

QQQ – Mechanics Year 1 – Chapter 9 – SUVAT Equations (Version 2)

Total Marks: 23

(23 = Platinum, 21 = Gold, 18 = Silver, 16 = Bronze)

1. In this question use $g = 9.8 \text{ m s}^{-2}$

A ball, initially at rest, is dropped from a height of 40 m above the ground.

Calculate the speed of the ball when it reaches the ground.

Circle your answer.

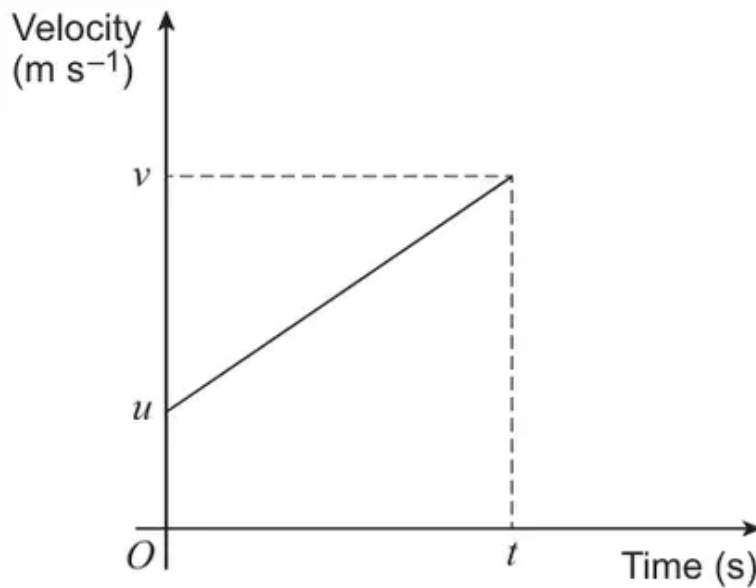
[1 mark]

- -28 m s^{-1}
- 28 m s^{-1}
- -780 m s^{-1}
- 780 m s^{-1}

(Total 1 marks)

2. An object is moving in a straight line, with constant acceleration $a \text{ m s}^{-2}$, over a time period of t seconds.

It has an initial velocity u and final velocity v as shown in the graph below.



Use the graph to show that

$$v = u + at$$

[3 marks]

(Total 3 marks)

AQA June 2020 Paper 1 Q13

3. In this question use $g = 10 \text{ m s}^{-2}$

A ball is thrown vertically upwards from a height of 1.8 metres above the ground.

The initial velocity of the ball is 12 m s^{-1}

The greatest height reached by the ball above the ground is h metres.

Find the value of h

[3 marks]

(Total 3 marks)

AQA June 2025 Paper 1 Q18

4. A small ball B is projected vertically upwards from a point 2 m above horizontal ground. B is projected with initial speed 3.5 m s^{-1} , and takes t seconds to reach the ground.

Find the value of t .

[3]

(Total 3 marks)

OCR A June 2022 Paper 2 Q10

5. A ball, initially at rest, is dropped from a vertical height of h metres above the Earth's surface.

After 4 seconds the ball's height above the Earth's surface is $0.2h$ metres.

(a) Assuming air resistance can be ignored, show that

$$h = 10g$$

[3 marks]

(b) Assuming air resistance cannot be ignored, explain the effect that this would have on the value of h in part (a).

[1 mark]

(Total 4 marks)

AQA June 2023 Paper 1 Q14

6. A lorry is moving along a straight horizontal road with constant acceleration. The lorry passes a point A with speed $u \text{ m s}^{-1}$, ($u < 34$), and 10 seconds later passes a point B with speed 34 m s^{-1} . Given that $AB = 240 \text{ m}$, find

(a) the value of u ,

(3)

(b) the time taken for the lorry to move from A to the mid-point of AB .

(6)

(Total 9 marks)

Edexcel M1 June 2013 Q4

Solutions

1.

Scheme	Marks	AO
Circles correct answer	B1	1.1b
	(1 mark)	

Typical solution

28 m s^{-1}

Notes

(corrected from the printed mark scheme: the typical solution is printed as “ $a = 28$ ”; 28 is the speed, 28 m s^{-1})

2.

