

Student #: _____

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Physics 11 Homework Unit 2: Two-Dimensional Kinematics

1. A kayaker paddles upstream in a river at $3.5m/s$ relative to the water. Observers on shore note that he is moving at only $1.7m/s$ upstream. Determine the velocity of the current in the river.
 2. A canoeist paddles from Tobermory heading directly east. When there is no wind, the velocity of the canoe is $1.5m/s$. However, a strong wind is blowing from the north, and the canoe is pushed southwards at a rate of $0.50m/s$. Use vectors to calculate the resultant velocity of the canoe relative to shore.
 3. A hot-air balloon has drifted $60.0km$ [E 60.0° N] from its launch point. It lands in a field beside a road that runs in a north-south direction. The balloonists radio back to their ground crew to come and pick them up. The ground crew can travel only on roads that run north-south or east-west. The roads are laid out in a grid pattern, with intersections every $2.0km$. How far east and then how far north will the pickup van need to travel in order to reach the balloon?
 4. Sanna rolls a ball up to another person along a smooth ramp $19.6m$ above her. The ball reaches the other person's hands when it is travelling $4.9m/s$ uphill. If the ramp angle slows the ball down by $3.7m/s$ each second it travels up the ramp, find the initial velocity of the ball.

5. A car waits at a red light for a few seconds, and then accelerates straight ahead to 54km/h in 3.1s and then cruises at a constant speed for 75m . The road is straight. Find the total distance and time travelled.
 6. A young girl gives her toboggan a push of 4.0m/s up a hill. It slides up the hill slowing down at an acceleration of 8.0m/s^2 [down]. It comes to a stop and then slides back towards her speeding up at the same rate as it slowed down on the way up. If the girl has to run 48m down the hill from where it first was pushed to get to where her sled stopped, find the elapsed time for the journey.
 7. A porpoise jumps straight up and crashes back into the water at 8.9m/s . The drag and buoyancy forces of the water slow the porpoise down with an acceleration of -9.3m/s^2 as the porpoise finally slows to a stop. Find the depth the porpoise reaches.
 8. A jet-ski driver wants to head to an island in the St. Lawrence River that is 5.0km [W 20.0° S] away. If he is travelling at a speed of 40.0km/h and the river is flowing 6.0km/h [E].
 - (a) In what direction should he head the jet-ski?
 - (b) How long will it take him to reach the island?

9. Ahmad is driving North on Highway 69 at 90km/h and sees a large moose on the road. He quickly slams on his brakes, but his reaction time is 1.35s (this is fairly average for an adult, as he sees the moose, thinks about his response, and then presses the brake pedal). He presses the brake for 2.65s and comes to a stop just in time (also stopping time for a mid-size sedan).
- (a) Find the distance travelled after seeing the moose and before pressing the brake.
 - (b) Find the total distance he travelled before coming to a stop.
 - (c) Find the average acceleration once he presses the brake.
10. A newspaper delivery boy throws a newspaper towards a porch which is 1.25m below the height of his hand and 12m in front of him when he releases the paper. Given that he throws the paper with a velocity of 25.0m/s [horizontal], find:
- (a) the maximum height of the paper's trajectory
 - (b) the time it takes for the paper to reach the ground
 - (c) the acceleration when the paper is only 1m from the ground
 - (d) the horizontal range of the paper (does it make it to the porch?)
 - (e) the velocity at impact

11. An airplane with airspeed of 370km/h flies perpendicularly across the jet stream, with its nose pointed into the jetstream at an 32° from the direction of flight. What is the speed of the jetstream?

12. Fill in the following table. The first answer has been filled in for your reference.

Type of Graph	Read Directly from Graph	Rise (from one point to another)	Slope of tangent (of a curved line)	Slope of secant	Area between line and time axis	area/time
Position-Time	Position				n.a.	n.a.
Velocity-Time						

13. In each of the following you are asked to find the net displacement. Identify the most appropriate method of solution from the following and explain why it is appropriate. (Remember that “displacement” is a vector quantity with both a magnitude and a direction.)

- I. Scale diagram (using a ruler and a protractor)
- II. Pythagorean Theorem (simply applied to the vectors given)
- III. Use of a number line (assign positive and negative values and just add them)
- IV. Component method (break each vector down to its x - and y - components and then find the total x and y sums. These sums can then be reconfigured into a right triangle to solve with Pythagorean Theorem).
- V. Cosine or sine law (this is a more difficult mathematical solution required for non-right triangles).

(a) A fly on a wall crawls up 10cm and then back down 8cm .

(b) A plane travels 300km [S] and then 200km [S 31° E].

- (c) A pool ball on a table travels $1.2m$ [N], then $0.85m$ [E], then $1.3m$ [S], and then $0.95m$ [W].
- (d) A runner on a track runs $100m$ [forward] and then $50m$ [backwards].
- (e) A student in a classroom walks $3.0m$ [forward] and then turns right and walks $4.0m$ in that direction.
- (f) A whale on a migration route swims $1,250km$ [N 30° W] and then heads due North for $890km$.

14. If a soccer player runs for $55m$ in $22s$, the speed of the player is _____ m/s .

15. Which of the following is not an example of uniform motion?

- (a) A car travelling down a long, gently sloped highway at $100km/h$.
- (b) A very large boulder in the middle of a farmer's field.
- (c) A BASE jumper who has just plummeted off a cliff edge.
- (d) A train going uphill on a straight track at $30km/h$.

16. At the end of the school day, at exactly $2 : 30\text{pm}$, a group of students run out of the school building and reach the edge of the school property at $2 : 30 : 45\text{s}$. Which of the following correctly describes the motion in terms of time?
- (a) $\Delta t = 2 : 30$
 - (b) $t_1 = 2 : 30, t_2 = 45\text{s}$
 - (c) $t_2 = 2 : 30 : 45\text{s}, \Delta t = 45\text{s}$
 - (d) $t_1 = 0, t_2 = 2 : 30 : 45\text{s}, \Delta t = 45\text{s}$
17. A field hockey player runs 45m forward and then straight back 65m during a game. If we consider forward to be positive her displacement is _____ m and the distance travelled is _____ m .
18. The slope of a position-time graph is the:
- (a) displacement
 - (b) time interval
 - (c) velocity
 - (d) acceleration
19. The area under a position-time graph (area between the graph and the x -axis) is the:
- (a) displacement
 - (b) time interval
 - (c) velocity
 - (d) none of these choices
20. The slope of a velocity-time graph is the:
- (a) displacement
 - (b) average velocity
 - (c) speed
 - (d) acceleration
21. The area under a velocity-time graph is the:
- (a) displacement
 - (b) position
 - (c) average velocity
 - (d) acceleration
22. For any motion, the average speed is always _____ the average velocity.
- (a) equal to
 - (b) equal or greater than
 - (c) equal or less than
 - (d) less than
23. If a motorcycle with an initial velocity of 25m/s forward changes its velocity to 55m/s in 4.5s , the acceleration of the motorcycle is _____ m/s^2 (rounded to the first decimal place).