GRADE 12 REVISION 2013
MECHANICS: VERTICAL PROJECTILE MOTION - MEMORANDUM

MULTIPLE-CHOICE QUESTIONS

1.[1] C
2.[2] B
3.[3] A
4.[4] D
5.[5] C
6.[6] C

The footnotes at the bottom of each page indicate from which NSC examination papers the questions were taken. All the options for answers are not given; only the first option in the memorandum. Teachers must use the footnotes to find the optional answers, plus other important marking criteria (e.g. the fact that symbols such as *u* and *v* for initial and final velocity are still accepted) in the original memorandums. Almost no one-word items were asked about this topic in previous papers; hence nothing is included in this document.

STRUCTURED QUESTIONS

Question 1[7]

1.1

$$\text{Gradient/}gradient = \frac{\Delta v}{\Delta t} \checkmark = \frac{-20-(-10)}{3-2} \checkmark = \frac{-10}{1} = -10 \text{ m·s}^{-2} \checkmark \text{ or } 10 \text{ m·s}^{-2} \text{ downwards}$$

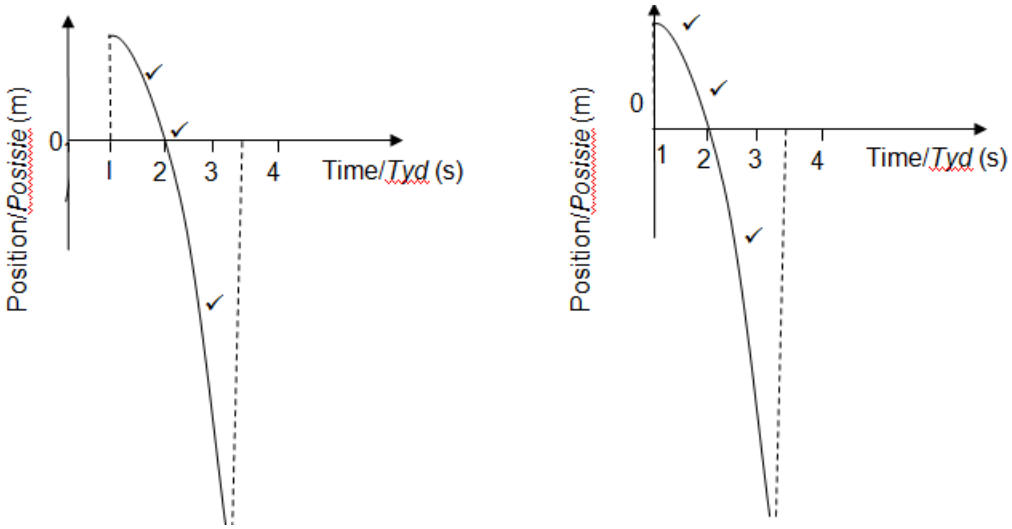
1.2 0,5 s ✓ and/*en* 1,5 s ✓

1.3 1 s ✓

1.4

Height of cliff/ *Hoogte van krans* = area of trapezium/area of trapezium
= ½ (sum of parallel sides/som van ewewydige sye)h ✓
= ½ (10 + 25) ✓ (1,5) ✓
= 26,25 m✓

1.5



[1] November 2009 Q3.1
[2] March 2010 Q3.1
[3] November 2010 Q2.1
[4] November 2011 Q2.3
[5] March 2012 Q2.3
[6] November 2012 Q2.2
[7] November 2008 Q6

Question 2[8]

2.1

$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$v_f^2 = (0)^2 + 2(9,8)(25)$ ✓
$v_f = 22,13$ down/*afwaarts* ✓

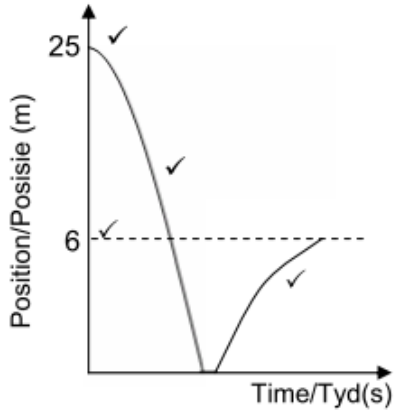
2.2

For upward bounce - upward motion as positive:
Opwaartse hop - *opwaartse beweging as positief:*
$v_f^2 = v_i^2 + 2a\Delta y$ ✓
0 ✓$= v_i^2 + 2(-9,8)(6)^2$ ✓
$v_i = 10,84\ m\cdot s^{-1}$
Impulse/*Impuls* = Δp ✓
$\therefore [(0,3)(10,84)$ ✓$- (0,3)(-22,13)]$ ✓$= +9,89\ N\cdot s$
$\therefore$ Impulse/*Impuls* = 9,89 N·s upward/*opwaarts* ✓

2.3

Take upward as positive/*Neem opwaarts as positief:*
$F_{net}\Delta t = \Delta p$ ✓
$F_{net} = \frac{\Delta p}{\Delta t} = \frac{+9,89}{0,9}$ ✓ $= +10,99$ N ✓ (11 N)

2.4



Due to the long contact time (0,9 s) in relation to the falling time (2,26 s), the graph should show the horizontal section on the time axis.

