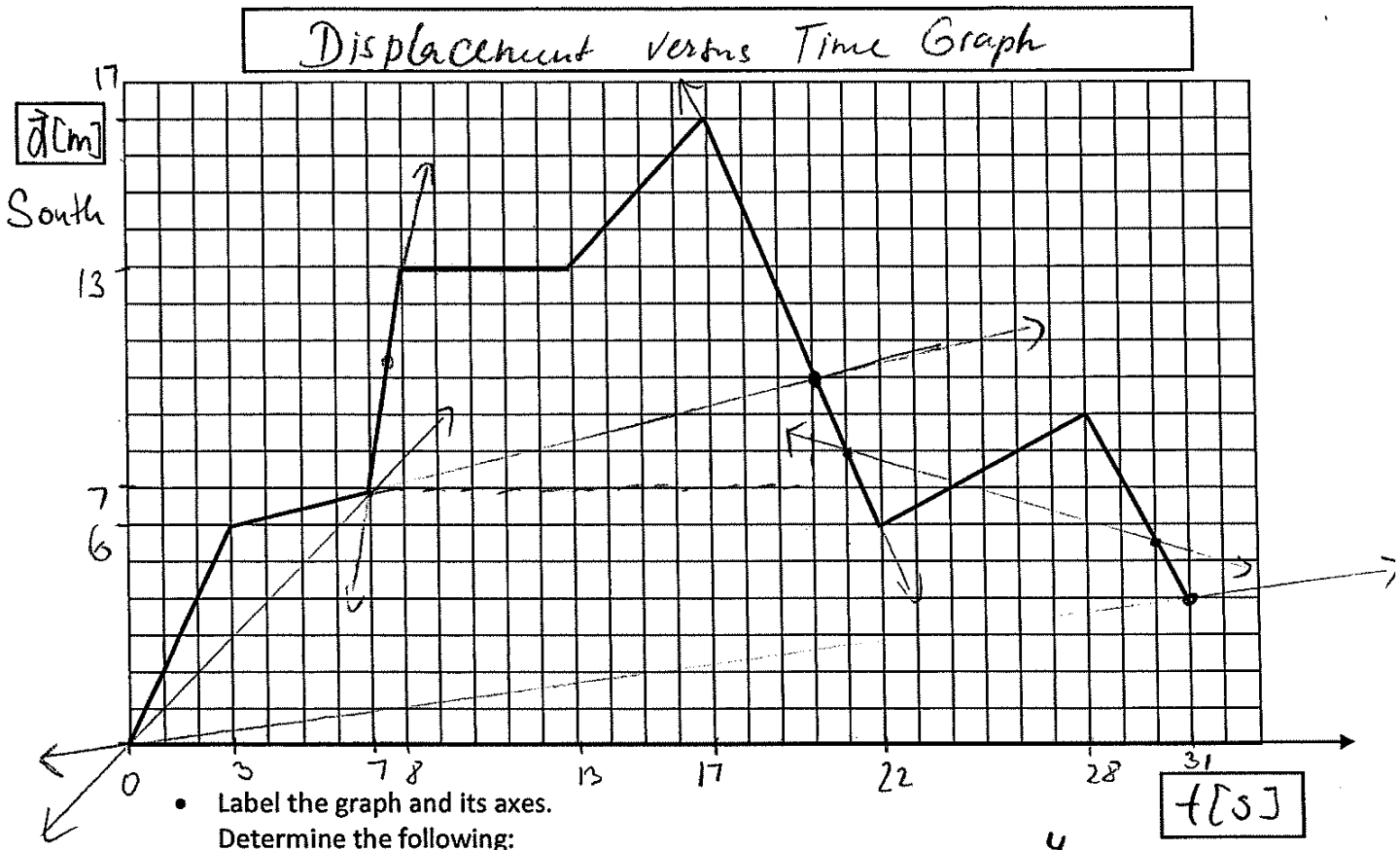
P11

1. **Describing Motion Using a Displacement versus Time Graph**

- Assume a one-to-one scale where time is measured in seconds and displacement is measured in m with South considered positive.



- Label the graph and its axes.

