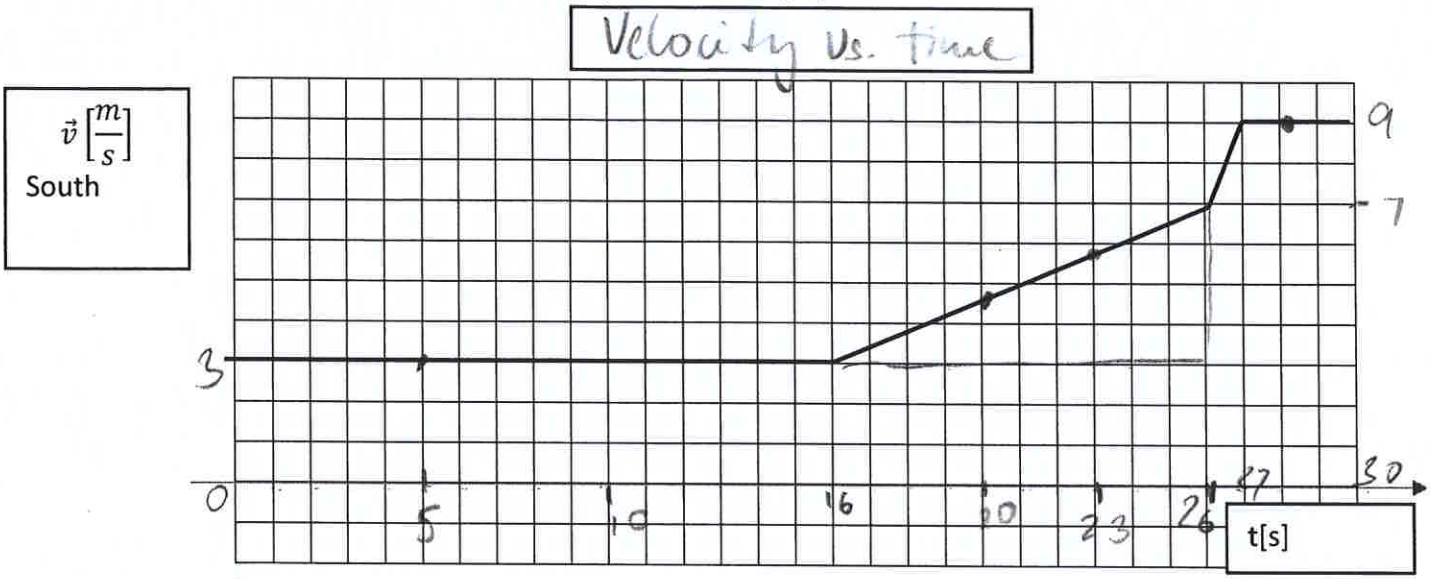
PHYSICS 11 **Name:** KEY

VELOCITY/TIME GRAPHS

Describe motion of an object using a velocity versus time graph.



Time taken	30s	Acceleration	$\frac{9-3}{30-0} = \frac{6}{30} = \frac{1}{5} = 0.2\ \frac{m}{s^2}$ [S]
Initial displacement	unknown	Time intervals of uniform motion	$t = [0,16)s$ $t = [27,30]s$
Final displacement	unknown	Time intervals of zero acceleration	$t = [0,16)s$ $t = [27,30]s$
Initial velocity	3m/s [S]	Time intervals (not instants) when the object is at rest	none
Final velocity	9m/s [S]	Instantaneous acceleration at 20s	$\frac{4}{10} = \frac{2}{5} = 0.4\ \frac{m}{s^2}$ [S]
Velocity at 10 s	3 m/s [S]	Average acceleration during t=[5,28)s	$\frac{6}{23} = 0.26\ m/s^2$ [S]
Velocity at 23 s	5.8 m/s [S]	Time interval when the acceleration is greatest.	$t = [26,27)s$

