PHYSICS 11

# ACCELERATION

Notes

- Acceleration is the rate of change in velocity.
- Recall that velocity is also a rate of change. As velocity is a rate of change in displacement, acceleration can be viewed as a rate of change in a rate of change. This brings some complexities that can seem counterintuitive.
- To complicate things even further, acceleration in rarely constant and it keeps changing over time. Thus, there is another physical quantity that can measure the rate of change in acceleration. To simplify scenarios for high school physics, we will always assume that acceleration is constant when solving word problems.

**Symbol:** $\vec{a}$

**Units:** $m/s^2$ ; $km/h^2$

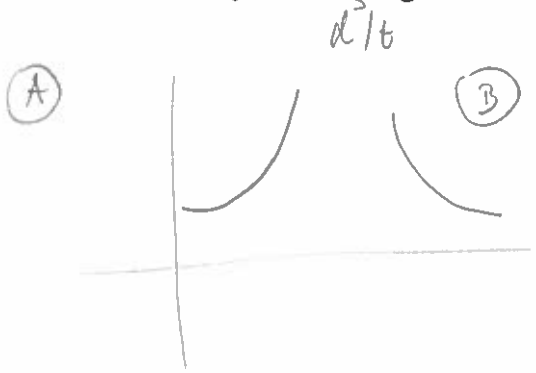
**Formula:**

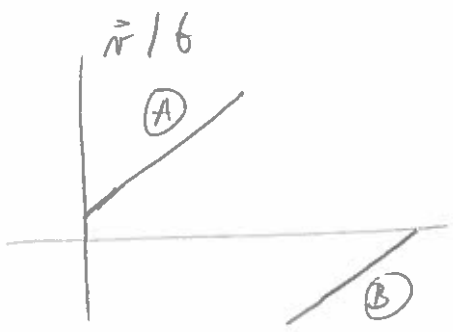
- $\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_f - \vec{v}_i}{t_f - t_i}$
- $\frac{d - v_i t}{\frac{1}{2} t^2} = a$
- $\vec{a} = \frac{2(d - v_i t)}{t^2}$
- $\frac{v_f^2 - v_i^2}{2d} = a$

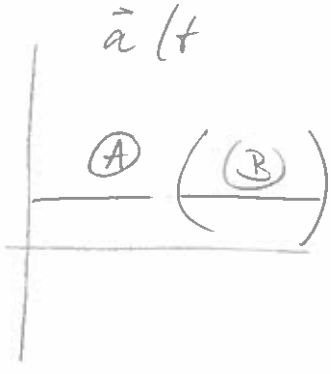
**Positive acceleration**

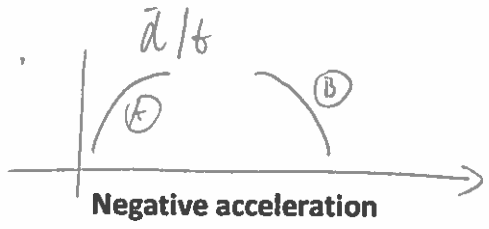
A – An object is speeding up in positive direction

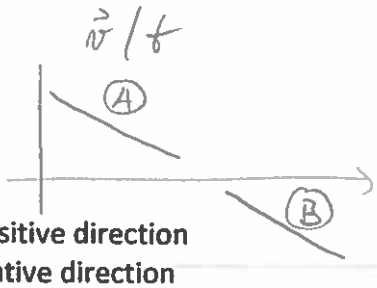
B – An object is slowing down in negative direction

