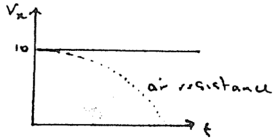
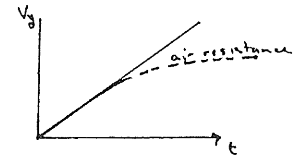
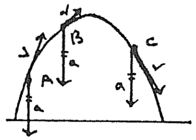
1. (1)

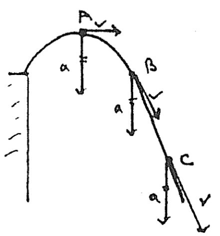


(2)



2.





3. (1) $s = v_0 t + \frac{1}{2}at^2$

$s = \frac{1}{2}at^2$ [$v_0 = 0$ in vertical dirⁿ]

$0.7 = 4.9t^2$

$t^2 = \frac{0.7}{4.9}$

$= \frac{1}{7}$

$\therefore$ $\underline{t \approx 0.378s}$

(2) The ball has to drop 0.7m to hit the net.

Distance travelled horizontally in 0.378s

$s_x = v_x t$

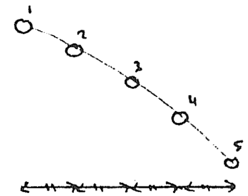
$= 35 \times 0.378$

$\approx \underline{\underline{13.3m}}$

$\therefore$ Ball passes over the net before it drops 0.7m

ie $\underline{\text{Ball clears the net}}$

4. (1)



horizontal distance travelled is constant. $\therefore$ horizontal velocity is constant.

(2) Measure the distance between the images vertically. The distance travelled between each image increases. $\therefore$ The velocity increases between each image. $\therefore$ it accelerates down.

(3) No force in the horizontal direction $\therefore$ no acceleration horizontally.

(4) Acceleration of B is $9.8 ms^{-2}$ down, as this is the direction of the force on B.

(5) Ball B. It is given an initial velocity, and it then accelerates down for the same time as A. $\therefore$ will have a greater speed at each "image".

5. (1)(a) $v = u + at$ $u = 0$

$= 0 + 9.8 \times 2$

$\vec{v} = 19.6ms^{-1}$ DOWN ↓

(b) $s = ut + \frac{1}{2}at^2$ $(u=0)$

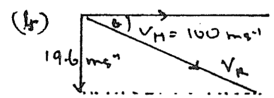
$120 = 0 + 4.9t^2$

$t^2 = \frac{120}{4.9}$

$\underline{t \approx 4.95s}$

(2)(a) $v_v = v_y = 19.6ms^{-1}$ ↓ (see (1)(a))

(b)



$\vec{v}$ resultant $= 101.9 ms^{-1}$ by Pythagoras

$\tan \theta = \frac{19.6}{100}$, $\theta = 11°$.

$\therefore \vec{V_R} = 101.9 ms^{-1}$ at 11° below horizontal.

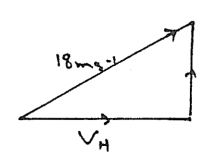
(c) Horizontal component stays the same. Vertical component increases.

(d) parcel hits water after ~4.95s. [From (1)(b)]

(e) Range $= V_H \times t = 100 \times 4.95$

$\underline{= 495m.}$

6. (1)



$V_v = 18 \sin 40° = 11.57 ms^{-1}$ up

$V_H = 18 \cos 40° = 13.79 ms^{-1}$

(2) V_H will stay the same. V_v will gradually decrease to zero upwards and then it will increase downwards because the gravitational force acts on it in the vertical direction.

(3) Only horizontal

$\therefore$ $\underline{13.79 ms^{-1}}$ horizontally

7. (1) Vertical movement to get time of fall

$s = v_0 t + \frac{1}{2}at^2$ $[v_0 = 0]$

$2 = 0 + \frac{1}{2}(9.8)t^2$

$\therefore t^2 = \frac{2 \times 2}{9.8}$

$\underline{t = 0.64s.}$

(2)(a) time of flight = 0.64s, as vertical motion is identical with that of a dropped body

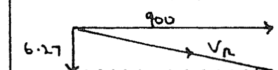
(c) Final vertical velocity

$V_f = V_0 + at$

$= 0 + 9.8(0.64)$

$\therefore V_f = 6.27 ms^{-1}$ ↓

$\therefore$ Resultant Velocity



$V_R = 900.02 ms^{-1}$.

