Name: ______________________________ Block: __________

Key

PART 2 (iii) – You may use a calculator for this section.

INSTRUCTIONS:

- SHOW ALL WORK REQUIRED TO SOLVE THE PROBLEMS
- PROVIDE ANSWERS WITH APPROPRIATE UNITS
- PROVIDE ANSWERS WITH APPROPRIATE SIGNIFICANT DIGITS
- DRAW A BOX AROUND YOUR FINAL ANSWER TO EACH PROBLEM TO CLEARLY INDICATE IT AS YOUR SOLUTION

1. The graph below depicts the ***position vs time*** for a child playing in a park.
   a. Determine the average velocity for the child from t = 0.0s to t = 70.0s.

   $\bar{v} = \frac{v_f - v_i}{\Delta t} = \frac{17.2m - 0m}{70.0s} = \boxed{0.25 m/s}$

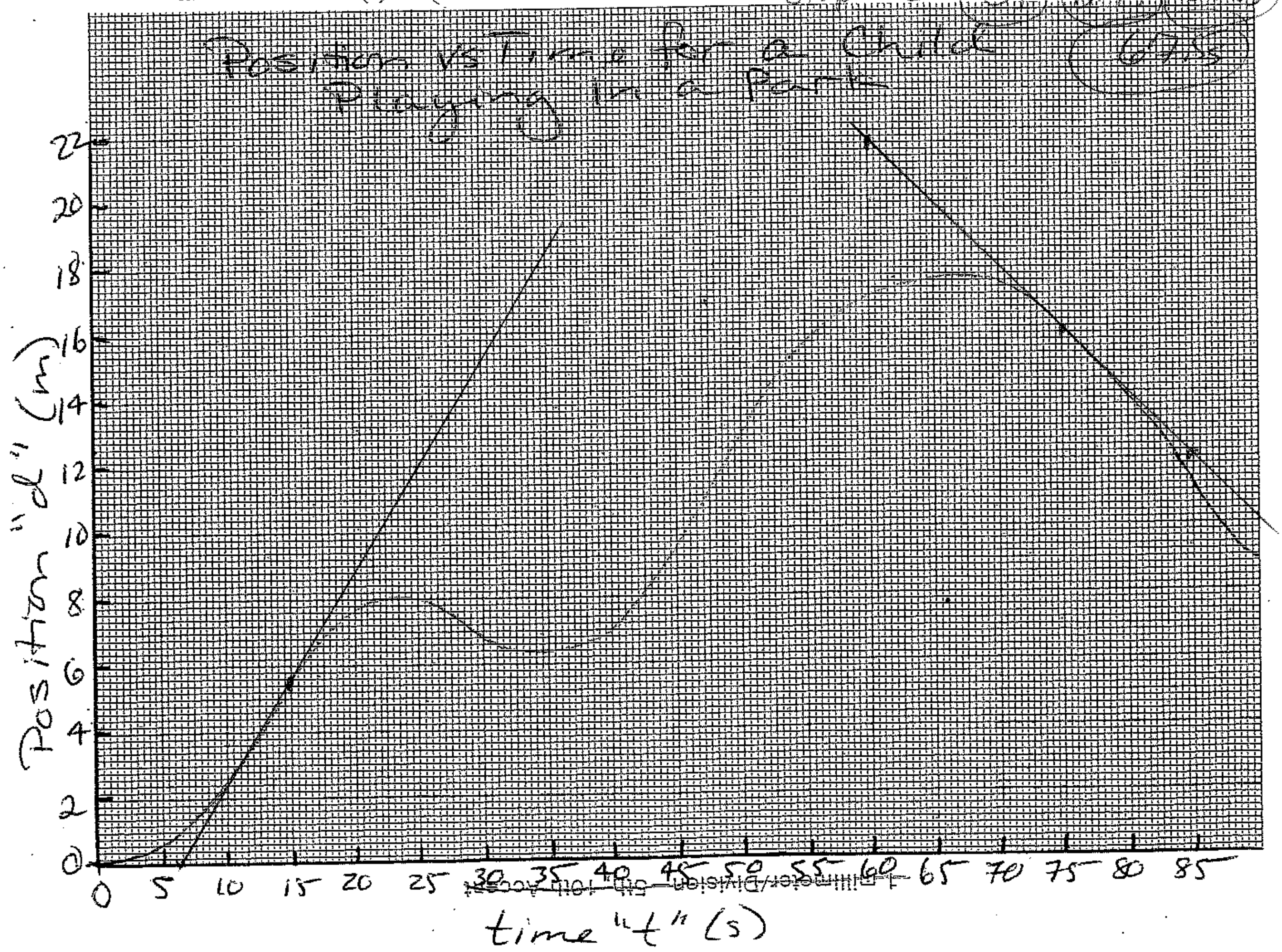
   b. Determine the instantaneous velocity for the child at t = 15.0s

