



## DO PHYSICS ONLINE

### SIMULATION WORKSHEET

### UNIFORM ACCELERATION

We will consider the motion of an object moving in a straight line with a [constant acceleration](#).

The equations describing the motion are

$$v = u + at \quad s = ut + \frac{1}{2}at^2 \quad v^2 = u^2 + 2as$$
$$v_{avg} = \frac{u + v}{2} \quad s = v_{avg} t$$

You are to answer each of the following questions using paper and pen and then [view the simulation on motion with uniform acceleration](#).

In the simulation, you can change the values of the initial velocity  $u$  in increments of  $5 \text{ m.s}^{-1}$  from  $-20 \text{ m.s}^{-1}$  to  $35 \text{ m.s}^{-1}$  or change the acceleration from  $-10 \text{ m.s}^{-2}$  to  $8 \text{ m.s}^{-2}$  in increments of  $2 \text{ m.s}^{-2}$ .

By changing the values of  $u$  and  $a$  in the simulation, you can check your answers to the following questions. For any questions that you got incorrect, you should be able to account for the discrepancies by running the simulation with different input parameters and hence gain a better understanding of the physics.

This technique of **POE** (**P**redict **O**bserve **E**xplain) is a powerful learning strategy that will help you improve your study methods.

## Questions

**Vertical motion of an object (up is positive).**

**initial conditions  $t = 0$ ,  $s = 0$ ,  $u$  and  $a$ .**

1. What is the shape of the displacement  $s$  / time  $t$  graph?
2. What is the shape of the velocity  $v$  / time  $t$  graph?
3. What is the shape of the acceleration  $a$  / time  $t$  graph?
4. What is the velocity  $v$  of the object when it reaches its maximum height?
5. What is the acceleration  $a$  of the object when it is moving up?
6. What is the acceleration  $a$  of the object when it is downing?
7. What is the acceleration  $a$  when the object stops at its highest point?
8. What is the slope of the  $s / t$  when the object is moving up?
9. What is the slope of the  $s / t$  when the object is moving down?
10. What is the slope of the  $s / t$  when the object is at its highest point?
11. What quantity does the slope of the  $s / t$  graph correspond too?
12. What is the slope of the  $v / t$  when the object is moving up?
13. What is the slope of the  $v / t$  when the object is moving down?
14. What is the slope of the  $v / t$  when the object is at its highest point?
15. What quantity does the slope of the  $v / t$  graph correspond too?
16. What is the slope of the  $a / t$  when the object is moving up?
17. What is the slope of the  $a / t$  when the object is moving down?
18. What is the slope of the  $a / t$  when the object is at its highest point?
19. Compare the times for the object to reach its maximum height and then return to  $s = 0$ .

20. Sketch the three graphs for the motion of a ball thrown vertically into the air (up is positive) where  $u = 20 \text{ m.s}^{-1}$  and  $a = -10 \text{ m.s}^{-2}$ .

$$s/t \quad v/t \quad a/t$$

21. What are the changes in the three graphs when only the initial velocity is changed?
22. What are the changes in the three graphs when only the acceleration is changed?
23. At time  $t = 0 \text{ s}$  and  $s = 0 \text{ m}$ , the initial velocity is  $u = 20 \text{ m.s}^{-1}$  and  $a = -10 \text{ m.s}^{-2}$ . Calculate the following for the motion of the object: (a) The velocity when the displacement is again zero,  $s = 0 \text{ m}$ . (b) The time taken to return to  $s = 0 \text{ m}$ . (c) The maximum height. (d) The velocity at the maximum height. (e) The time taken to reach the maximum height.
24. At time  $t = 0 \text{ s}$  and  $s = 0 \text{ m}$ , the initial velocity is  $u = 20 \text{ m.s}^{-1}$  and  $a = -10 \text{ m.s}^{-2}$ . Calculate the following for the motion of the object at time  $t = 1.0 \text{ s}$ : (a) acceleration. (b) velocity. (c) displacement.
25. At time  $t = 0 \text{ s}$  and  $s = 0 \text{ m}$ , the initial velocity is  $u = 20 \text{ m.s}^{-1}$  and  $a = -10 \text{ m.s}^{-2}$ . Calculate the following for the motion of the object at time  $t = 3.0 \text{ s}$ : (a) acceleration. (b) velocity. (c) displacement.

### Motion in a straight line

26. Given  $t = 0$ ,  $s = 0$ ,  $a = 4.0 \text{ m.s}^{-2}$  and  $u = -20 \text{ m.s}^{-1}$ . Sketch the three graphs
- $$s/t \quad v/t \quad a/t$$
27. Given  $t = 0$ ,  $s = 0$ ,  $a = 4.0 \text{ m.s}^{-2}$  and  $u = -20 \text{ m.s}^{-1}$ . Calculate the following for the motion of the object at time  $t = 5.0 \text{ s}$ : (a) acceleration. (b) velocity. (c) displacement.
28. Given  $t = 0$ ,  $s = 0$ ,  $a = 4.0 \text{ m.s}^{-2}$  and  $u = -20 \text{ m.s}^{-1}$ . Calculate the following for the motion of the object at time  $t = 10.0 \text{ s}$ : (a) acceleration. (b) velocity. (c) displacement.

## [VIEW SIMULATION](#)

Investigate how the simulation works by continually clicking the two buttons [increment u] and [increment a]