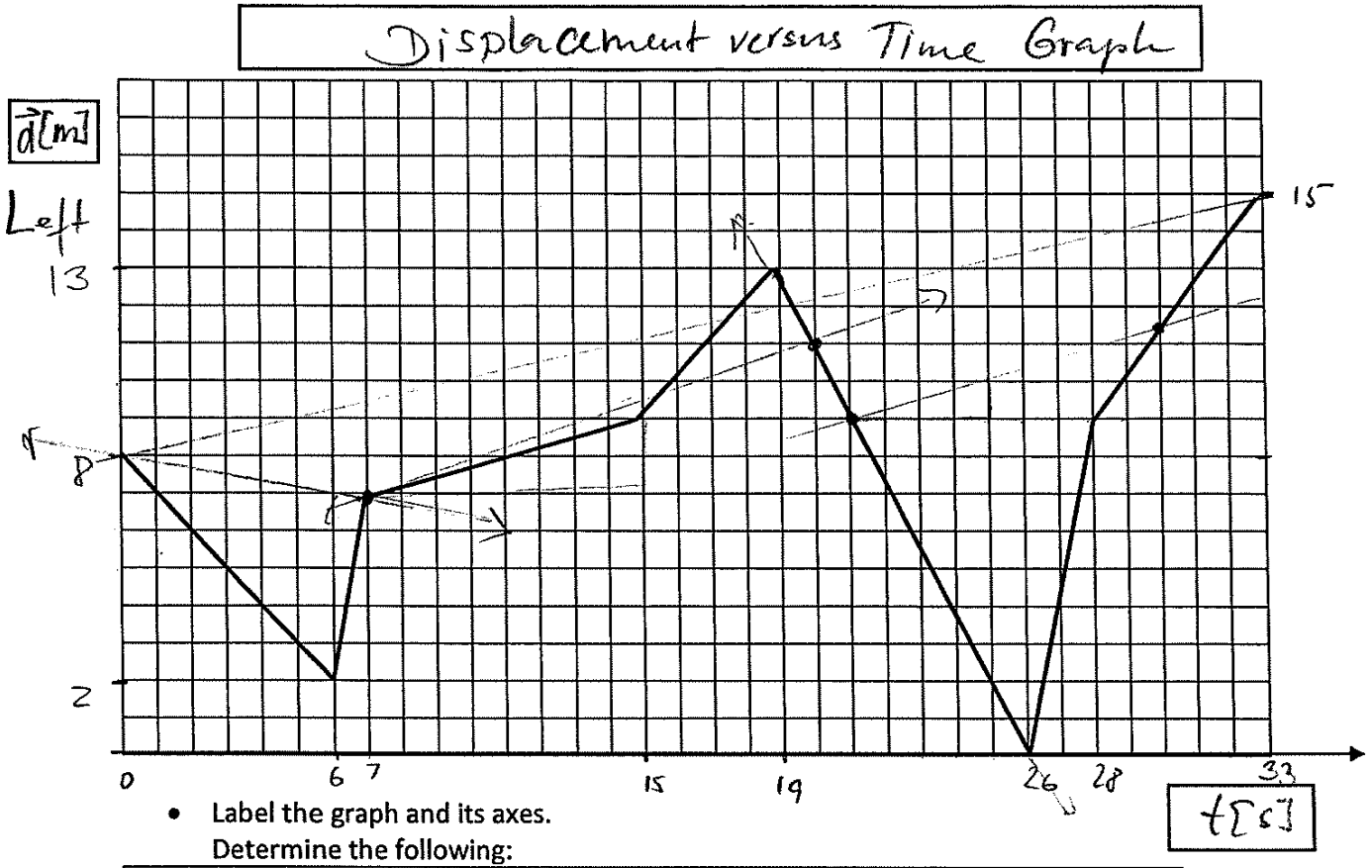
Determine the following:

Time taken	31 s	**Average velocity**	$\vec{v}_{avg} = \frac{4}{31} = 0.13$ m/s [S]
Time intervals (not instants) when the object is at rest	$t = [8, 13]$ s	**Average velocity** during t=[0,7]s	$\vec{V}_{avg} = 1\frac{m}{s}[S]$
Initial displacement	$\vec{d}_i = 0m\,[S]$	**Average velocity** during t=[7,20]s	$\vec{v}_{avg} = \frac{3}{13} = 0.23$ m/s [S]
Final displacement	$\vec{d}_f = 4m\,[S]$	**Average velocity** during t=[21,30]s	$\vec{v}_{avg} = \frac{-2.5}{9} = 0.28$ m/s [S] (*)
Change in displacement	$\Delta\vec{d} = \vec{d}_f - \vec{d}_i = 4 - 0 = 4m[S]$	**Instantaneous** velocity at t=7.5 s	$\vec{v}_{ins} = \frac{6}{1} = 6\frac{m}{s}[S]$
* **Distance travelled**	$17m + 11m + 3m + 5m = 36m$	**Instantaneous** velocity at t=20 s	$\vec{v}_{ins} = \frac{-11}{5} = -2.2$ m/s [S] $= 2.2\frac{m}{s}[N]$