   $\vec{v}$ = slope of tangent = $\frac{d_f - d_i}{t_f - t_i}$ = $\frac{15.2m - 0m}{30.0s - 6.5s} = \boxed{0.65 m/s}$

   c. Determine the instantaneous velocity for the child at t = 75.0s

   $\vec{v} = \frac{d_f - d_i}{t_f - t_i} = \frac{12.6 m/s - 21.8 m/s}{85.0s - 60.0s} = \boxed{-0.37 m/s}$

   d. At what time(s) is the child instantaneously at rest? slope = 0 (0s) (24s) (34.5s) (60.5s)



2. The graph below depicts the ***velocity vs time*** for a particle.

a. What is the acceleration of the particle at t = 16.0s?

Slope = 0 ∴ $\boxed{\vec{a} = 0\,m/s^2}$

b. Determine the displacement of particle over its entire motion (t = 0.0s to t = 18.0s).

Δd = area under the curve

$= \frac{1}{2}(48.5\,m/s + 13.0\,m/s)(6.8s) + \frac{1}{2}(13.0\,m/s + 7.5\,m/s)(12.5s - 6.8s) + (7.5\,m/s)(18s - 12.5s) = \boxed{3.1 \times 10^2\,m}$

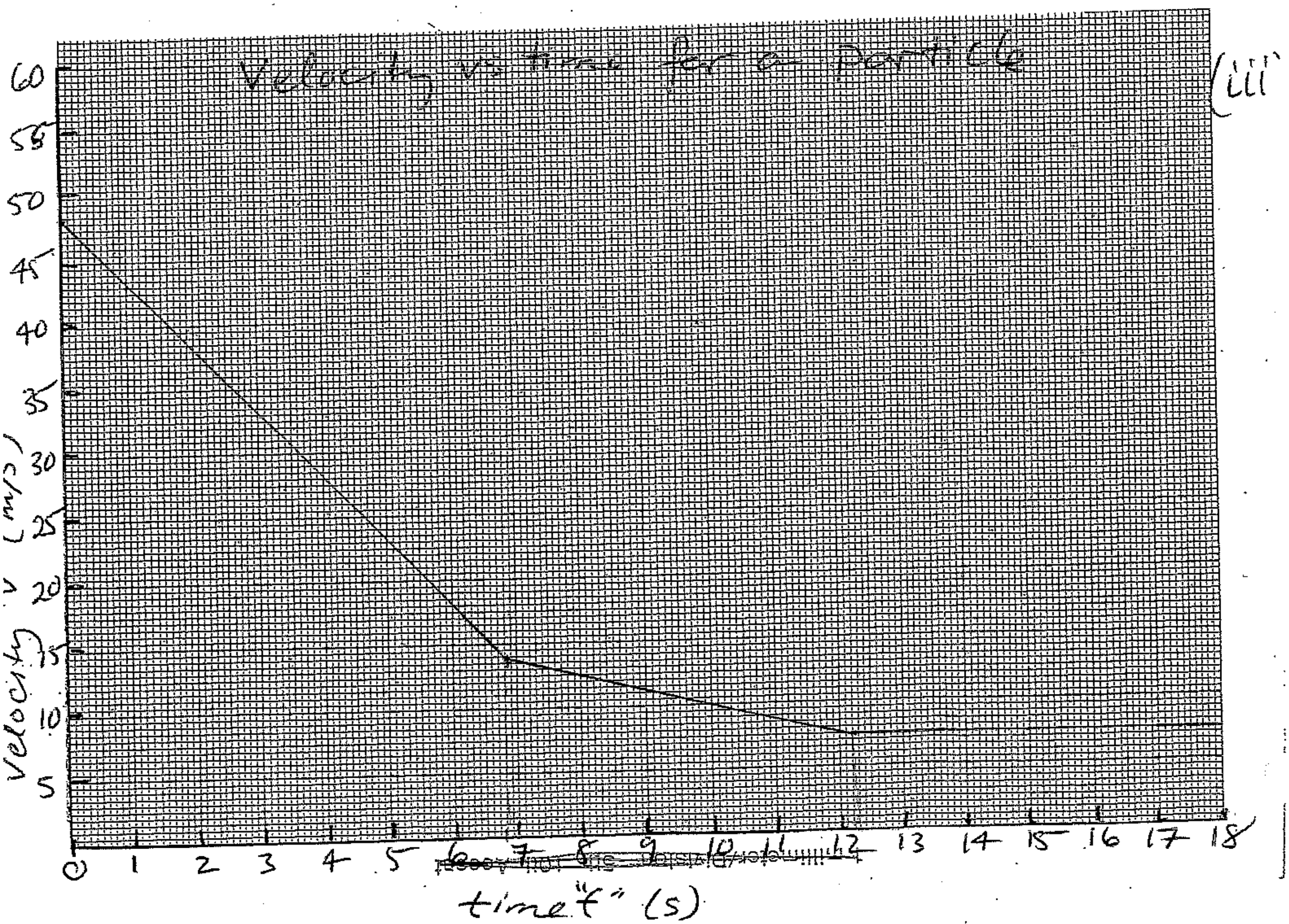
c. Write the equation for the portion of the graph from t = 0.0s to t = 6.8s (the equation is in the form $y = mx + b$).