Scheme	Marks	AO
Uses definition of acceleration	B1	1.2
Uses appropriate gradient formula OE	M1	1.1a
Substitutes u , v and t into gradient formula and rearranges to find given equation AG	R1	2.1
	(3 marks)	

Typical solution

Gradient of v - t graph represents acceleration

$$a = \frac{v - u}{t}$$

$$\Rightarrow v = u + at$$

3.

Scheme	Marks	AO
--------	-------	----

Selects an appropriate equation of constant acceleration and substitutes $u = \pm 12, a = \pm 10, v = 0$ Condone use of $g = 9.8$ or 9.81	M1	3.1b
Substitutes consistent correct values to obtain s or h Condone $h + 1.8$ for s	A1	1.1b
Obtains 9	B1	3.2a
	(3 marks)	

Typical solution

$$u = 12, a = -10, v = 0$$

Using $v^2 = u^2 + 2as$

$$0^2 = 12^2 + 2(-10)s$$

$$s = 7.2$$

$$h = 7.2 + 1.8 = 9$$

4.

Scheme	Marks	AO
	M1	3.3
$-2 = 3.5t + \frac{1}{2}(-9.8)t^2 \quad (\Rightarrow 4.9t^2 - 3.5t - 2 = 0)$	A1	1.1
$t = 1.09$	A1	1.1
	[3]	

Notes

M1: M1 for use of $s = ut + \frac{1}{2}at^2$ with $s = \pm 2, u = \pm 3.5$ and $a = \pm g$ and t is the total time for the motion

A1: Correct equation – need not be simplified

Possible to consider for eg motion up and motion down. In this case: M1 for **complete** method to find relevant times. A1 All equations correct – need not be simplified

A1: BC (positive root only). $t = 1.0890679 \dots$

5.

Mark scheme (a)

Scheme	Marks	AO
Selects an appropriate equation of constant acceleration. and states $u = 0, t = 4$ and $a = g$ PI by correct substitution	M1	1.1a
Substitutes $s = 0.8h$	M1	1.1a
Completes reasoned argument to obtain given answer	R1	2.1
	(3)	

Typical solution

$$s = ut + \frac{1}{2}at^2$$

$$u = 0, t = 4 \text{ and } a = g$$

$$0.8h = \frac{1}{2}g \times 4^2$$

$$0.8h = 8g$$

$$h = 10g$$

Mark scheme (b)

Scheme	Marks	AO
Explains that h will be less	E1	3.5a
	(1)	
	(4 marks)	

Typical solution

Air resistance will cause h to be lower

6.

Mark scheme (a)

Scheme	Marks
$240 = \frac{1}{2}(u + 34)10$	M1 A1
$u = 14$	A1
	(3)

Notes

First M1 for a complete method to produce an equation in u only.

First A1 for a correct equation. ($u^2 - 48u + 476 = 0$ oe is possible).

Second A1 for $u = 14$.

Mark scheme (b)

Scheme	Marks
$34 = 14 + 10a \Rightarrow a = 2$	M1 A1
$120 = 14t + \frac{1}{2} \times 2 \times t^2$	M1 A1
$t^2 + 14t - 120 = 0$	
Solving, $t = -20$ or 6	DM1
$t = 6$	A1
	(6)
	(9 marks)

OR

$34 = 14 + 10a \Rightarrow a = 2$	M1 A1
$v^2 = 14^2 + 2 \times 2 \times 120 \Rightarrow v = 26$	
AND $26 = 14 + 2t$	M1 A1
$t = 6$	DM1 A1
	(6)

Notes

EITHER

First M1 for an equation in a only. (M0 if $v = 34$ when $s = 120$ is used)

First A1 for $a = 2$. (This may have been found in part (a))

Second M1 for a 3-term quadratic equation in t only, allow sign errors (must have found a value of a . (M0 if $v = 34$ when $s = 120$ is used)

Second A1 for a correct equation.

Third M1 dependent on previous M1 for solving for t .

Third A1 for $t = 6$

OR

First M1 for an equation in a only.

First A1 for $a = 2$. (This may have been found in part (a))

Second M1 for a complete method to obtain an equation in t only, allow sign errors. (must have found a value of a)

Second A1 for a correct equation.

Third M1 dependent on previous M1 for solving for t .

Third A1 for $t = 6$