Edexcel M1 May 2013(R) Q4

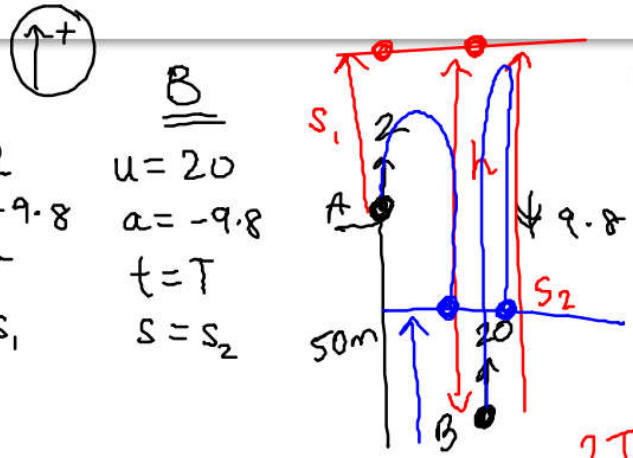
At time $t = 0$, two balls A and B are projected vertically upwards. The ball A is projected vertically upwards with speed 2 m s^{-1} from a point 50 m above the horizontal ground. The ball B is projected vertically upwards from the ground with speed 20 m s^{-1}. At time $t = T$ seconds, the two balls are at the same vertical height, h metres, above the ground. The balls are modelled as particles moving freely under gravity. Find

(a) the value of T,

(5)

(b) the value of h.

(2)



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

$s_1 = 2T - 4.9T^2$

$s_2 = 20T - 4.9T^2$

$s_1 + 50 = s_2$

$2T - 4.9T^2 + 50 = 20T - 4.9T^2$

$50 = 18T$

$T = \frac{50}{18} = 2.8$ secs (2sf)

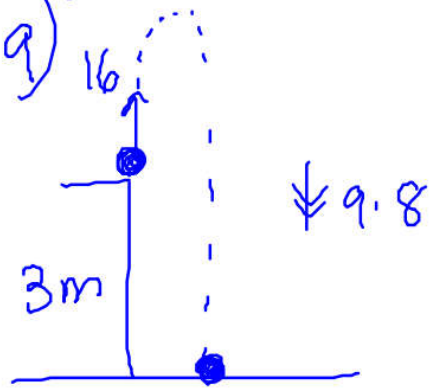
b) $s_2 = ?$ $T = \frac{50}{18} = \frac{25}{9}$

$s_2 = 20 \times \frac{25}{9} - 4.9\left(\frac{25}{9}\right)^2$

$= 17.7$ m

Ex 9E

9)



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$a = 9.8$

$s = 3$

$u = -16$

$t = ?$

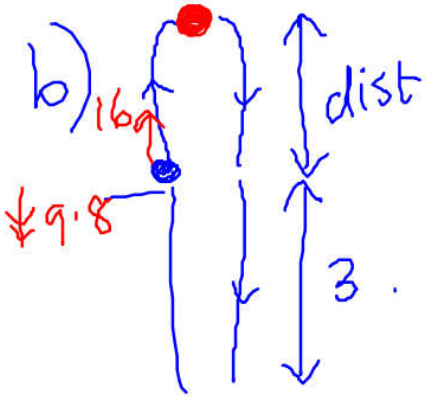
$s = ut + \frac{1}{2}at^2$

$3 = -16t + 4.9t^2$

$0 = 4.9t^2 - 16t - 3$

$t = \underline{3.4}$ (2sf)

b)



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$u = 16$

$a = -9.8$

$v = 0$

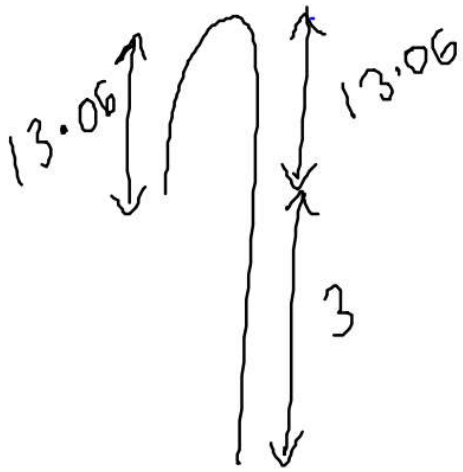
$s = ?$

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

$0 = 16^2 - 2 \times 9.8s$

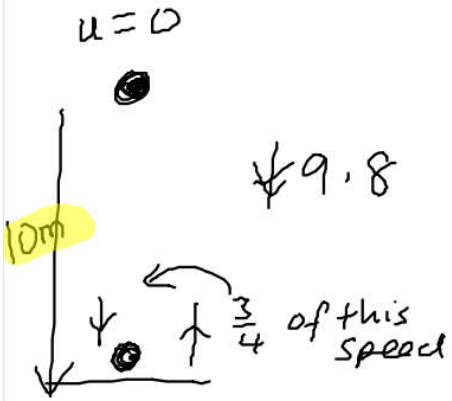
$19.6s = 16^2$

$s = 13.061\ldots$ m



distance travelled $= 2 \times 13.06 + 3$

$= \underline{29\text{ m}}$ (2sf)



