Assignment 6

The due date for submitting this assignment has passed. **Due on 2016-08-30, 23:59 IST.**

Submitted assignment

1) A projectile of mass 10 kg is fired with a speed of \( v_0 = 10 \text{ m/s} \) at an angle of \( \theta_0 = 30^\circ \) from the horizontal. The height that it attains during its flight and the range \( R \) (if there is no drag) are given by

- Height=1.25m and Range=5m
- Height=1.25m and Range=5\( \sqrt{3} \)m
- Height=1.25m and Range=15m
- Height=1.25m and Range=\( \sqrt{3} \)m

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

**Height=1.25m and Range=5\( \sqrt{3} \)m**

2) A particle is moving in a viscous medium under the influence of a constant force. If it started from the rest at \( t = 0 \), its speed \( v(t) \) as a function of time \( t \) is properly represented by

![Graph showing speed as a function of time](image-url)
3) A particle is observed after it has been moving for a long time under the influence of the constant force in a medium that applies a drag force proportional to the square of its velocity. Distance versus time graph made by the observer will look like.
No, the answer is incorrect.
Score: 0

Accepted Answers:

4) A particle of mass 0.1 kg is moving with a speed of \( 2 \, m/s \) along \( x \) - axis. Another particle of mass 0.2 kg is moving along \( y \) - axis with the same speed. If two particles are treated as part of one system and both particles pushed in the direction of their motion by a force of 1 N. Acceleration of their CM given as:

\[
\frac{1}{3} (\hat{i} + \hat{j}) \, ms^{-1}
\]

\[
\frac{10}{3} (\hat{i} + \hat{j}) \, ms^{-1}
\]

\[
\frac{10}{3} (\hat{i} - \hat{j}) \, ms^{-1}
\]

\[
\frac{10}{3} (-\hat{i} + \hat{j}) \, ms^{-1}
\]

No, the answer is incorrect.
Score: 0

Accepted Answers:

\[
\frac{10}{3} (\hat{i} + \hat{j}) \, ms^{-1}
\]

5) Position of CM of one half of a solid cylinder ,having radius \( R \) and length \( L \) is:

\[
\frac{4R}{3\pi} \, \text{above the flat surface}
\]

\[
0
\]

\[
\frac{2R}{3L} \, \text{above the flat surface}
\]
6) The mass of an hourglass with sand in it is $m$. It is kept on a weighing scale. During the time 1 point when the flow of the sand from its upper portion to the lower one is steady. The reading on the weighing will be

- mg
- greater than mg
- lower than mg
- Can not say anything.

No, the answer is incorrect.  
Score: 0  
Accepted Answers:

- above the flat surface

4) $\frac{4R}{3\pi}$ below the flat surface

No, the answer is incorrect.  
Score: 0  
Accepted Answers:

5) $\frac{4R}{3\pi}$ above the flat surface

7) A rocket is launched in a uniform gravitational field. It accelerates by ejecting exhaust at 1 point constant relative speed of $u$. Assume that the rate at which the burnt fuel is exhausted is $\gamma m$, where $m$ is the instantaneous mass of the rocket and $\gamma$ is a constant. In addition to gravity, the rocket also experiences a retarding force of $mb$, where $b$ is a constant. Find the speed $\nu(t)$ of the rocket as a function of time.

\[ \nu(t) = \frac{ru+\gamma}{b} \left( 1 - e^{-bt} \right) \]

No, the answer is incorrect.  
Score: 0  
Accepted Answers:

\[ \nu(t) = \frac{ru+\gamma}{b} \left( 1 + e^{-bt} \right) \]

8) A 3 kg bomb falling vertically down splits into two pieces of masses 1 kg and 2 kg. The 1 kg 1 point piece flies off in the vertically upward direction. $a_1$ is the accelerations of the 1 kg mass, $a_3$ is the acceleration for the 3 kg mass and $a_{CM}$ is the acceleration for their centre of mass (the vertically upward direction is taken as positive and magnitude of gravitational acceleration is indicated as $g$). Which of the following statements is true for their accelerations?

- $a_{CM} = -g$  
- $a_1 = g$  
- $a_3 = -2g$

No, the answer is incorrect.  
Score: 0  
Accepted Answers:

- $a_{CM} = -g$  
- $a_1 = -g$  
- $a_3 = -g$
A 150 gm ball is dropped from a height of 5 meter and bounces back with the same speed after hitting the ground. The impulse that it imparts to the ground is close to which of the following?  
(Take g= 9.8 m/s²)

- 3 Ns  
- 1.5 Ns  
- 0  
- 6 Ns

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
3 Ns

10A 900-g plate is held above ground by a fountain of water. The speed of water drops, before they hit the plate, is 4 m/s. If the water drops strop momentarily after hitting the plate, the rate at which water is coming out of the fountain is close to (g = 9.8 m/s²)

- 1.2 kg/s  
- 2.2 kg/s  
- 1.0 kg/s  
- 0.4 kg/s

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
2.2 kg/s

11In a rocket engine, the hot gas generated in the combustion chamber exits the nozzle with a mass flow rate of 314 kg/s and a relative velocity of 4545 m/s. The thrust produced by the engine is close to

- 1427 KN  
- 2172 KN  
- 1290 KN  
- 1354 KN

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
1427 KN

12A spacecraft of mass 90 kg, moving at an instantaneous speed of 2.4 x 10⁴ m/s, picks up interstellar dust at the rate of 4.2 x 10⁻⁸ kg/s. Assuming that the dust was initially at rest, the instantaneous rate of retardation of the spacecraft is close to

- 7.9 x 10⁻⁶ m/s²  
- 1.12 x 10⁻⁶ m/s²  
- None  
- 1.12 x 10⁻⁶ m/s²

No, the answer is incorrect.  
Score: 0  
Accepted Answers:  
1.12 x 10⁻⁶ m/s²

13A projectile of mass m is shot with initial speed v₀ at an angle θ₀ from the horizontal. If the drag force F of the air is −kv, then the angle θ between the horizontal velocity and the radial vector at the highest point is given by (Assume \( \frac{k_0}{mg} \) \( \sin(\theta_0) \ll 1 \))

\[
\tan^{-1}\left\{(1 + \frac{k_0}{mg} \sin(\theta_0)) \frac{\tan(\theta_0)}{x}\right\}
\]
\[
\begin{align*}
\tan\left(1 + \frac{k_0}{mg} \sin(\theta_0)\right) \tan(\theta_0) \\
\tan^{-1}\left(1 + \frac{k_0}{mg} \cos(\theta_0)\right) \frac{\tan(\theta_0)}{2} \\
\tan\left(1 + \frac{k_0}{mg} \sin(\theta_0)\right) \cot(\theta_0)
\end{align*}
\]

No, the answer is incorrect.

Score: 0

Accepted Answers:
\[
\tan^{-1}\left(1 + \frac{k_0}{mg} \sin(\theta_0)\right) \frac{\tan(\theta_0)}{2}
\]