(*) $\vec{v}_{avg} = 0.28$ m/s [N]

2. Describing Motion Using a Displacement versus Time Graph

- Assume a one-to-one scale where time is measured in seconds and displacement is measured in m with **left** considered positive.



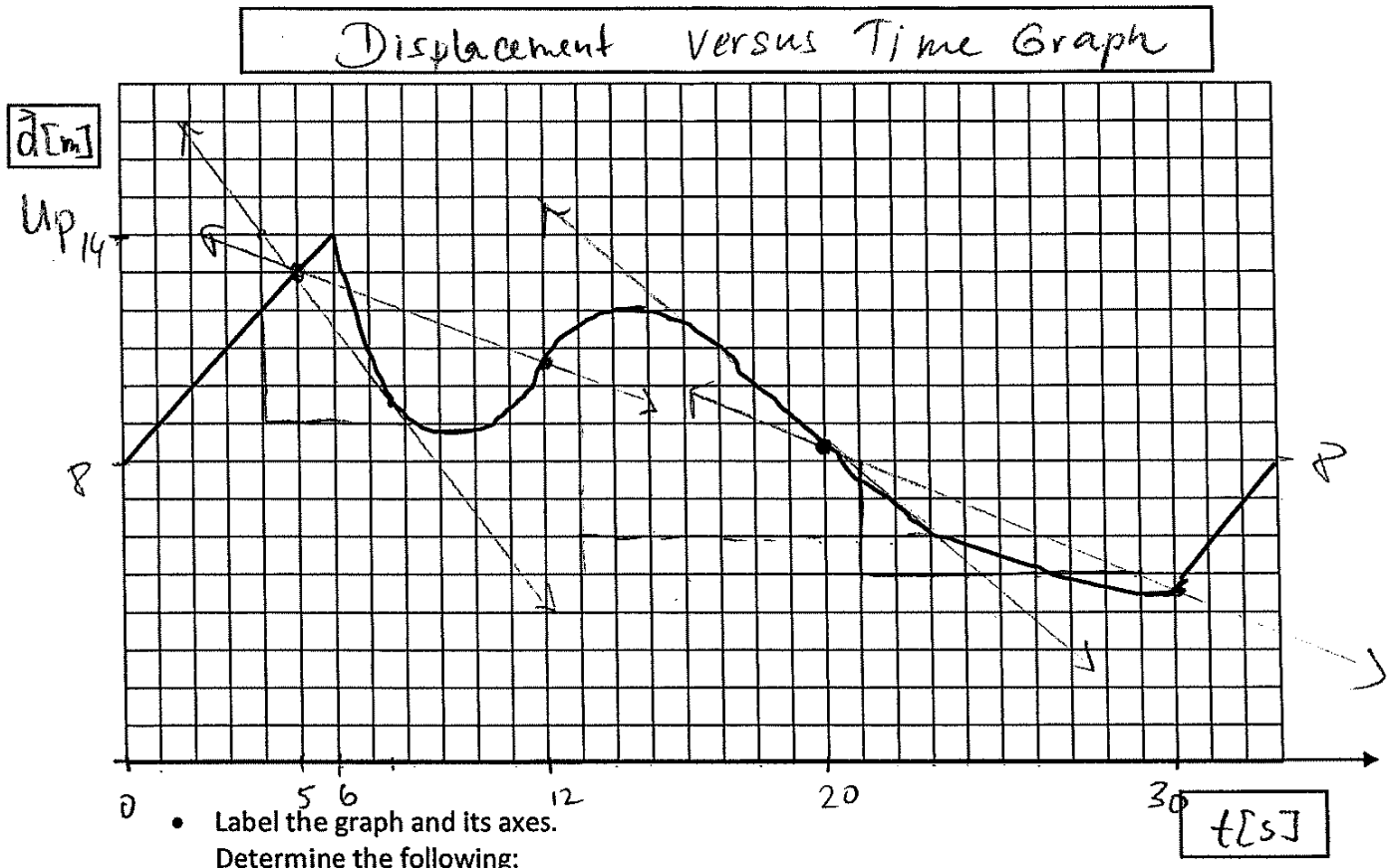
- Label the graph and its axes.