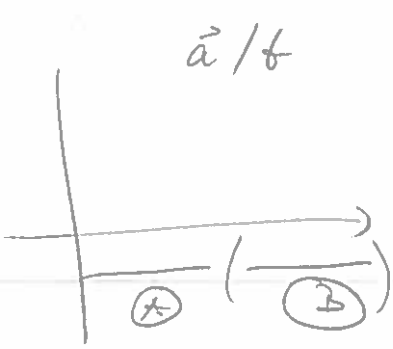




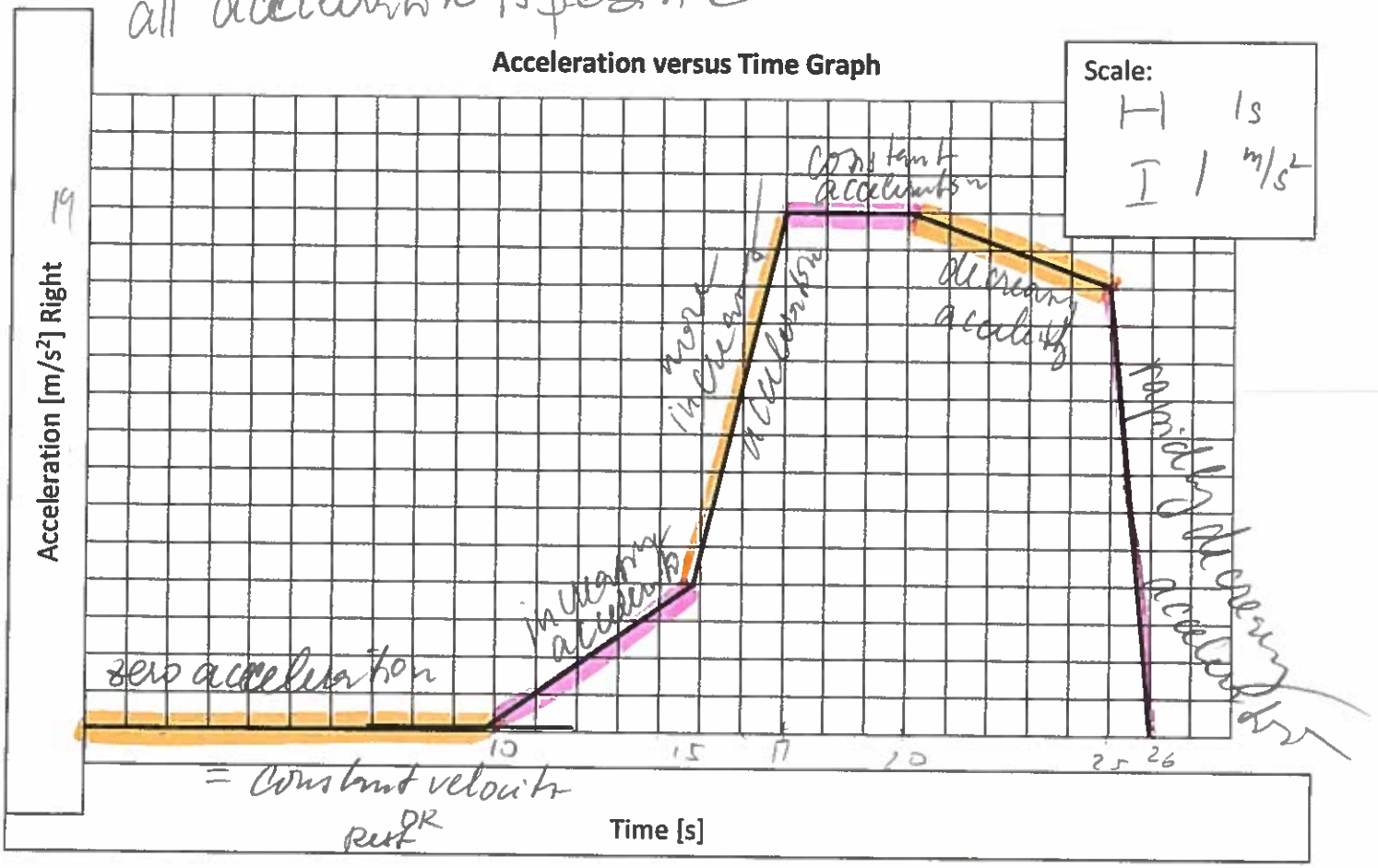

**Negative acceleration**

A – An object is slowing down in positive direction

B – An object is speeding up in negative direction

all acceleration positive