m = slope $= \frac{v_f - v_i}{\Delta t} = \frac{13.0\,m/s - 48.5\,m/s}{6.8s} = -5.2\,m/s^2$

b = y-intercept = 48.5 m/s

$y = mx + b$ $\quad y = v$, $x = t$

$\boxed{v = (-5.2\,m/s^2)\,t + 48.5\,m/s}$



(not speed!)

3. A man walks for 15 minutes toward the south, at a speed of 3.0 m/s. Their friend happens to be driving north along the same road and picks them. They drive north to a restaurant 1.5 km away, driving at an average speed of 45.0 km/h. What is the average velocity of the man for the entire journey?

$t_2 = \frac{1500}{45/3.6}$, $t_2 = 120s$

$V_{ave} = \frac{\text{total displacement}}{\text{total time}} = \frac{\vec{v}_1 \times t_1 + \vec{v}_2 t_2}{t_1 + t_2}$

$V_{ave} = \frac{(-3.0\,m/s)(15 \times 60s) + 1500m}{(15 \times 60s) + 120s} = -1.2\,m/s$

1.2 m/s [South]

4. A car is moving at a constant velocity when it is involved in a collision. The car comes to rest after 0.450s with an average acceleration of 65.0 m/s^2 in the direction opposite that of the car's velocity. What was the speed of the car before the collision?

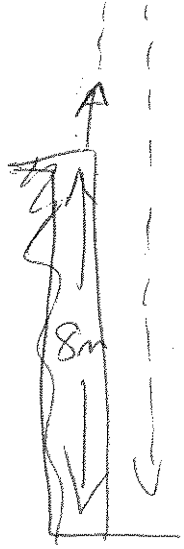
$v_i = ?$
$a = -65.0\,m/s^2$
$t = 0.450s$
$v_f = 0$

$v_f = at + v_i$

$\therefore v_i = v_f - at = 0 - (-65\,m/s^2)(0.450s)$

$v_i = +29.2\,m/s$

5. A tennis ball was shot vertically upward from the edge of a cliff on the surface of an atmosphere-free planet (not Earth!) with an initial speed of 20.0m/s. One (1.00) second later, the ball had an instantaneous velocity of 15.0 m/s in the upward direction.



a. What is the magnitude of the acceleration due to gravity on the surface of this planet?

$v_i = 20.0\,m/s$
$t = 1.00s$
$v_f = +15.0\,m/s$
$a = ?$

$a = \frac{v_f - v_i}{\Delta t} = \frac{15.0 - 20.0}{1.00}$

$a = -5.00\,m/s^2$

b. How high did the ball rise above the edge of the cliff?

$v_f = 0.0\,m/s$
$\Delta d = ?$

$v_f^2 = 2a\Delta d + v_i^2$

$\Delta d = \frac{v_f^2 - v_i^2}{2a} = \frac{0 - (20.0\,m/s)^2}{2(-5.00\,m/s^2)}$

when it stops → $\Delta d = 40.0m$

If you assume Δd at $t = 1.00s$ …

$\Delta d = \frac{1}{2}at^2 + v_i t = \frac{1}{2}(-5)(1)^2 + (20)(1)$

$\Delta d = 17.5m$

c. On the way down, the ball landed at the base of the cliff, 8.0 meters below the level from which it was originally shot. How long (time) was the ball in flight (from the time it was shot until the instant before it landed)?

$\Delta d = -8.0m$
$a = -5.00\,m/s^2$
$v_i = 20.0\,m/s$
$t = ?$

$\Delta d = \frac{1}{2}at^2 + v_i t$

$0 = \frac{1}{2}at^2 + v_i t - \Delta d$

$0 = \frac{1}{2}(-5)t^2 + (20)t - (-8)$

$0 = -2.5t^2 + 20t + 8$

$t = \frac{-20 \pm \sqrt{20^2 - 4(-2.5)(8)}}{2(-2.5)} = \frac{-20 \pm 21.9}{-5}$

$\therefore t = -0.38s$ or $8.4s$

$t = 8.4s$