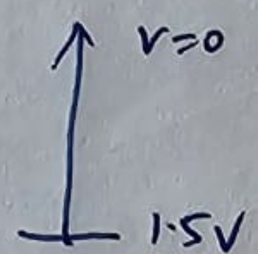
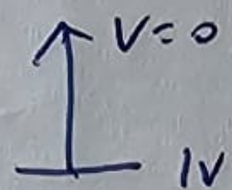
Q3.





$s_{bill} = \frac{1}{2}(1.5v + 0)t = \frac{1}{2} + \frac{3}{2}t = \frac{3}{4}tv$

This is a different time!!!

$s_{John} = \frac{1}{2}(1v)t = \frac{1}{2}tv.$

Q3.

Bill: $v^2 = u^2 + 2as_{Bill.}$

$0^2 = 1.5v^2 + 2as_{bill.}$

$s_{bill} = \frac{(1.5v)^2}{2a.}$

$\therefore s_{John} = \frac{(1.0v)^2}{2a.}$

$\therefore$ Ratio $= \frac{2.25v^2}{1.0v^2} = 2.25$

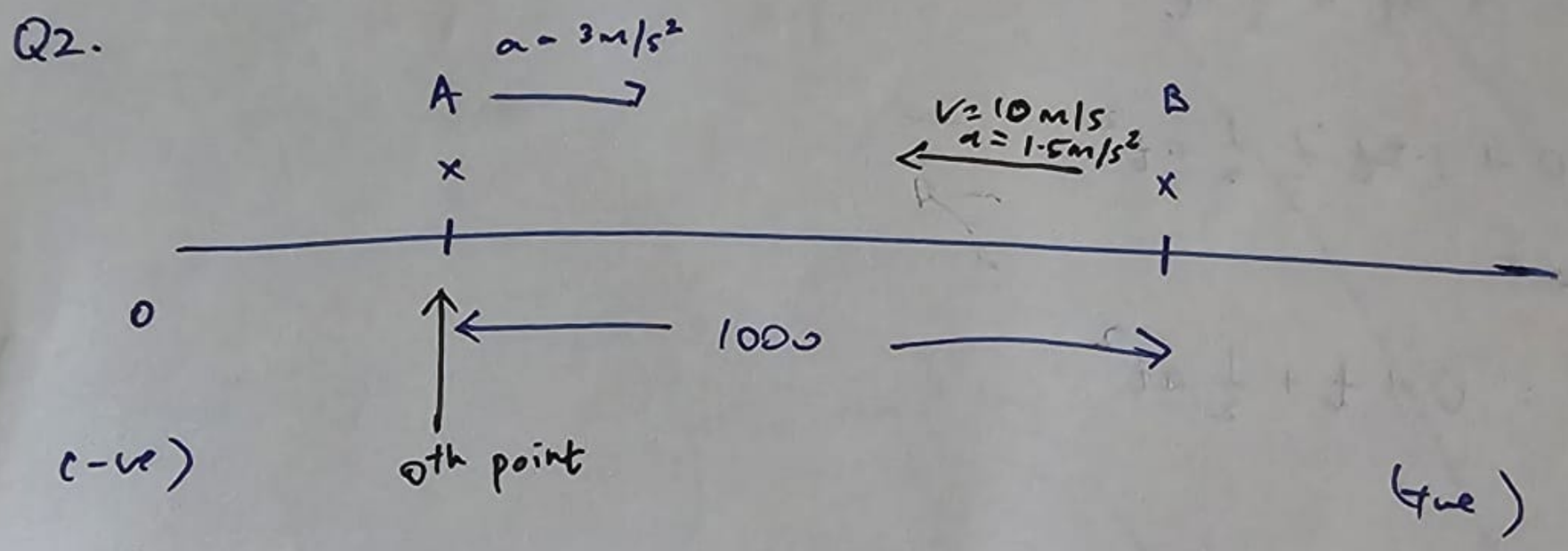
PC1201 : Tutorial 1

Q1. If $v=0$, a cannot be non-zero.

$$a = \frac{v-u}{t},$$

But question phrasing does not specify "velocity" is initial or final, so it is possible

Q2.



