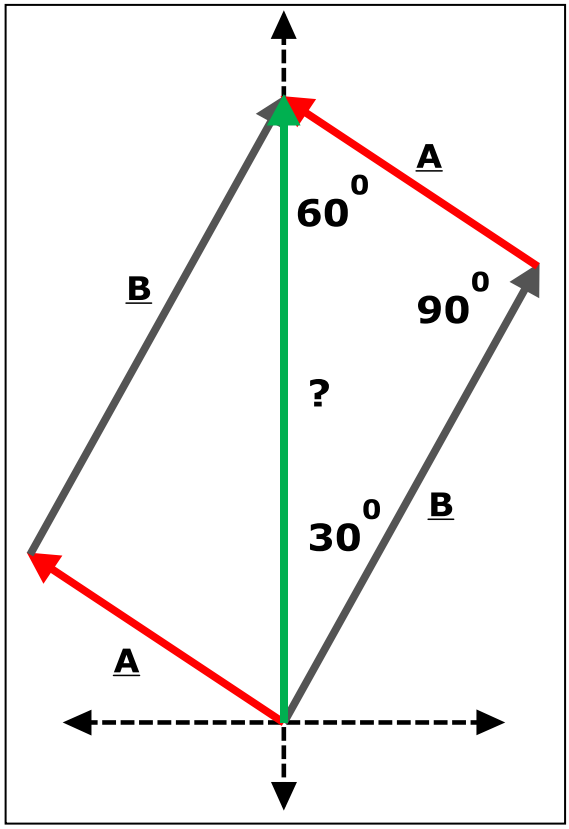
5. How would you **graphically** show the velocity of a school bus, which is travelling **West** at 10.0 m s $^{-1}$? [3 marks]

6. How would you **graphically** show the velocity of a school bus, which is travelling **East** at 10.0 m s $^{-1}$? [3 marks]

7. Can a velocity of 10.0 m s $^{-1}$ East be **mathematically** shown as – 10.0 m s $^{-1}$ West? You must fully explain your answer.

[3 marks]

Vector Addition (C = A + B)



- The **resultant** or vector sum of vectors **A** and **B** is a vector **C** whose effect on an object is equal to the combined effects of vectors **A** and **B** on that object.

8. How could you describe in words the unknown vector (**?**) in terms of vectors **A** and **B**?

[1 mark]

9. How could you describe **mathematically** the magnitude of the unknown vector (**?**) in terms of vectors **A** and **B**?

[2 marks]

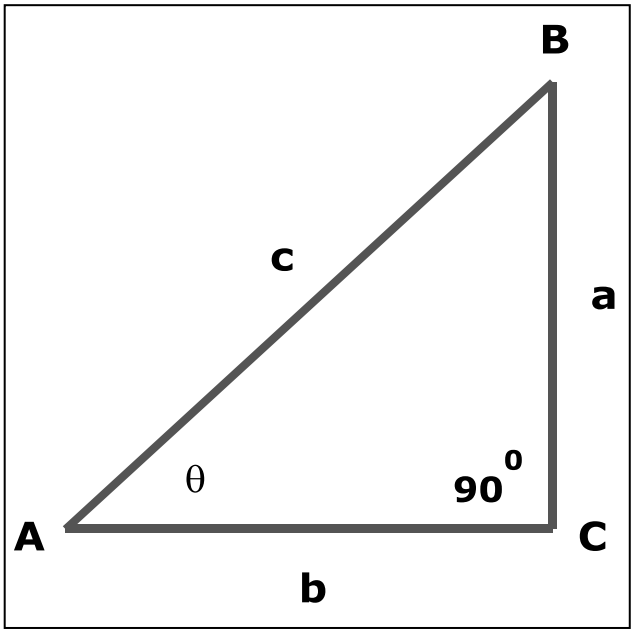
Does the **order of vector addition** affect either the magnitude or the direction of the resultant vector?

10. If vector **B** is added to vector **A** is the resultant obtained the same, as when vector **A** is added to vector **B**? You must fully explain your answer? HINT: Refer back to the **vector addition** diagram on Page 2.

[3 marks]