(Angle) $\tan\theta = \frac{6.27}{900}$

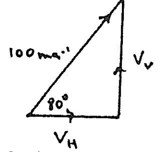
$\theta = 0.4°$

$\therefore$ Velocity $= 900.02 ms^{-1}$ at 0.4° below the horizontal

(b) Range $s_x = v_x t$

$s_x = 900 \times 0.64$

$\underline{= 576m}$



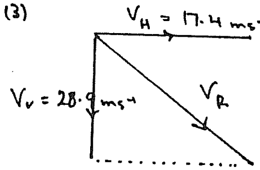
Vertical velocity $= 100 \sin 80°$
$= 98.5\ ms^{-1}$

Horizontal velocity $= 100 \cos 80°$
$= 17.4\ ms^{-1}$

(2) at 1 sec. $V_v = V_o + at$
$= 98.5 + (-9.8)1$
$\vec{V_v} = 88.7\ ms^{-1}$

at 13 sec. $V_v = V_o + at$
$= 98.5 + (-9.8)13$
$\vec{V_v} = -28.9\ ms^{-1}$
ie $28.9\ ms^{-1}$ down

(3)



$\vec{V}_{resultant} = 33.7\ ms^{-1}$.
(angle: $\tan\theta = \frac{28.9}{17.4}$ $\therefore \theta = 58.9°$)
$\therefore \vec{V_R} = 33.7\ ms^{-1}$ @ 58.9° below the horizontal

(4) $V_{horizontal}$ only
$\therefore = 17.4\ ms^{-1}$ horizontally

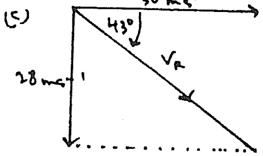
(5) $\vec{a} = \vec{g} = 9.8\ ms^{-2} \downarrow$

9.(1) $s = V_o t + \frac{1}{2}at^2$
$40 = 0 + \frac{1}{2}(9.8)t^2$
$t = 2.86\ s.$

(2) (b) $V_t = V_o + at$
$= 0 + 9.8 \times 2.86$
$= 28.0\ ms^{-1}$

(a) Stone hits ground after 2.86s.

(c)



$\vec{V_R} = 41.0\ ms^{-1}$ @ 43° below the horizontal

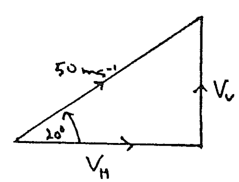
(d) Range $= V_H \times t$
$= 30 \times 2.86$
$= 85.8\ m$

(e) Energy at the start
= potential + kinetic
$= mgh + \frac{1}{2}mv^2$
$= (\frac{1}{2} \times 0.2 \times 30^2) + (0.2 \times 9.8 \times 40)$
$= 168.0$ Joules.

Energy on impact is all kinetic (K)
$K = \frac{1}{2}mv^2$
$= \frac{1}{2} \times 0.2 \times (41.0)^2$
$= 168.0$ Joules.

ie The Law of Conservation of Energy holds.

10.
(1)



$V_{horizontal} = 50 \times \cos 20°$
$= 47.0\ ms^{-1}$

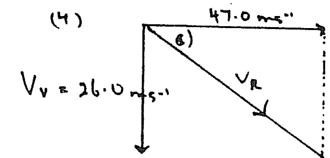
$V_{vertical} = 50 \sin 20°$
$= 17.1\ ms^{-1}$

10.(2) time to max. height is given by
$v_y = u_y + at$ ($v_y = 0$)
$0 = 17.1 - 9.8t$
$\therefore t = \frac{17.1}{9.8}$
$\approx 1.745\ s$

$\therefore$ time to point B is
$t = 2 \times 1.745$
$\approx 3.49\ s$

(3) Range $= \vec{V_H} \times t$
$= 47.0 \times 4.4$
$= 206.8\ m$

(4)



$\vec{V_R}$ (by Pythag) $= 53.7\ ms^{-1}$
$\theta = 29°$

Velocity of ball at green $= 53.7\ ms^{-1}$ at 29° below the horizontal

(5) From the green the ball loses potential energy and it is converted to kinetic energy. Hence its velocity is greater at the green than at X and at the point of impact.