**Acceleration versus Time Graph**




**Describe the motion of the object based on an acceleration vs. time graph.**

**What information about the object's motion is lost?**

→ initial and final position; velocity

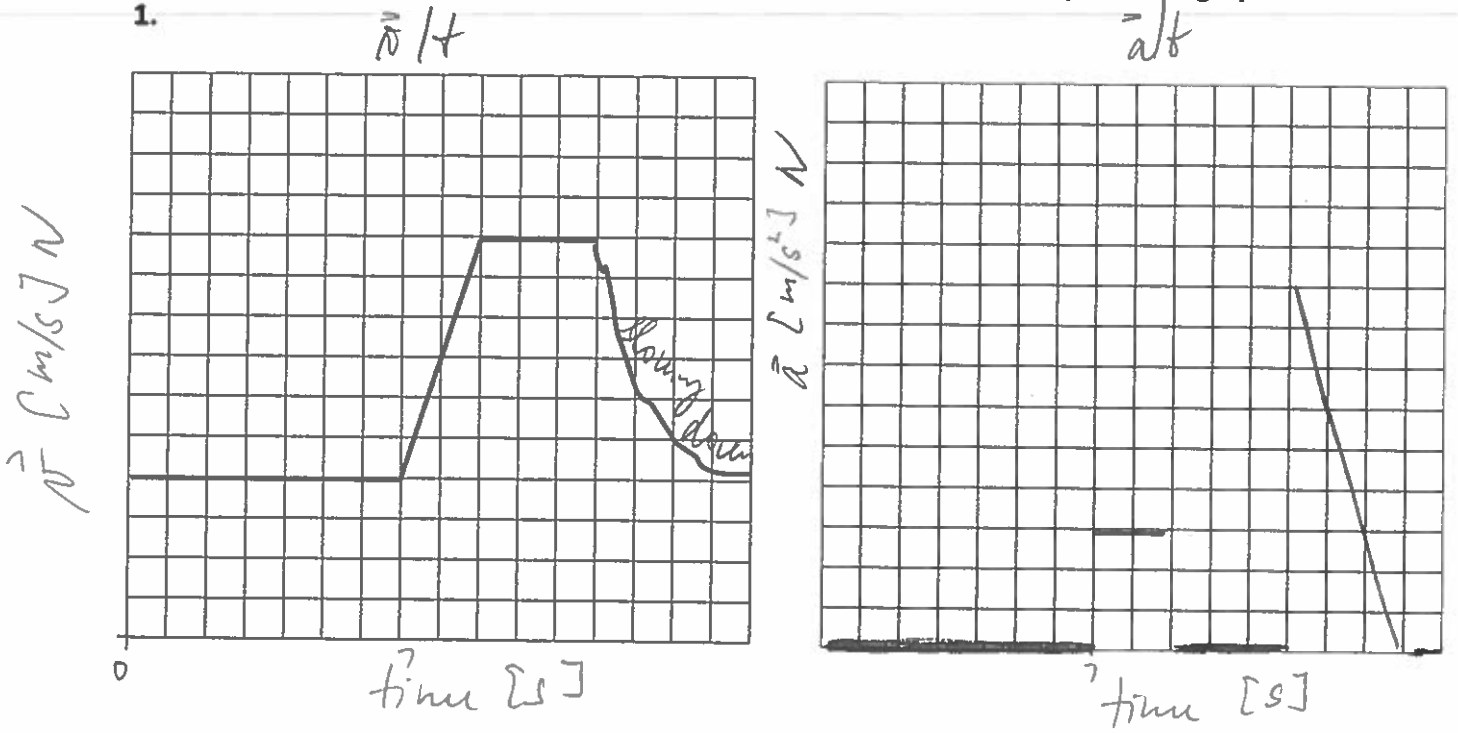
**When is the object experiencing uniform motion?**