Determine the following:

Time taken	33s	**Average velocity**	$\vec{v}_{avg} = 7/33 = 0.21$ m/s [L]
Time intervals (not instants) when the object is at rest	none	**Average velocity during t=[0,7]s**	$\vec{v}_{avg} = \frac{-1}{7} = -0.14$ m/s [L] = 0.14 m/s [R]
Initial displacement	8m [L]	**Average velocity during t=[7,20]s**	$\vec{v}_{avg} = \frac{4}{13} = 0.31$ m/s [L]
Final displacement	15 m [L]	**Average velocity during t=[21,30]s**	$\vec{v}_{avg} = \frac{1}{4} = 0.25$ m/s [L]
Change in displacement	$\vec{d}_f = 15 - 8 = 7$m [L]	**Instantaneous velocity at t=7.5 s**	$\vec{v}_{ins} = \frac{2}{8} = 1/4 = 0.25$ m/s [L]
Distance travelled	6 + 11 + 13 + 15 = 45m	**Instantaneous velocity at t=20 s**	$\vec{v}_{ins} = \frac{-13}{7} = -1.86$ m/s [L]

3. **Describing Motion Using a Displacement versus Time Graph**

- Assume a one-to-one scale where time is measured in seconds and displacement is measured in m with **up** considered positive.



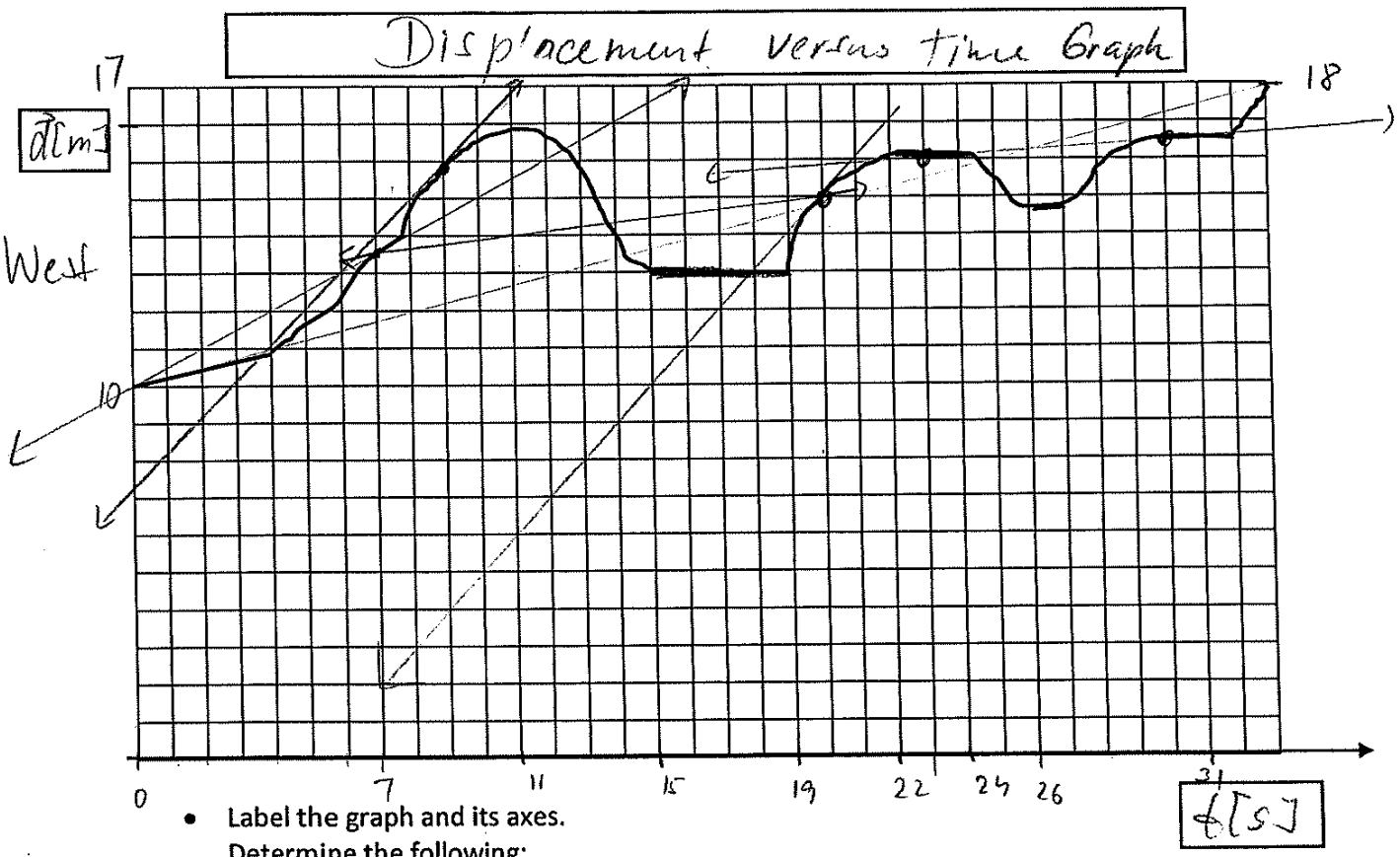
- Label the graph and its axes.

