PHY111 Term Test 1 SAMPLE TEST

Time: 2 hours Marks: 50

Question 1 (10)

1.1.1 Can the force vectors 4 N and 3 N have a sum of 5 N. Explain your answer with the aid of a sketch. *[Note: the same question would apply to vectors 8N and 6N having a sum of 10N – any ratio of a 3-4-5 triangle]* (3).

1.1.2 Under what conditions can the force vectors 3 N and 4 N have a sum of 8 N. Explain your answer with the aid of a sketch. (2)

1.2 A 20 kg box is standing at the bottom of an inclined plane. The coefficient of static friction between the surfaces of the box and the inclined plane is 0.15. The inclined plane makes and angle of 30 degrees with the horizontal. Can a 100N force applied to the box parallel to the inclined plane move the box up the inclined plane? Support your answer with a calculation. (5)

Question 2 (10)

2.1 Is the following statement "The car's speedometer indicate that its speed is 45 km.h^{-1}", correct or incorrect? Explain your answer. (2)

2.2.1 Can an object's acceleration be non-zero if its velocity is zero.

2.2.2 Give an example.

2.3.1 Draw a motion diagram for a dust particle that has reached terminal velocity *(i.e falling with a constant velocity)* . (2)

2.3.2 Draw a rough velocity-time graph depicting the settling of the dust particle to the ground. (1)

2.4 An object is projected straight up with an initial speed of 29,4 ms^{-1}. Without using equations of motion, calculate how long it will take to reach its maximum height. (3)

Question 3 (10)

3.1 A particle, at initial position $\vec{r}_i = (2\ \mathrm{m}, 180^0)$, undergoes two displacements, $\vec{\mathrm{A}}$ and $\vec{\mathrm{B}}$, to position P. $\vec{\mathrm{A}}$ and $\vec{\mathrm{B}}$ are given as follows: $\vec{A} = 3\ m\hat{\imath} + 6\ m(-\hat{\jmath})$ and $\vec{B} = 0\ m\ (\hat{\imath}) + 10\ m\hat{\jmath}$.

3.1.1 Determine the magnitude and direction of the particle's displacement. (3)

3.1.2 Determine the object's final position vector. Give your answer in polar form. (3)

3.3 A car travels in a straight line with an average velocity of 50 km.h^{-1}, west for 2 hours and then with an average velocity of 40 km.h^{-1}, west for 1 hour. What is the average velocity for the entire trip? (4)

Question 4 (10)

4.1 The equation relating the position, y and time, t of an object projected vertical upwards

$\vec{y}(t) = 3\ \text{m}\,\hat{j} + 5.0\ \text{m.s}^{-1}t\,\hat{j} + 4.9\ \text{m.s}^{-2}t^2(-\hat{j})$

4.1.1 What type of motion is the object undergoing? Explain your answer. (2)

4.1.2 Your classmate Evidence claims that at time t = 0.75 s the object is moving towards it starting point of motion. Do you agree with Evidence? Validate your answer with a calculation. (3)

4.2 Pat throws a ball straight upwards. At t = 0.0 s the ball is moving at 10.0 m.s^{-1} in the positive y-direction, it passes a signpost at y = 8.0 m. The ball's acceleration as a function of time is $a(t) = 6\ m.s^{-2} - 3.0\ t$ m.s^{-3}. Calculate how long it will take the ball to reach its maximum height. (5)

Question 5 (10)

5.1 Read the statement below and answer the questions that follow.

"The equation $\vec{r}_f = \vec{r}_i + \vec{v}\Delta t$ can be used to calculate the distance covered by a car undergoing uniform motion.

5.1.1 Do you agree or disagree with the statement. (1)

5.1.2 Give a reason(s) for your answer to question (5.1.1). (2)

5.2 A hot-air balloon moves vertically downwards at a constant velocity of 1,2 ms^{-1}. When it reaches a height of 22 m from the ground, a ball is dropped from the balloon. When the ball lands on the ground, it is in contact with the ground for 0,3 s and then it bounces vertically upwards with a speed of 15 ms^{-1}. Calculate how high the balloon is from the ground when the ball reaches its maximum height after the first bounce. (7)

Note on the memo:

1. *First calculate the time (t) for the ball to reach the ground (its initial velocity is 1.2m/s downwards)*
2. *Then calculate the time (t_{fb}) to reach the max height for the first bounce*
3. *You then calculate the total time the ball was in the air (t + 0,3s + t_{fb}) = 3.83s*
4. *Finally, you determine how far the balloon travelled downwards in this time, moving at a constant velocity of 1,2m/s.*