2. Calculate the distance travelled by the object over the entire time interval.

I. $t = [0, 16)\,s$ no acceleration

$d = v \times t$

$d = (3)(16)$

$d = 48\,m$

II. $t = [16, 26)\,s \rightarrow 10\,s$

$\vec{a} = \frac{2}{5}\,m/s^2\,[S]$

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

$d = (3)(10) + \frac{1}{2}(\frac{2}{5})(10)^2$

$d = 30 + 20$

$d = 50\,m$

III $t = [26, 27)\,s \rightarrow t = 1\,s$

$\vec{a} = 2\,m/s^2\,[S]$

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

$d = (7)(1) + \frac{1}{2}(2)(1)^2$

$d = 8\,m$

IV. $t = [27, 30]\,s$

$a = 0\,m/s^2$

$d = vt$

$d = (9)(3)$

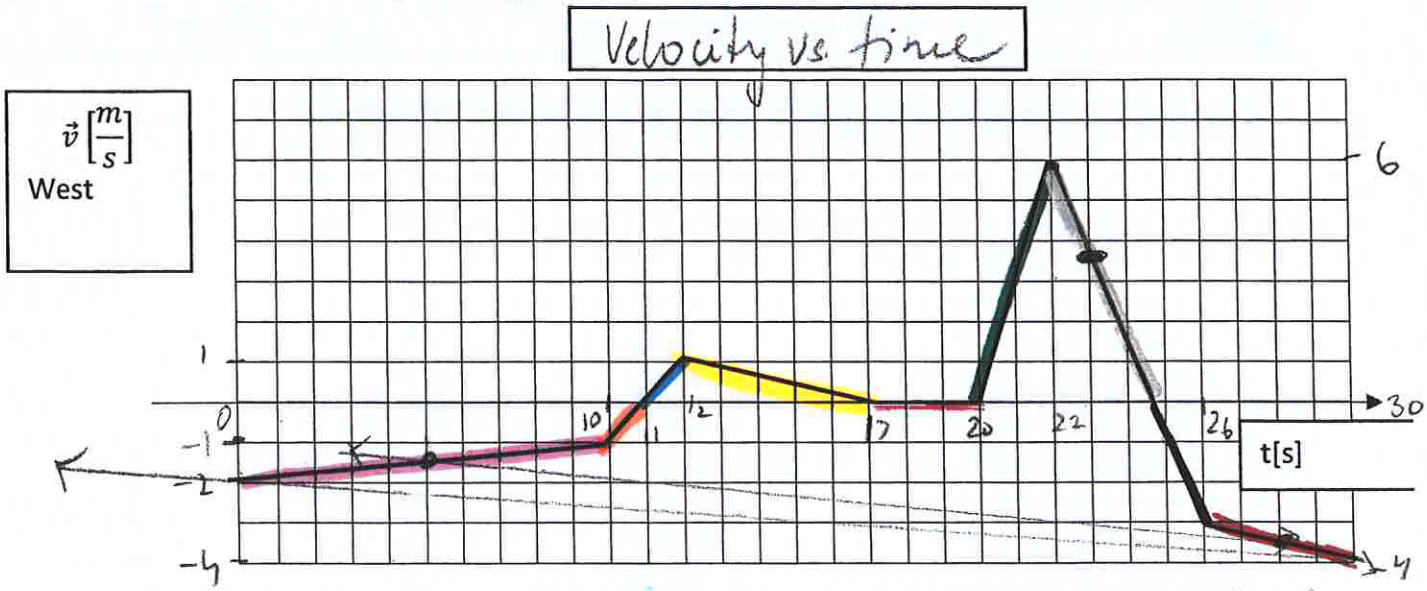
$d = 27\,m$

$\Rightarrow$ distance

$48 + 50 + 8 + 27$

$\therefore d = 133\,m$

3. Describe motion of an object using a velocity versus time graph.



negative acceleration

Time taken	33s	Acceleration !	$\frac{2}{30} = 0.0\overline{6}\ m/s^2$ [E] speeding up in (−) direc
Initial displacement	unknown	Time intervals of motion in negative direction	t = [0, 11)s t = [24.6, 30]s
Final displacement	unknown	Time intervals of zero acceleration	t = [17, 20)s
Initial velocity	2 m/s [E] −2 m/s [W]	Time intervals (not instants) when the object is at rest	t = [17, 20)s
Final velocity	4 m/s [E] −4 m/s [W]	Instantaneous acceleration at 20s	unknown (N/A) → no tangent
Velocity at 10 s	−1 m/s [W] 1 m/s [E]	Average acceleration ! during t=[5,28)s	$\frac{2}{23} = 0.08696\ m/s^2$ [E]
Velocity at 23 s	~ 3.75 m/s [W]	Time interval when the acceleration is greatest.	t = [20, 22)s

↑ steepest line

$t = [11, 24.6)\ s$

OR

Time intervals of motions in positive direction	$t = [11, 17)\ s$ $t = [20, 24.6)\ s$	Instants when the object is at rest	$t = 11\ s$ $t = 24.6\ s$

4. Calculate the distance travelled by the object over the entire time interval.

I $t = 10\ s$

$\vec{a} = -\frac{1}{10}\ m/s^2\ [E]$

$\vec{v}_i = 2\ m/s\ [E]$

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

$d = (2)(10) + \frac{1}{2}(-0.10)(10)^2$

$d = 15\ m$

II $t = 1\ s$

$\vec{a} = -1\ m/s^2\ [E]$

$\vec{v}_i = 1\ m/s\ [E]$

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

$d = (1)(1) + \frac{1}{2}(-1)(1)^2$

$d = 0.5\ m$

III $\vec{v}_i = 0\ m/s\ [W]$

$t = 1\ s$

$\vec{a} = 1\ m/s^2\ [W]$

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

$d = (0)(1) + \frac{1}{2}(1)(1)^2$

$d = 0.5\ m$

IV $\vec{v}_i = 1\ m/s\ [W]$

$\vec{a} = -\frac{1}{5}\ m/s^2\ [W]$

$t = 5\ s$

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

$d = (1)(5) + \frac{1}{2}(-\frac{1}{5})(5)^2$

$d = 2.5\ m$

V $t = 3\ s$

$v = \vec{v}_i = 0\ m/s\ [W]$

$\vec{a} = 0\ m/s^2\ [W]$

$d = vt$

$d = (0)(3)$

$d = 0\ m$

VI $t = 2\ s$

$\vec{a} = 3\ m/s^2\ [W]$

$\vec{v}_i = 0\ m/s\ [W]$

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

$d = 6\ m$

VII $t = 2.6\ s$

$\vec{v}_i = 6\ m/s\ [W]$

$\vec{a} = -9/4\ m/s^2\ [W]$

$d = (6)(2.6) + \frac{1}{2}(-9/4)(2.6)^2$

$d = 8\ m$

VIII $t = 1.4\ s$

$\vec{a} = 9/4\ m/s^2\ [E]$

$\vec{v}_i = 0\ m/s\ [E]$

$d = (0)(1.4) + \frac{1}{2}(9/4)(1.4)^2$

$d = 2.205\ m$

IX $t = 4\ s$

$\vec{a} = 1/4\ m/s^2\ [E]$

$\vec{v}_i = 3\ m/s\ [E]$

$d = (3)(4) + \frac{1}{2}(\frac{1}{4})(4)^2$

$d = 14\ m$

$\therefore$ distance travelled is $48.705\ m$

$d \doteq 49\ m$