↳ zero acceleration

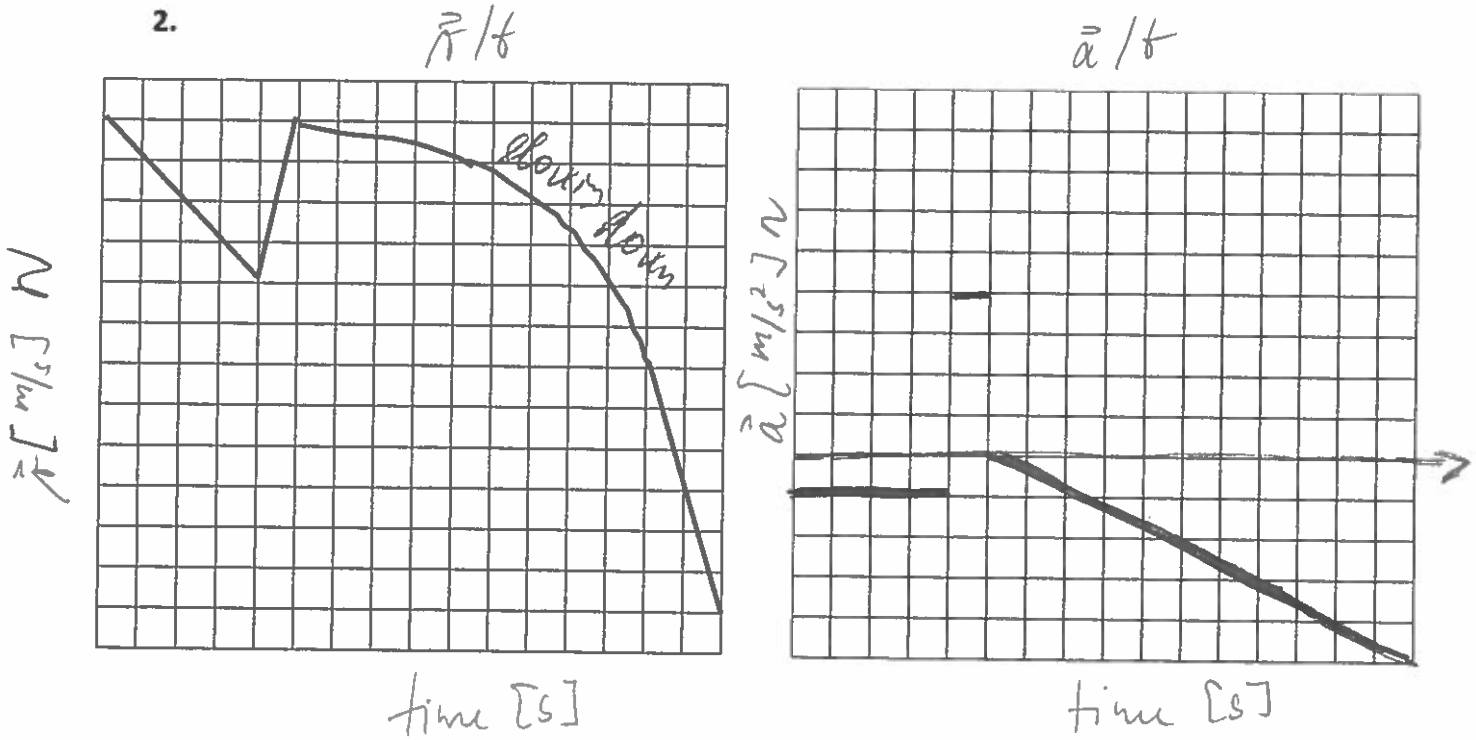
$t = [0, 10)$ s

**Sketching an acceleration vs. time graph based on a velocity vs. time