2.5 Lesser/smaller ✓
Collision of softer ball more inelastic/more kinetic energy lost. ✓
Smaller upward velocity. ✓
Reaches smaller height.

Question 3[9]

3.1 Statements not correct (or no) ✓
The bricks will experience the same (gravitational) acceleration / free fall ✓ and thus reach the ground at the same time. ✓

[8] March 2009 Q5
[9] November 2009 Q4

3.2.1 Any two ✓✓

- Ensure that both bricks are dropped from same height.
- Ensure that both bricks are dropped at the same time OR Ensure that the stopwatch starts at instant that each brick is released and stopped at the instant that each brick reaches the ground.
- Repeat the experiment several times and use the average of the results.
- Make sure that $v_i = 0$ for both bricks.
- Make sure that there is no strong wind.
- Use bricks made of the same material / of same density.

3.2.2 External force(s) may be present e.g. friction/air resistance / strong wind blowing. ✓

3.3

Downward direction positive / *Afwaartse rigting positief:*

A:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

8 ✓ $= (0)\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓

$\therefore \Delta t = 1,28$ s

B:

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

8 ✓ $= v_{iB}(1,28 - 0,6)$ ✓ $+ \frac{1}{2}(9,8)(1,28 - 0,6)^2$ ✓

$\therefore v_{iB} = 8,43\ m\cdot s^{-1}$ ✓ (8,43 to/*tot* 8,48 $m\cdot s^{-1}$)

Question 4[10]

4.1

Velocity after / *snelheid na* 30 m:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$= 0 + 2(9,8)(50 - 20)$ ✓

$v_f = 24,25\ m\cdot s^{-1}$ ✓

4.2

Velocity after a further 18,2 m:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$= 24,25^2 + 2(9,8)(20 - 1,8)$ ✓

$\therefore v_f = 30,74\ m\cdot s^{-1}$

$v_f = v_i + a\Delta t$ ✓

$30,74 = 24,25 + 9,8t$ ✓

$\therefore t = 0,66$ s ✓

He will not be struck – reaction time is shorter than the time for the brick to reach his head.

Question 5[11]

5.1 3 s ✓

5.2

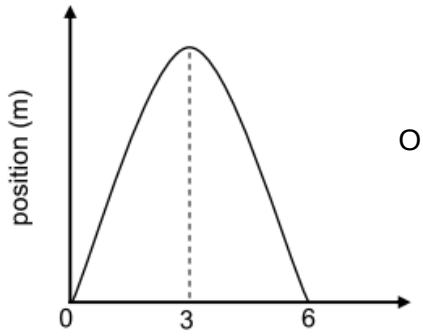
[10] March 2010 Q5

[11] November 2010 Q3

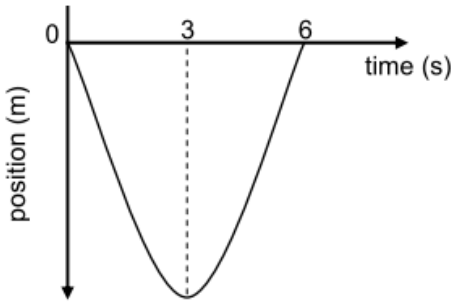
Area between graph and time axis
Δy = (area of triangle)/ ½ bh ✓
= ½ (3)(29,4) ✓
= 44,1 m

Maximum height above ground:
100 +✓ 44,1 = 144,1 m ✓

5.3



OR



5.4.1

Upward positive:

$v_f = v_i + a\Delta t$ ✓
$= \underline{29,4}$✓ $+ \underline{(-9,8)(5,23)}$ ✓
$= -21,85\ m\cdot s^{-1}$ ✓downwards ✓
OR
$v_f = 21,85\ m\cdot s^{-1}$ ✓downwards✓

5.4.2

Upward positive:

$\Delta t = (5,23 - 1)$ ✓ $= 4,23$ s

$v_f = v_i + a\Delta t$ ✓
$= \underline{49 + (-9,8)(4,23)}$ ✓
$v_f = 7,55\ m\cdot s^{-1}$ upwards