Determine the following:

Time taken	33 s	**Average** velocity	0 m/s [U]
Time intervals (not instants) when the object is at rest	t=[9,10]s, [14,15]s and [29,30]s	**Average** velocity during t=[0,5]s	$\vec{v}_{avg} = 1\frac{m}{s}$[U]
Initial displacement	8m [U]	**Average** velocity during t=[5,12]s	$\vec{v}_{avg} = \frac{-2.5}{7} = -0.36$ m/s [U]
Final displacement	8m [U]	**Average** velocity during t=[20,30]s	$\vec{v}_{avg} = \frac{-3}{8} = -0.375$ m/s [U]
Change in displacement	$\Delta\vec{d}$ = 0m[U]	**Instantaneous** velocity at t=7.5 s	$\frac{-5}{4} = -1.25$ m/s [U]
Distance travelled	6+5+3+7.5+3.5 = 25m	**Instantaneous** velocity at t=20 s	$\frac{-8}{10} = -\frac{4}{5} = -0.80$ m/s [U] = 0.80 m/s [D]

4. **Describing Motion Using a Displacement versus Time Graph**

- Assume a one-to-one scale where time is measured in seconds and displacement is measured in m with **west** considered positive.



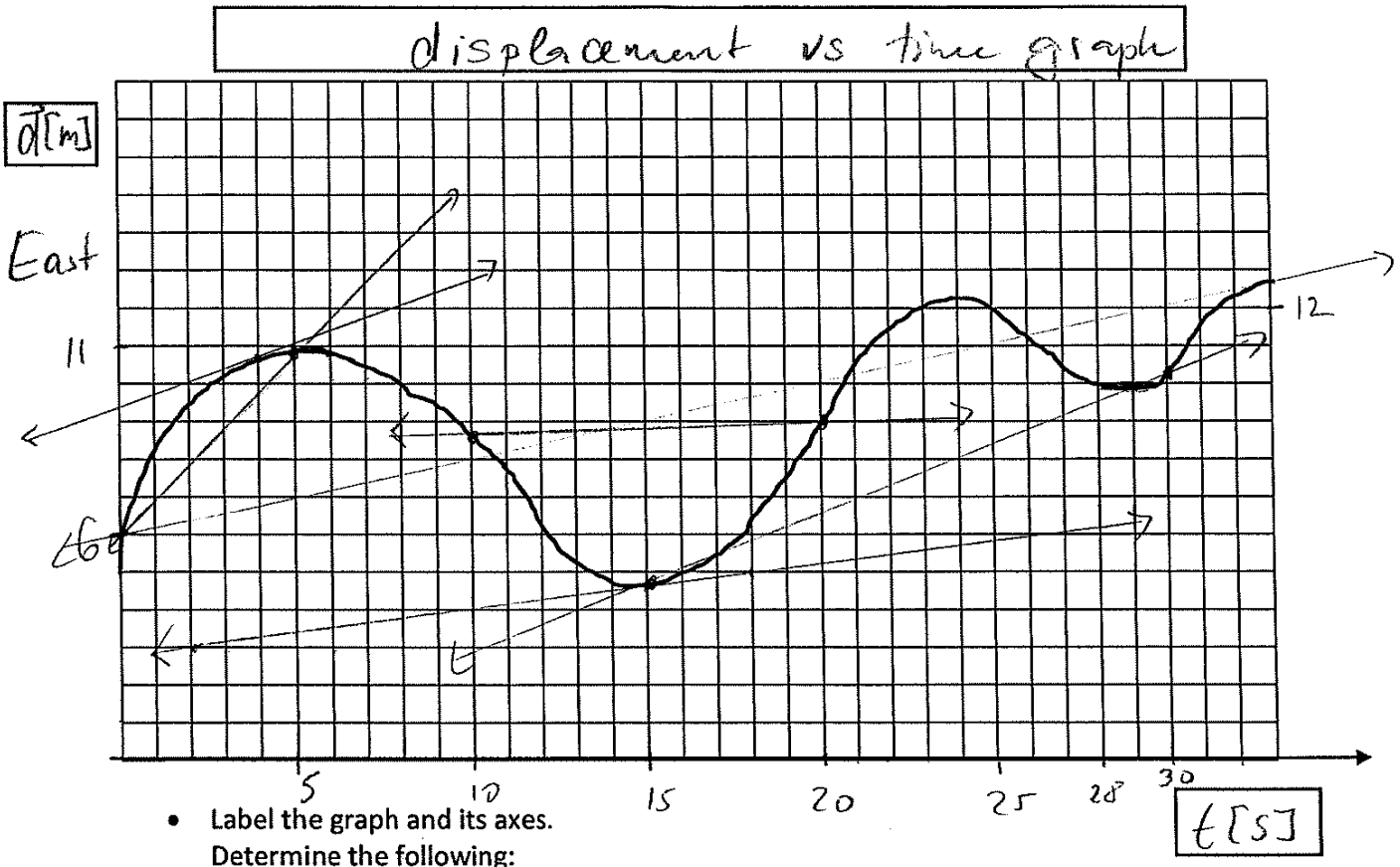
- Label the graph and its axes.

Determine the following:

Time taken	33 s	**Average** velocity	$8/33 \doteq 0.24$ m/s [W]
Time intervals (not instants) when the object is at rest	t=[15,19] s [22, 24.5] s [26,27] s, [30,32] s	**Average** velocity during t=[0,7]s	$\frac{3.5}{7} = 0.5$ m/s [W]