Displacement of A : $S = S_0 + ut + \frac{1}{2}at^2$

$$S = 0 + 0(t) + \frac{1}{2}(3)t^2$$

$$S = \frac{3}{2}t^2 \quad -(1)$$

Displacement of B : $S = 1000 - 10t - \frac{1}{2}(1.5)t^2$

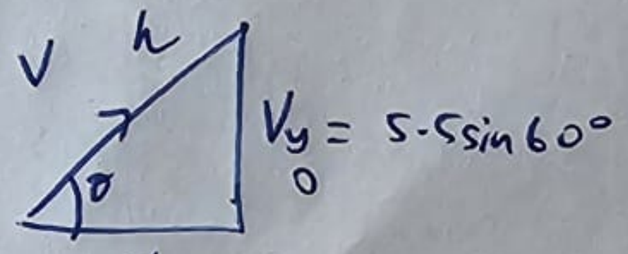
$$S = 1000 - 10t - \frac{3}{4}t^2 \quad -(2)$$

$\therefore$ (1) = (2)

$$2.25t^2 + 10t - 1000 = 0$$

$\therefore t = 18.97\,s$ or $-23.4\,s$ (rej)

Q5. $y = \tan$



$= 5.5\cos 60°$

$s = 4.4$

$4.4 = 0 + 5.5\sin 60\, t + \frac{1}{2}(-9.8)t^2$

$4.4 = 5.5 \times \frac{\sqrt{3}}{2} t - 4.9t^2$

$0 = 4.9t^2 - \frac{11\sqrt{3}}{2} t - 4.4$

$0 = t$

$t = 2.329\ s \quad$ or $\quad -0.385\ s.$

$\therefore V = u + at$

$= 5.5\sin 60 + 2.321 \times -9.8$

$=$

PC1201 Fundamentals of Physics

Semester-2, AY2023/2024

Tutorial 1

Week 3 and Week 4

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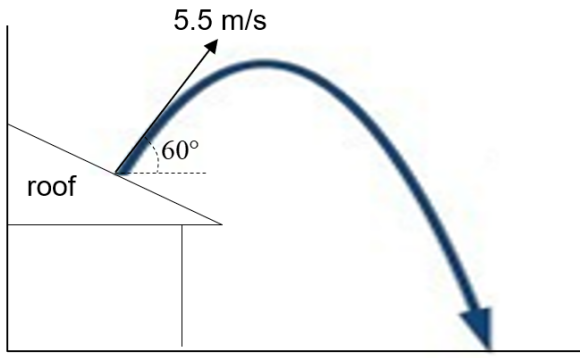
1. If the velocity of a particle is zero, can its acceleration be nonzero? Explain.

2. Two cars start from points **A** and **B** which are 1000 m apart on a straight horizontal road. The first car starts from rest from **A** and moves towards **B** with an acceleration of 3 m/s^2. The second car starts from **B** with a velocity of 10 m/s towards **A** and accelerates in the same direction at 1.5 m/s^2. Find the time when the cars pass one another. (18.98 sec)

3. Bill can throw a ball vertically up at a speed 1.5 times the speed of the ball thrown by John. What is the ratio of the two heights for the balls? (2.3)

4. The acceleration due to gravity in a 3D space is denoted as (0, 0, -9.8) m/s^2. A shell is fired from the point O. An aircraft flying with a velocity of (150, 150, 0) m/s is at the point whose position vector is (-500, 500, 1510) m with respect to point O when the shell is fired. If the altitude of the aircraft is maintained at 1510 m, and the firing angles in this question are denoted by 2 angles, namely (i) horizontal rotation angle in counter-clockwise direction from the *x*-axis of the artillery gun and (ii) elevation angle of the artillery gun in a vertical plane, find the initial speed and the firing angles of the shell if it strikes the aircraft after 10 seconds. (300 m/s, $\theta_{\text{Rotation}} = 63.43°$, $\theta_{\text{Elevation}} = 41.81°$)

5. A raindrop falls on a slanted roof and rebounds off with a velocity of 5.5 m/s at an angle 60° with respect to the horizontal as shown in the following figure. The maximum horizontal distance travelled by the raindrop is 4.4 m. Calculate the speed of the raindrop when it hits the ground. Assume that air resistance is negligible. Approximate the raindrop as a projectile. (11.26 m/s)



6. A small car with a spring cannon which is positioned vertically upward on the car runs down a slanted track so that it is constantly accelerating. When the car has accelerated a short distance of the slanted track it will fire a ball straight out of the cannon, and subsequently the car will be still accelerating without the ball. After the ball is fired, will it land ahead of, on top of, or behind the car? Why? Assume that the tilted track is long enough to receive the ball and the mass of the wheels is negligible. Neglect the air resistance.