$\Delta v_{XY} = v_X - v_Y$ (vector difference)
$= -21,85 - 7,55$
$= -29,40\ m\cdot s^{-1}$ ✓downwards✓
OR
$v_{XY} = 29,40\ m\cdot s^{-1}$✓ downwards✓

$v_{XY} = v_{XG} + v_{GY}$
$= -21,85 + (-7,55)$
$= -29,40\ m\cdot s^{-1}$ ✓downwards✓
OR
$v_{XY} = 29,40\ m\cdot s^{-1}$ ✓downwards✓

$v_{XG} = v_{XY} + v_{YG}$
$-21,85 = v_{XY} + (7,55)$
$= -29,40\ m\cdot s^{-1}$ ✓downwards✓
OR
$v_{XY} = 29,40\ m\cdot s^{-1}$ ✓downwards✓

Question 6[12]

6.1 Gradient of graph is constant. ✓✓

6.2 At t = 1 s ✓ and t = 3 s ✓

6.3

$V_{AB} = V_{AC} + V_{CB}$
$= -10 + (-10)$
$= -20\ m\cdot s^{-1}$
$= 20\ m\cdot s^{-1}$ ✓✓downwards ✓

6.4

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$= (0)(4) + ½\ (10)(4)^2$✓
$= 80$ m✓ (78,4 m if $a = 9,8\ m\cdot s^{-2}$)

[12] March 2011 Q3

6.5 Displacement ✓✓ / Change in position

6.6

Distance covered by object B

$\Delta y = \frac{1}{2}bh + lb$ ✓

= ½ (1)(10) + (10)(1)✓

= 15 m

Distance covered by object A

$\Delta y = \frac{1}{2}bh$ ✓

= ½ (1)(-10) ✓ Accept: ½ (1)(10)

= - 5 m = 5 m

Distance between A and B = 15 – (-5) = 20 m ✓

Accept:
Distance between A and B = 15 + (5) = 20 m ✓

Question 7[13]

7.1 The initial velocity / speed of the camera is the same ✓ (as that of the balloon)..

7.2

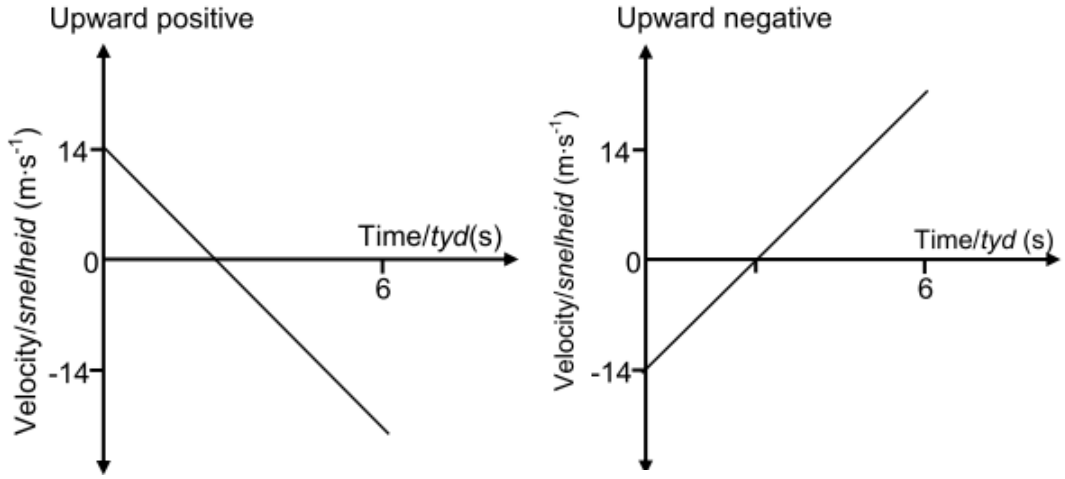
$\Delta y = v_i \Delta t + \frac{1}{2}a\Delta t^2$ ✓

$\therefore 92,4$ ✓= $v_i(6) + ½(9,8)(6)^2$ ✓

$\therefore v_i = -14\ m \cdot s^{-1}$

$\therefore v_i = 14\ m \cdot s^{-1}$ ✓

7.3



7.4

$\Delta x = v\Delta t$✓

$\therefore 10$ ✓= $(2)\Delta t$ ✓

$\therefore \Delta t = 5$ s ✓

Yes/ Will catch the camera, time is less than 6 s. ✓

[13] November 2011 Q3

Question 8[14]