graph**

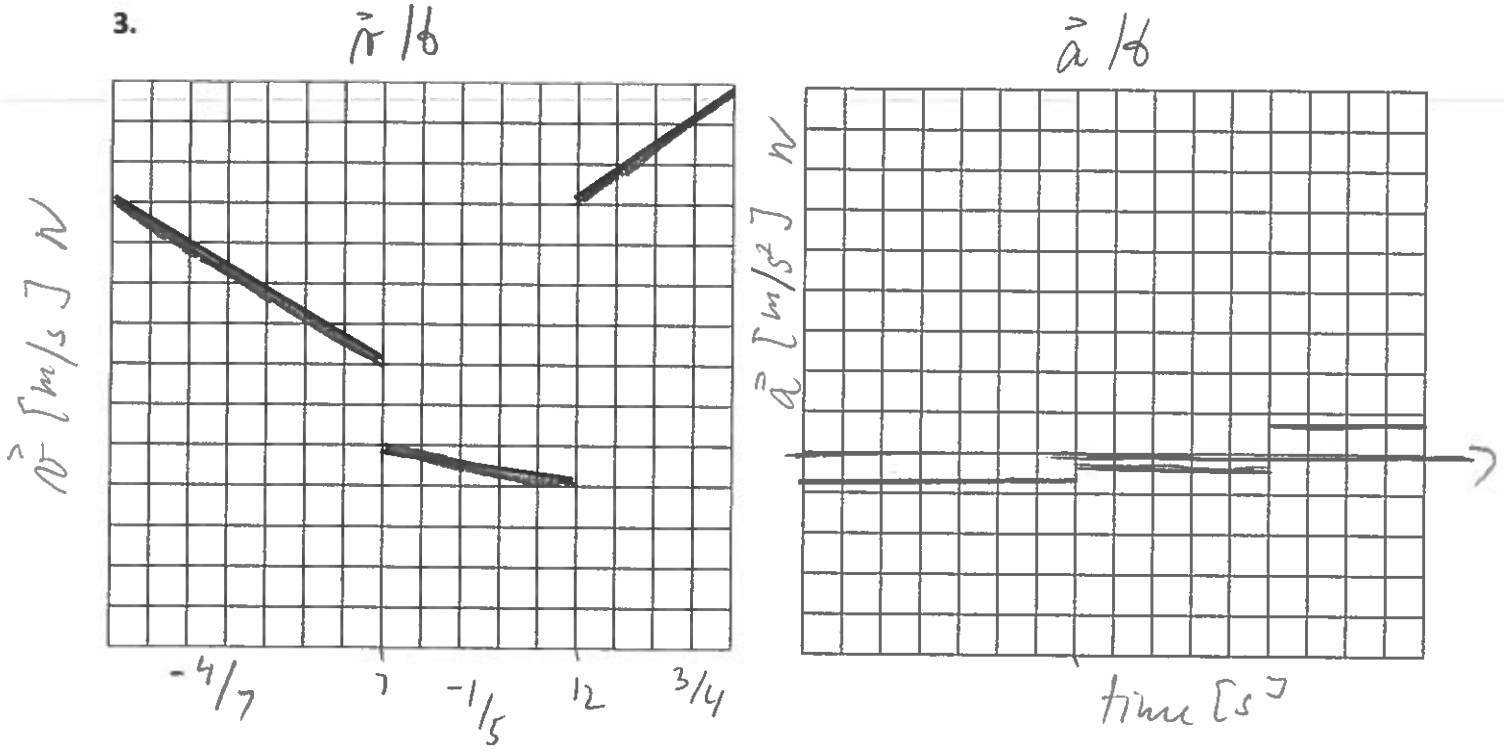
**1.**



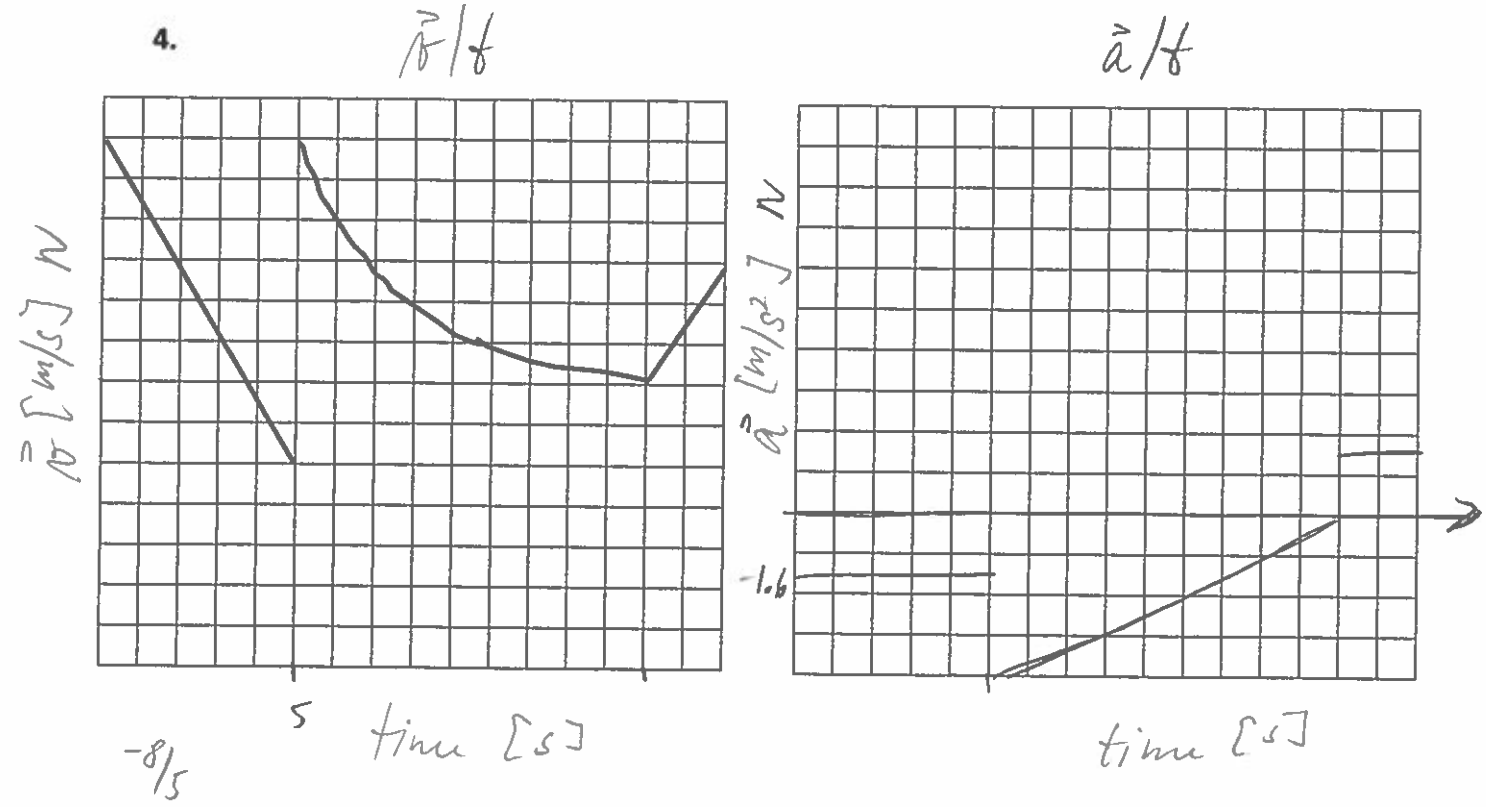

**2.**



**3.**


$\vec{r}$ /t
$\vec{v}$ [m/s] N
-4/7
1
-1/5
1/2
3/4
$\vec{a}$ /t
$\vec{a}$ [m/s²] N
time [s]

**4.**


$\vec{r}$ /t
$\vec{v}$ [m/s] N
5
-8/5
time [s]
$\vec{a}$ /t
$\vec{a}$ [m/s²] N
-1.6
time [s]