- End -

Self-revision Questions
(These additional questions will not be discussed during the tutorial classes.)

7. A car, initially traveling east with a speed of 5 m/s, is accelerated uniformly at 2 m/s^2 east for 10 s along a straight line. During this 10-second interval the car travels a total distance of

   (A) 50 m (B) 60 m (C) 100 m (D) 150 m (E) 155 m

8. A child riding a bicycle at 15 m/s accelerates at 3 m/s^2 for 4 s. What is the child's speed at the end of this 4-second interval?

   (A) 12 m/s (B) 27 m/s (C) 3 m/s (D) 7 m/s (E) 8 m/s

9. Two vectors, **A** and **B**, are added together to form the vector **C** = **A** + **B**. The relationship between the magnitudes of these vectors is given by:

   $C_x = 0$

   $C_y = A \sin 60° + B \sin 30°$

   $\mathbf{A_x}$ and $\mathbf{A_y}$ point in the positive x and y directions, respectively.

   How does the magnitude of **A** compare with that of **B**?

   (A) $A = 0.7B$ (B) $A = B$ (C) $A = 1.7B$ (D) $A = 0.4B$ (E) $A = 0.5B$

10. A boat radioed a distress call to a Coast Guard station. At the time of the call, a vector **A** from the station to the boat had a magnitude of 45.0 km and was directed 15.0° east of north. A vector from the station to the point where the boat was later found is **B** = 30.0 km, 15.0° north of east.

    Ignore the curvature of the Earth in the small region. How far did the boat travel from the point where the distress call was made to the point where the boat was found?

    (A) 26.5 km (B) 65.3 km (C) 42.5 km (D) 54.0 km (E) 39.7 km

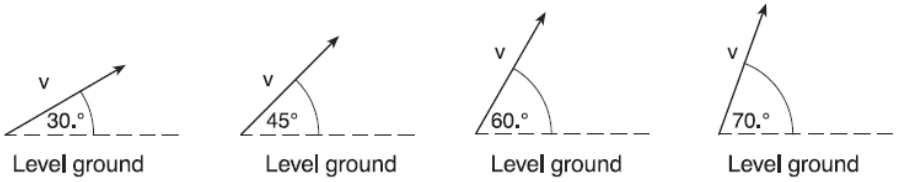
11. A rock is dropped from a bridge. What happens to the magnitude of the acceleration and the speed of the rock as it falls? [Neglect any friction.]

(A) Both acceleration and speed increase.
(B) Both acceleration and speed remain the same.
(C) Acceleration increases and speed decreases.
(D) Acceleration remains the same and speed increases.
(E) The answer is uncertain due to insufficient information.

12. A soccer ball kicked on a level field has an initial vertical velocity component of 15 m/s. Assuming the ball lands at the same height from which it was kicked, what is the total time the ball is in the air? [Neglect any friction.]

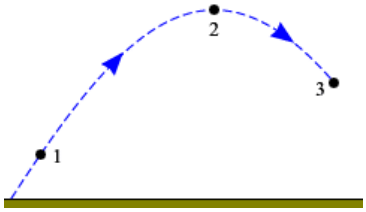
(A) 0.654 s (B) 1.53 s (C) 3.06 s (D) 6.12 s (E) 9.8 s

13. Four identical projectiles are launched with the same initial speed, *v*, but at various angles above the level ground. Which diagram represents the initial velocity of the projectile that will have the largest total horizontal displacement? [Neglect any resistance.] (only 4 choices for this question)



(A) (B) (C) (D)

14. The drawing shows projectile motion at three points along the trajectory. The speeds at the points are v1, v2, v3. Assume there is no air resistance. Rank the speeds at the 3 points from largest to smallest.



(A) v1 > v3 > v2
(B) v1 > v2 > v3
(C) v2 > v3 > v1
(D) v2 > v1 > v3
(E) v3 > v2 > v1

15. A player hits a ball from a height 1 m at an angle of 45° to the horizontal. A member of the opposing team, 21 m horizontally away, catches the ball at a height of 2 m from the ground. Find the initial speed of the ball and its greatest height above the ground. (14.7 m/s, 6.5 m)

Please put in your best effort. Thank you. - A/Prof Tay