8.1

Accepted Labels/*Aanvaarde benoemings*	
w	F_g / F_w / force of Earth on stone/weight/mg/gravitational force *F_g / F_w / krag van Aarde op klip/gewig/mg/gravitasiekrag*

8.2.1

Upward positive/*Opwaarts positief*:

$v_f = v_i + a\Delta t$ ✓

$0 = 10$ ✓$+(-9,8)\Delta t$ ✓

$\therefore \Delta t = 1,02$ s ✓

Upward negative/*Opwaarts negatief*:

$v_f = v_i + a\Delta t$ ✓

$0 = -10$ ✓$+ 9,8\Delta t$ ✓

$\therefore \Delta t = 1,02$ s ✓

8.2.2

Upward positive/*Opwaarts positief*:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

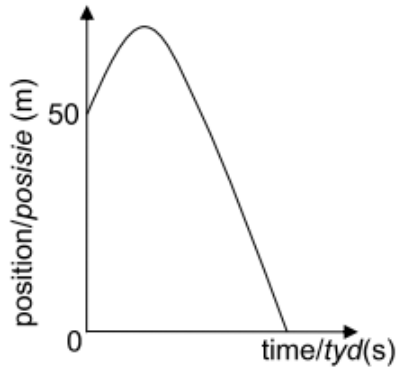
$0^2 = 10^2 + 2(-9,8)\Delta y$ ✓

$\therefore \Delta y = 5,1$ m

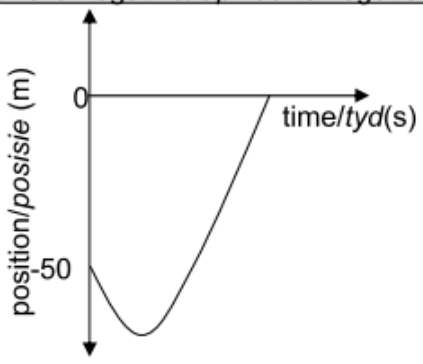
Height/*Hoogte* = 50 + ✓ 5,1
= 55,1 m ✓

8.3

Upward positive/*Opwaarts positief*



Upward negative/*Opwaarts negatief*



Notes/*Aantekeninge:*

If wrong labels/*Indien verkeerde byskrifte*: Max./*Maks.* $\frac{2}{3}$

[14] March 2012 Q3

8.4

$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ ✓

$1,5$ ✓$= v_i(0,1) + \frac{1}{2}(9,8)(0,1)^2$ ✓

$\therefore v_i = 14,51\ m \cdot s^{-1}$

From maximum height/*Van maksimum hoogte:*

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$14,51^2$✓ $= (0)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 10,74$ m

Height/*Hoogte* = 55,1 –10,74
= 44.36 m ✓

Question 9[15]

9.1 Downwards ✓

9.2.1

$v_f = v_i + a\Delta t$ ✓
$= 8$ ✓$+ (-9,8)(4)$ ✓
$= -31,2\ m \cdot s^{-1}$
$\therefore v_f = 31,2\ m \cdot s^{-1}$ ✓

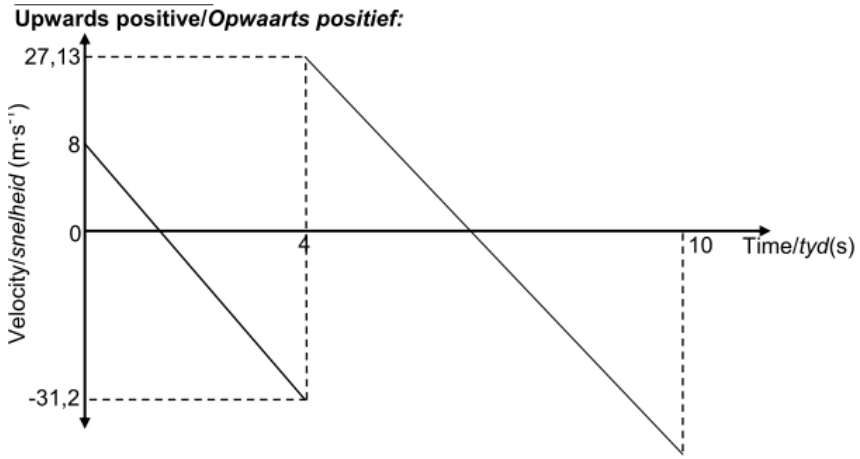
9.2.2

Upwards positive/*Opwaarts positief*:

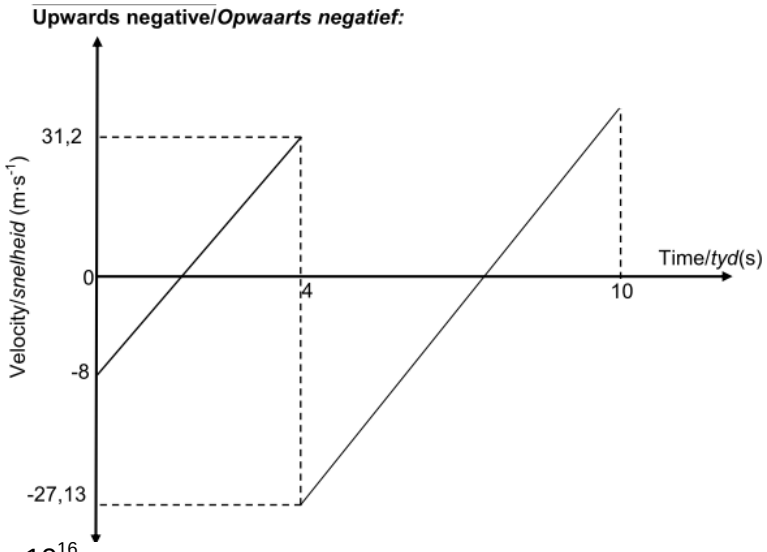
$\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$✓
$= (8)(4)$ ✓ $+ \frac{1}{2}(-9,8)(4)^2$ ✓
$= -46,4$ m

Height of balcony/*Hoogte van balkon:*
60 – 46,4 ✓= 13,6 m ✓

9.3



[15] November 2012 Q3



Question 10[16]

10.1 50 N ✓ downwards ✓

10.2.1

Downward positive:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$\therefore v_f^2 = 0^2 + \underline{2(9,8)(0,8)}$ ✓

$\therefore v_f = 3,96\ m\cdot s^{-1}$ ✓ downward /*afwaarts*✓

10.2.2

Downward positive

$F_{net}\Delta t = \Delta p$ OR $F_{net}\Delta t = m(v_f - v_i)$ ✓

$(F_{app} + mg)\Delta t = \Delta p$

$(-50 + (0,2)(9,8)\Delta t$ ✓ $= 0,2(-3,43 - 3,96)$ ✓

$\therefore \Delta t = 0,03$ s ✓ $(3 \times 10^{-2}$ s)

Downward negative/*Afwaarts negatief:*

$F_{net}\Delta t = \Delta p$ OR $F_{net}\Delta t = m(v_f - v_i)$ ✓

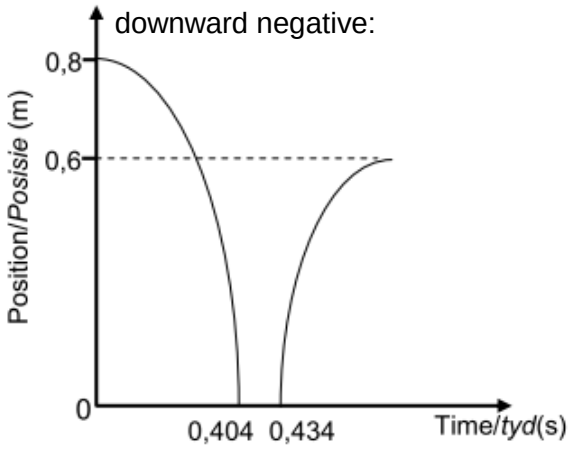
$(F_{app} + mg)\Delta t = \Delta p$

$(50 - (0,2)(9,8)\Delta t$✓ $= 0,2[3,43 - (-3,96)]$ ✓

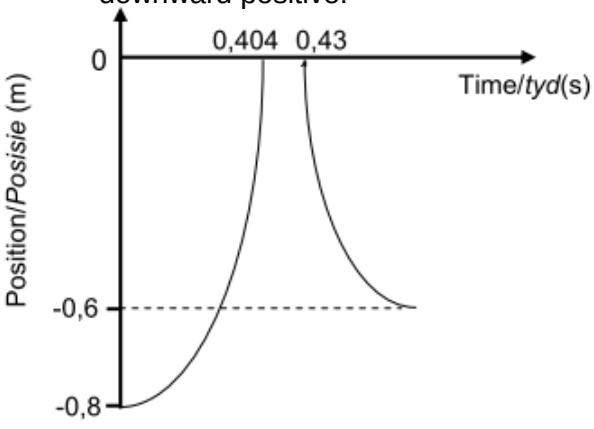
$\therefore \Delta t = 0,03$ s ✓ $(3 \times 10^{-2}$ s)

10.3

Ground as zero reference and downward negative:



Ground as zero reference and downward positive:



[16] March 2013 Q3