1.3 and 2.1 Review Problems for IB Physics SL1 (Cooper)
(Motion problems taken from Mr./Ms. Bobenreith)

Test preparation tips:

- 🎯 *Have a calculator (not smartphone) that you are very familiar with and use it all of the time. -*
- 🎯 *Complete these questions on separate paper. Spread out your work, show steps/formulas and box your answer(s).*
- 🎯 *Check your answers against a solution key to be provided in the next few days.*
- 🎯 *Study with friends and review past problem sets, warm up questions, homeworks.*
- 🎯 *Consult the extra online resources that your teacher has offered on the class website.*

Basic math skills: The Nido assumption is, that by the end of 10th grade, you are to be comfortable with scientific notation, converting between basic metric units, and understand that your answer should not be more precise than any measurements used to get that answer in a calculation (signficant digits).

1. Convert the following numbers to SI fundamental units (s, m, kg):
   a) 3231.2 ms b) 27.9 cm c) 729.8 g

2. Convert 34 km/day to m s-1 and then to cm hr-1 .
   Show your work so that a) you circle the conversion factors that you use, and
   b) you clearly show how the units cancel from the expression.

3. Convert the following to scientific notation: a) 0.003257 b) 123,000,000 c) 300.1

4. Convert the following to standard notation: a) 5.98×10^{6} b) 3.95×10^{-4}

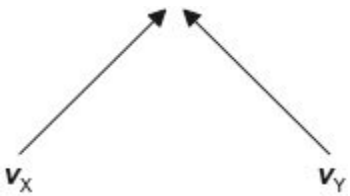
5. Identify the number of significant figures in each number:
   a) 0.0030400 b) 4000 c) 200.0 d) 6020

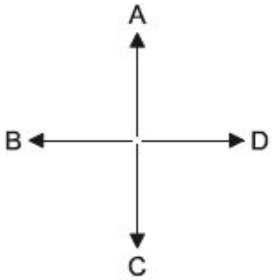
6. Perform the following computations and round to the correct number of sig figs:
   a) 32 + 1.23 = b) 1000.2 – 1.56 = c) 230 x 0.1 d) .03/123

1.3 Vectors and Scalars:

7. The velocities $\boldsymbol{v}_X$ and $\boldsymbol{v}_Y$ of two boats, X and Y, are shown.

Which arrow represents the direction of the vector $\boldsymbol{v}_X - \boldsymbol{v}_Y$?





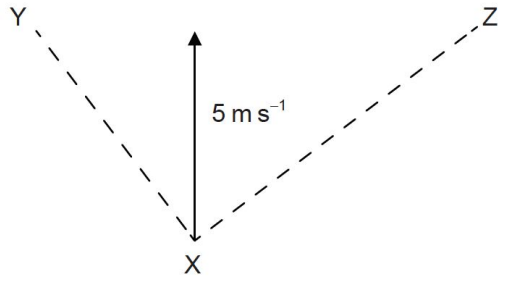
8. Which of the following is a scalar quantity?

A. Velocity B. Momentum C. Kinetic energy D. Acceleration

9. Which is a vector quantity?

A. Pressure B. Electric current C. Temperature D. Magnetic field

10. A velocity of 5 m s^{-1} can be resolved along perpendicular directions XY and XZ.



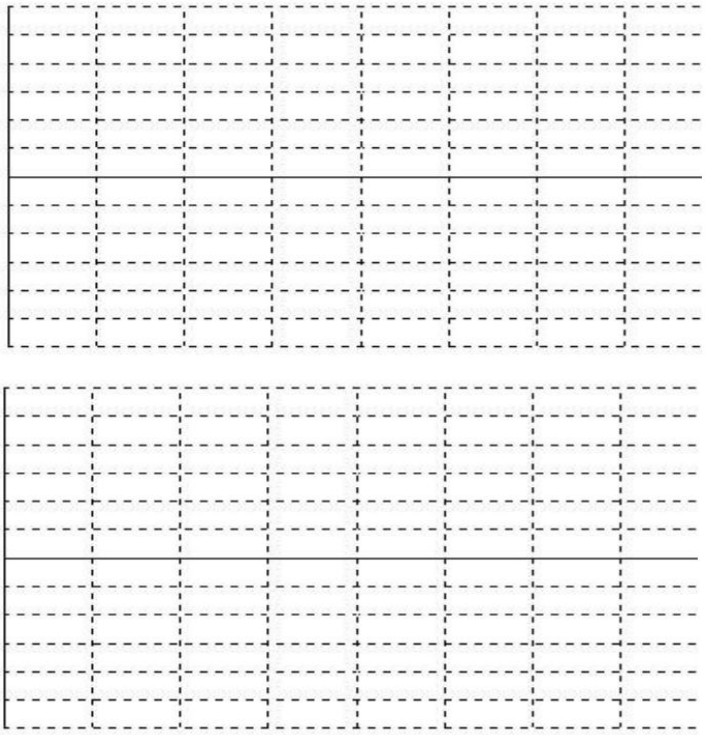
The component of the velocity in the direction XY is of magnitude 4 m s^{-1}. What is the magnitude of the component in the direction XZ?

A. 4 m s^{-1} B. 3 m s^{-1} C. 2 m s^{-1} D. 1 m s^{-1}

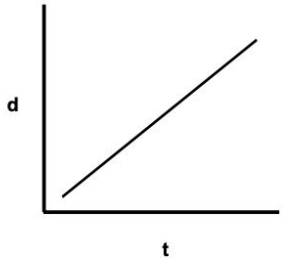
Graphical analysis:

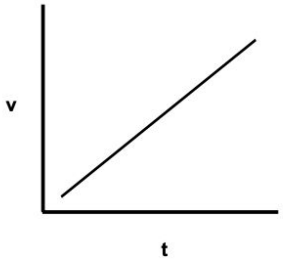
11. Calculate the average velocity for each increment of data shown below. Then make a plot of position v. time and velocity v. time for the entire duration. Describe the motion as specifically as you can over the entire 10 seconds. Differentiate as needed throughout.