Trigonometric Formulas

For a right-angled Triangle



Pythagorean theorem

$c^2 = a^2 + b^2$

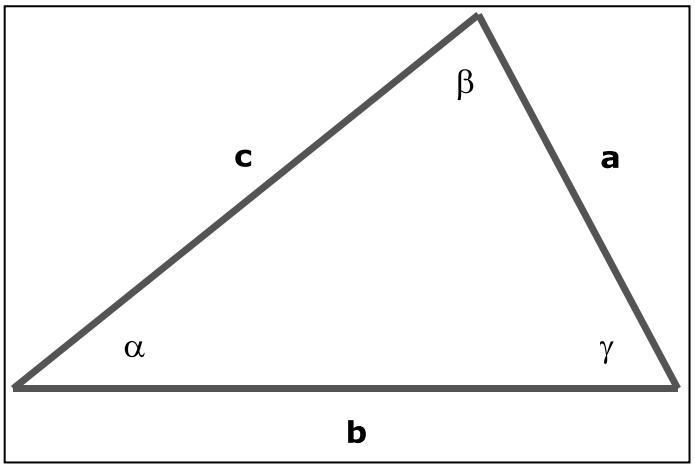
$\sin\theta = a / c$

$\cos\theta = b / c$

$\tan\theta = a / b$

$\tan\theta = \sin\theta / \cos\theta$

For any Triangle



Law of cosines

$c^2 = a^2 + b^2 - 2ab\cos\gamma$

Law of sines

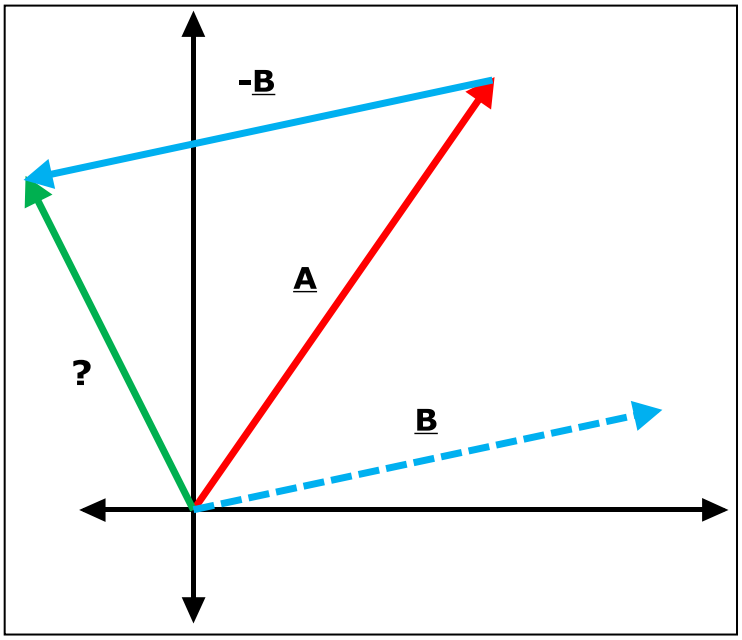
$\sin\alpha / a = \sin\beta / b = \sin\gamma / c$

11. If a bushwalker walks 6.5 km North East, then 4.5 km North, what is his/her resultant displacement? You must draw a **vector addition** diagram, with labelled arrows, in your solution to this problem.

[6 marks]

Vector Difference (<u>C</u> = <u>A</u> – <u>B</u>)

- The **difference** of vectors **<u>A</u>** and **<u>B</u>**, represented by **<u>A</u> – <u>B</u>** is best defined as the sum of **<u>A</u> + (– <u>B</u>).**



12. How is vector – **<u>B</u>** different from vector **<u>B</u>**?

[1 mark]

13. How could you describe **mathematically** the unknown vector (**?**) in terms of vectors **<u>A</u>** and **<u>B</u>**?

[1 mark]

14. How does **reversing the order of subtraction** of two vectors affect the vector difference? For example, how would the vector difference of **<u>A</u> – <u>B</u>** differ from the vector difference of **<u>B</u> – <u>A</u>**?

[1 mark]

- Change in velocity **(Δ v) = (v – u) = v + (– u)**; where **v** = final velocity, and **u** = initial velocity.

In a tennis match at the Kooyong Classic, a player receives a served ball that was travelling at 30 m s^{-1} South just before the ball hit his/her racquet. Immediately after leaving his/her racquet, the tennis ball is now travelling at 25 m s^{-1} North.

15. What **change in velocity** (magnitude and direction) did the receiving player give to the tennis ball? You must draw a **vector difference** diagram, with labelled arrows, in your solution to this problem.

[5 marks]

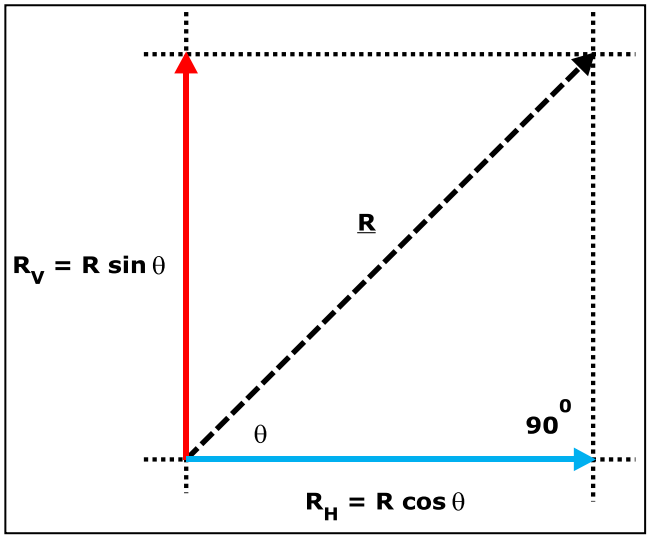
A cyclist travelling at 12 km h^{-1} East makes a right-hand turn at an intersection without changing speed.

16. What **change in velocity** (magnitude and direction) did the cyclist experience in making the right-hand turn? You must draw a **vector difference** diagram, with labelled arrows, in your solution to this problem.

[7 marks]

Resolution of a Vector

- **Resolution** is the process of splitting or resolving a single vector into its component vectors.



Consider a single vector **R** making an angle θ^0 with the horizontal.

Vector **R** can be resolved or split into two rectangular (at 90^0) component vectors:

Vertical component: $R_V = R \sin \theta$

Horizontal component: $R_H = R \cos \theta$.

The single vector **R** has been replaced by its two rectangular (at 90^0) component vectors R_V and R_H.

A gardener is pushing with a force of **150 N** on the handle of a lawn roller inclined at **40^0** to the ground.

17. What vertical downward force is exerted by the gardener on the lawn roller?

[2 marks]

18. What horizontal force is moving the lawn roller forward across the lawn?

[2 marks]

19. If the lawn roller has a weight of **303.6 N**, what is the total force pushing downwards on the lawn?

[2 marks]

[Total marks = 60]

Percent score =