Initial displacement	10 m [W]	**Average** velocity during t=[7,20]s	$\frac{1.5}{13} \doteq 0.12$ m/s [W]
Final displacement	18 m [W]	**Average** velocity during t=[21,30]s	$\frac{1.5}{9} = 0.16$ m/s [W]
Change in displacement	$\Delta\vec{d} = 18-10 = 8$ m 8 m [W]	**Instantaneous** velocity at t=9 s	$\doteq$ 1 m/s [W]
Distance travelled	7+4+3+1.2+1.8 +1.5 $\doteq$ 18.5 m	**Instantaneous** velocity at t=20 s	$\doteq$ 1 m/s [W]

5. **Describing Motion Using a Displacement versus Time Graph**

- Assume a one-to-one scale where time is measured in seconds and displacement is measured in m, with **east** considered positive.



- Label the graph and its axes.

Determine the following:

Time taken	33 s	**Average velocity**	$6.8/33 = 0.21$ m/s [E]
Time intervals (not instants) when the object is at rest	$t = [28, 30]$ s	**Average velocity during t=[0,5]s**	$5/5 = 1$ m/s [E]
Initial displacement	6 m [E]	**Average velocity during t=[10,20]s**	$\frac{0.3}{10} = 0.03$ m/s [E]
Final displacement	12.8 m [E]	**Average velocity during t=[15,30]s**	$\frac{5.5}{15} = 0.37$ m/s [E]
Change in displacement	$\Delta d = 6.8$ m [E]	**Instantaneous velocity at t=4s**	$\frac{2.1}{6} \doteq 0.35$ m/s [E]
Distance travelled	$5 + 6.3 + 7.5 + 2.2 + 2.8$ $\doteq 23.8$ m	**Instantaneous velocity at t=15 s**	$\frac{2}{16} = 0.13$ m/s [E]