11.(1) Range $s_x = v_x t$
$= 2\cos 45° \times 2.96$
$\approx 4.19\ m$

11(2) $v_x = v\cos 45° = 1.414\ ms^{-1}$
$\therefore K = \frac{1}{2}mv^2 = \frac{1}{2} \times (0.001) \times (1.414)^2$
$\approx 0.001\ J$

(3) 1.2 m above the ground on the downward path.

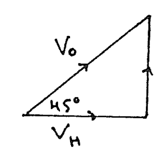
(4) Gravit^l PE is converted into KE.
$\Delta PE = mgh = 1 \times 9.8 \times 2$
$= 19.6\ J$
$\therefore$ KE increases by 19.6 J.

(5) The range will be reduced.

(6) The range may increase if the change in angle is small enough. [as horizontal component of velocity increases].

12.
(1) Range $= V_H \times t$
$5297 = V_H \times 32.88$
$\vec{V_H} = 161.1\ ms^{-1}$

(2)



$V_H = V_o \cos 45°$
$\therefore 161.1 = V_o \cos 45°$
$\therefore V_o = 227.8\ ms^{-1}$ at 45°

(3) $V_v = V_o \sin 45°$
$= 161.1\ ms^{-1}$

(4) time for maximum height $= 32.9/2 = 16.45$

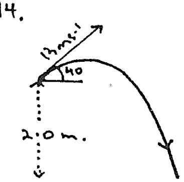
12 (5). Time of flight will not be effected as the time is dependent on the vertical motion due to the force of gravity.
The range will be reduced.

13. (1) The time of flight t is given by the equation $t = \frac{2V_0 \sin\theta}{g}$.
$\therefore$ if we increase θ, $\sin\theta$ increases $\therefore$ time of flight increases.

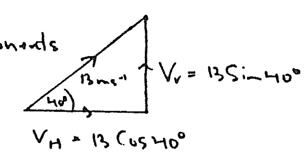
(2) $V_H = V_0 \cos\theta$, as θ increases, $\cos\theta$ decreases
$\therefore$ V_H decreases.

(3) The range will decrease because V_H decreases.
(45° is maximum range)

14.



Components



$V_V = 8.36\,ms^{-1}$
$V_H = 9.96\,ms^{-1}$.

(1) $v_y = u_y + at$ $(v_y = 0)$
$0 = 8.36 - 9.8t$
$\therefore t = \frac{8.36}{9.8} \approx 0.853s$

14 (2) $s = ut + \frac{1}{2}at^2$ $u = 0$
$5.56 = 0 + 4.9t^2$
$\therefore t \approx 1.065s$
(3) $t = 0.853 + 1.065 = 1.92s$
(4) Range $= V_H \times t$
$= 9.96 \times 1.9$
$= 18.9\,m$

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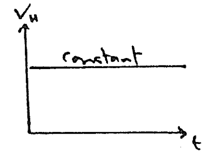
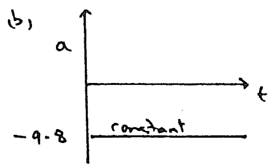
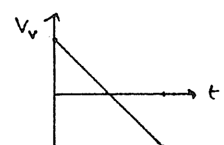
15 (1)
(a)



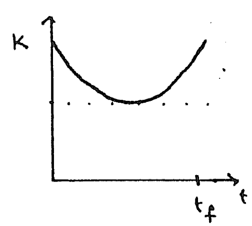
(b)



(c)



(d)



(2) (a) horizontal velocity will not change
(b) acceleration due to gravity is constant.
(c) time of flight has increased $\therefore$ The vertical velocity will increase

15. (2) d. The kinetic energy will increase as the velocity increases due to the longer time of flight.

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16. (1) $V_0 \cos\phi$
(2) $V_0 \sin\theta$
(3) A + E. B + D.
(4) None. (projectile is always accelerating $\therefore$ always changing velocity.)
(5) C.
(6) None. (no force horizontally $\therefore$ constant velocity)
(7) Vertically down.
(8) Tangents to the curve. $\therefore$ at B ↗, at E ↘
(9) Vertical velocity = 0.
Acceleration = $9.8\,ms^{-2}$ ↓

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17. See text.