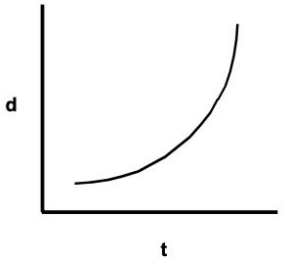
Time (s)	Position (m)	Average Velocity (m/s)
0	1.5	
1	3.0	
2	4.5	
3	6.0	
4	7.5	
5	9.0	
6	11.0	
7	13.5	
8	16.5	
9	20.0	
10	24.0	

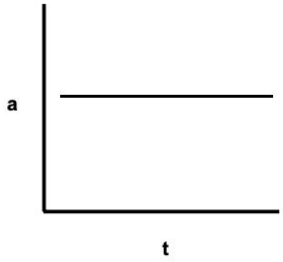


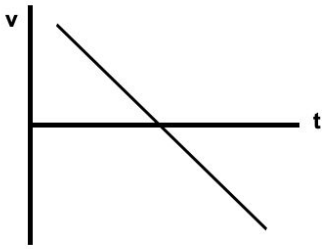
12. For each of the graphs shown below describe whether the motion is constant velocity, constant acceleration, or neither. Also, list what kinematic term the slope corresponds to, and what kinematic term the area under the graph gives.











SUVAT Problems:

13. Feeling mischievous, Mr. Bob sneaks into a room that overlooks the Courtyard, opens a window, and drops a textbook so that it falls into the courtyard. Assuming air resistance is negligible, determine the velocity and displacement of the book for the times indicated below:

Time (sec)	Velocity (m/s)	Displacement (m)
0		
0.5		
1.5		

14. An airplane starts from rest and accelerates at a rate of 20.0 m/s/s as it travels down a runway. The runway is 250 meters long. What is the airplane's speed when it reaches the end?

15. A skateboarder traveling along Powell St. is coasting at an initial velocity of 3.0 m/s. They accelerate uniformly for 2.0 seconds until they reach a final velocity of 11.0 m/s.

a. What is the skateboarder's acceleration for that 2-second period?
b. What is the skateboarder's displacement during that 2-second period?

16. Luci punts a soccer ball vertically in the air. It departs her foot with a speed of 18.0 m/s. Assume air resistance is negligible.

a. How much time does the soccer ball take to reach the highest point?
b. What is the maximum displacement the soccer ball reaches?
c. What is the total time the soccer ball is in the air?
d. What is the speed of the soccer ball just as it returns to the original spot where it left Luci's foot?

Harder Problems:

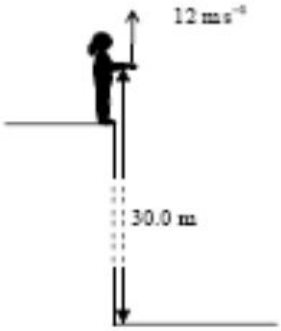
17. A cyclist starts at rest at time t_0 and uniformly accelerates at 0.2 m/s/s for 30 seconds. At that time (t_1) the cyclist coasts at a constant velocity for 2 seconds. She then applies the brakes (t_2 and uniformly slows down, stopping in 3.0 meters.

a. Sketch the position v. time, velocity v. time, and acceleration v. time graphs for the motion.
b. What is the cyclist's velocity after the first 30 seconds?
c. What is the cyclist's displacement for the entire time?

18. A car with an initial speed of 20 m/s has a maximum braking capacity that allows it to stop in 12 meters. If the car's initial speed is 40 m/s, what is the new minimum stopping distance?

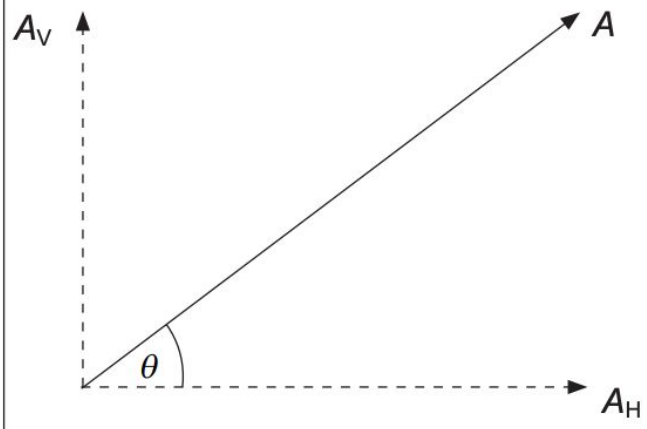
19. A girl stands on the edge of a vertical cliff and throws a stone vertically upwards. The stone eventually lands in the sea below. The stone leaves her hand with a speed of 12 m s−1 at a height of 30.0 m above the sea. Ignoring air resistance, determine the following:

a. the maximum height, measured from sea-level, reached by the stone.
b. the time that it takes the stone to hit the sea after leaving the girl's hand.



20. Starting from rest, a ball rolls down a long incline with a constant acceleration. After 3 seconds, it has traveled 18.0 cm. Between 3 seconds and 4 seconds, how far will it travel?

Sub-topic 1.3 – Vectors and scalars



$A_H = A\cos\theta$

$A_V = A\sin\theta$

Sub-topic 2.1 – Motion

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

$s = \frac{(v+u)t}{2}$

mega	M	10^6
kilo	k	10^3
hecto	h	10^2
deca	da	10^1
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}