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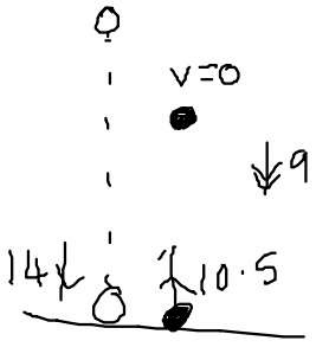
$u=0$
$a=9.8$
$s=10$
$v=?$

$v^2=u^2+2as$
$v^2=2\times9.8\times10$
$v^2=196$
$v=14\ ms^{-1}$

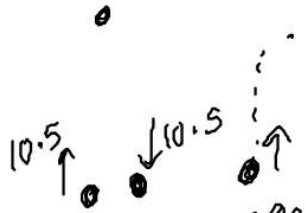


Rebound speed $\frac{3}{4}\times14=10.5ms^{-1}$

↑+

$u=10.5$
$v=0$
$a=-9.8$
$s=?$

$v^2=u^2+2as$
$0=10.5^2-2\times9.8s$
$19.6s=10.5^2$
$s=5.625\ m=5.6m$ (2sf)



$\frac{3}{4}\times10.5=7.875$

$u=7.875$
$v=0$
$s=$
$a=-9.8$

$s=3.16\ m$
$=3.2m$

More practice!
Mixed Exercise
Exam Questions

5. A small ball is projected vertically upwards from a point A which is 19.6 m above the ground. The ball strikes the ground, for the first time, 4 s later.

The motion of the ball is modelled as that of a particle moving freely under gravity.

(a) Use the model to find the speed of the ball as it hits the ground for the first time.

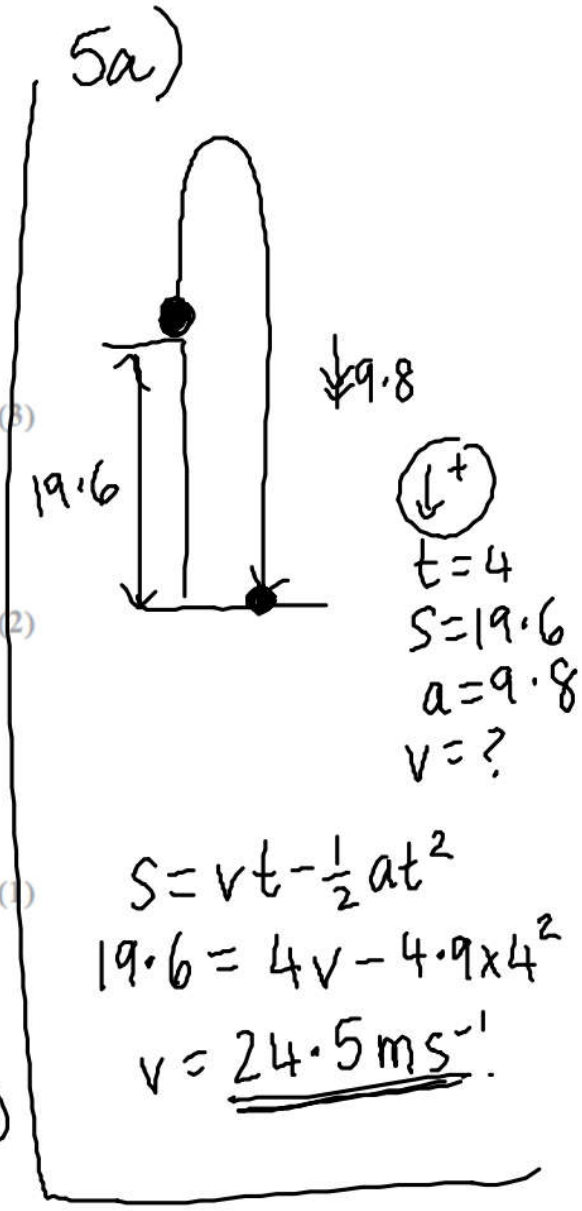
The ball rebounds from the ground with a vertical speed of 14.7 m s^{-1} and next comes to instantaneous rest at the point B.

(b) Use the model to find the height of B above the ground.

In a refined model of the motion of the ball, the effect of air resistance is included and this refined model is now used to find the speed of the ball as it hits the ground for the first time

(c) How would this new value of the speed of the ball as it hits the ground for the first time compare with the value found using the initial model in part (a)?

5a)



(3)

(2)

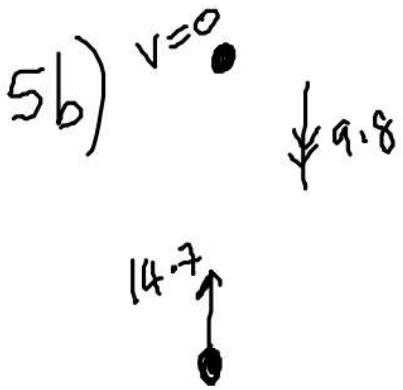
(1)

$s = vt - \frac{1}{2}at^2$

$19.6 = 4v - 4.9 \times 4^2$

$v = 24.5 \text{ ms}^{-1}$.

5b)



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$u = 14.7$
$a = -9.8$
$v = 0$
$s = ?$

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

$0^2 = 14.7^2 - 2 \times 9.8s$

$s = \frac{14.7^2}{19.6} = 11.025$

$= 11 \text{ m (2sf)}$

5c) **Because of air resistance, the ball would be slowed down - so the value from (a) would be decreased.**