Name: 
Class: 
Class Number: 

Time allowed: 1hr  
(Take \( g = 9.81\text{ms}^{-2} \))

Q1  A ball is projected horizontally from the top of a building at 20 ms\(^{-1}\). Assume that there is no air resistance. What is its horizontal speed 5 s later?

A 20 m s\(^{-1}\)  
B 30 m s\(^{-1}\)  
C 40 m s\(^{-1}\)  
D 50 m s\(^{-1}\)

Q2  A ball is projected at an angle of 75° to the ground. It hits a target at the ground level. If the ball is projected with the same speed again, which of the following angle of projection would also enable the ball to hit the target? (Neglect air resistance.)

A 2.5°  
B 5°  
C 12.5°  
D 15°

Q3  Two balls A and B are placed at the edge of a table. The mass of B is twice that of A. At the same instant, A is released from rest while B is projected horizontally with speed \( u \). Which of the following statements are correct? (Neglect air resistance.)

(1) A and B reach the ground at the same time.  
(2) A and B have the same acceleration.  
(3) A and B have the same vertical speed on reaching the ground.

A (1) and (2) only  
B (2) and (3) only  
C (1) and (3) only  
D (1), (2) and (3)

Q4  A particle is projected horizontally from a table with an initial speed \( u \). It attains a speed 2\( u \) just before hitting the ground. If air resistance is neglected, what is the time of flight of the particle?

A \( \frac{\sqrt{3}u}{2g} \)  
B \( \frac{\sqrt{3}u}{g} \)  
C \( \frac{u}{g} \)  
D \( \frac{2u}{g} \)

\[
\sqrt{3}u = 0 + (9.81)t
\]
Q5 The diagram shows the path of a projectile fired with a horizontal velocity $v$ from a cliff of height $h$. Which of the following values of $v$ and $h$ will give the greatest value of the angle $\theta$?

\[ \begin{array}{|c|c|}
\hline
v & h \\
\hline
10 \text{ m s}^{-1} & 30 \text{ m} \\
10 \text{ m s}^{-1} & 50 \text{ m} \\
30 \text{ m s}^{-1} & 30 \text{ m} \\
50 \text{ m s}^{-1} & 10 \text{ m} \\
\hline
\end{array} \]

Q6 A tennis ball is projected upwards with an initial speed $u$ at an angle $\theta$ with the horizontal. Which of the following graphs represents the variation of the ball’s speed $v$ with time?

\[ \begin{array}{c}
A \\
B \\
C \\
D \\
\end{array} \]

MC Answer Area (3 marks each)

\begin{tabular}{cccccc}
1. & 2. & 3. & 4. & 5. & 6. \\
\hline
\end{tabular}
Q7 A ball is projected horizontally from the top of a cliff with a speed of $40\text{ms}^{-1}$. Assume that there is no air resistance.

(a) Find its vertical velocity at $t = 3\text{s}$. (2 marks)

(b) Find its speed at $t = 3\text{s}$. (2 marks)

\[
\begin{align*}
\text{(a)} & \quad V_y = (g)(3) = 27.43\text{ms}^{-1} \\
\text{(b)} & \quad V = \sqrt{V_x^2 + V_y^2} \\
& \quad = \sqrt{40^2 + 27.43^2} \\
& \quad = 49.7\text{ms}^{-1}
\end{align*}
\]

Q8 A bullet is fired horizontally towards a vertical wall 1.0 m away. It hits the wall at a point 0.5 m below the point of projection. At what speed does the bullet hit the wall? (2 marks)

\[
\begin{align*}
V_y^2 &= 2(g)(0.5) \\
V_y &= 3.13\text{ms}^{-1} \\
3.13 &= (9.81)t \\
t &= 0.3195
\end{align*}
\]

\[
\begin{align*}
V_x &= \frac{1}{0.3195} = 3.13\text{ms}^{-1} \\
V &= \sqrt{3.13^2 + 3.13^2} \\
& = 4.43\text{ms}^{-1}
\end{align*}
\]

Q9 A ball is projected from $X$ with a speed of $10\text{ms}^{-1}$ at an angle of $30^\circ$ below the horizontal. Point $X$ is 0.3 m above the ground. The ball rebounds from the ground at $Y$ and $Z$. If the collisions are perfectly elastic, find the horizontal distance $YZ$. (2 marks)

\[
\begin{align*}
V_x &= 10\cos30^\circ = 8.66\text{ms}^{-1} \\
V_y &= 10\sin30^\circ = 5\text{ms}^{-1} \\
\text{After rebound, } V_y^2 &= 5^2 = 2(9.81)(x) \\
V_y &= 5.56\text{ms}^{-1} \\
\text{time of flight: } &-5.56 = 5.56 - 9.81t \\
t &= 1.133\text{s}
\end{align*}
\]

\[
\begin{align*}
S_x &= 8.66 \times 1.133 = 9.81\text{m}
\end{align*}
\]
Q10 As shown in the figure, a ball is projected horizontally with a speed of 8 m s\(^{-1}\) from point A on an inclined plane of inclination 45°. The ball then landed on another point B on the inclined plane.
(a) Find the time of travel of the ball. (4 marks)
(b) Find the distance AB. (2 marks)

\[
\begin{align*}
(a) & \quad u_x = 8 \text{ m s}^{-1}, \quad u_y = 0 \\
& \quad s_x = 8t \\
& \quad s_y = \frac{1}{2} (9.81) t^2 \\
& \quad \frac{1}{2} (9.81) t^2 = 8t \\
& \quad t = 1.63s \\
(b) & \quad AB = \sqrt{s_x^2 + s_y^2} = 8(1.63)(\sqrt{2}) = 18.5m
\end{align*}
\]

Q11 A cannonball is fired with an initial horizontal speed of 50 m s\(^{-1}\) and vertical speed of 30 m s\(^{-1}\) at ground level. Assume air resistance is negligible and take the acceleration due to gravity as 10 m s\(^{-2}\).
(a) Find the equation of the trajectory of the cannonball. (3 marks)
(b) What is the range of the cannonball? (2 marks)

\[
\begin{align*}
(a) & \quad x = 50t \\
& \quad y = 30t - \frac{1}{2} (10)t^2 \\
& \quad y = \frac{3}{5}x - \frac{10}{2} \left( \frac{x}{50} \right)^2 \\
& \quad y = 0.6x - 0.002x^2 \\
(b) & \quad \text{put } y = 0, \quad x = \frac{0.6}{0.002} = 300 \text{ m}
\end{align*}
\]