Unit 23 · Dynamics

WORKSHEET

Full marks 35

Name _____ Class _____ Roll no. _____ Date _____ Marks _____ / 35

1 Key words [3]

Fill in the blanks with words from the box. Two words in the box are not needed. Each blank carries 0.5 mark.

displacement	**distance**	**inclined**	**particle**	**retardation**	**smooth**	**speed**	**velocity**

A body whose size we can ignore is a _____. The change of its position is its _____; the length of path it actually covers is the _____. The rate of change of its position is its _____, and an acceleration that slows it down is a _____. A plane with no friction on it is called _____.

2 True or false [3]

Write ✓ for a true statement and ✗ for a false one. Correct the false ones.

i. A particle can be at rest at an instant while its acceleration is not zero. ☐

ii. The distance a particle travels is always equal to the size of its displacement. ☐

iii. At the top of its flight, a stone thrown straight up has no acceleration. ☐

iv. A heavy block slides down a smooth plane with a greater acceleration than a light one. ☐

v. The slope of a velocity–time graph is the acceleration. ☐

vi. The equation $v^2 = u^2 + 2as$ holds only when the acceleration is constant. ☐

3 Multiple choice [6]

Choose the correct option for each of the following questions.

i. When the velocity v of a particle is given as a function of its position x, its acceleration is: [1]

a. $\frac{dv}{dx}$ **b.** $v\frac{dv}{dx}$

c. $\frac{v}{x}$ **d.** $x\frac{dv}{dx}$

ii. A stone is thrown vertically up at 19.6 m/s. It comes back to the point of projection after: [1]

a. 2 s **b.** 4 s

c. 8 s **d.** 19.6 s

iii. A particle starts from rest with uniform acceleration and covers 10 m in the first 2 s. In the first 4 s it covers: [1]

a. 20 m **b.** 30 m

c. 40 m **d.** 80 m

iv. A car moving at 20 m/s brakes uniformly and stops in 40 m. Its retardation is: **[1]**

a. 0.5 m/s^2 **b.** 2.5 m/s^2

c. 5 m/s^2 **d.** 10 m/s^2

v. A particle moves with velocity $v = 6 - 2t$ m/s. The distance it travels in the first 4 s is: **[1]**

a. 2 m **b.** 8 m

c. 9 m **d.** 10 m

vi. A stone dropped from the top of a tower falls the last 44.1 m in the final second of its fall. The tower's height is: **[1]**

a. 78.4 m **b.** 99.2 m

c. 122.5 m **d.** 176.4 m

4 Spot the error **[2]**

Find the mistake in the working and correct it.

A particle moves so that $x = t^2 - 6t$ meters after t seconds. Pratima finds the distance it travels in the first 5 s: "$x(5) - x(0) = -5 - 0 = -5$, so the distance is **5 m**."

5 Short questions **[10]**

Answer the following questions. Show your working.

a. A particle moves along a line so that its position after t seconds is $x = 2t^3 - 15t^2 + 36t + 5$ meters. **[5]**

a. When is it at rest? [2]

b. Find its acceleration at those times. [1]

c. Find the distance it travels in the first 3 s. [2]

Answer:

b. A point moving with uniform acceleration covers 25 m in the half second from $t = 1$ s to $t = 1.5$ s, and 198 m in the eleventh second of its motion. **[5]**

a. Find its acceleration and its initial velocity. [3]

b. Find its velocity at the end of the eleventh second. [2]

Answer: _____

6 Long question **[8]**

Answer the following question. Show your working.

Take $g = 9.8\ \text{m/s}^2$.

a. A body is let go from rest at the top of a smooth plane inclined at θ to the horizontal, at a height h above its foot. Show that it reaches the foot after $\frac{1}{\sin\theta}\sqrt{\frac{2h}{g}}$ seconds, with speed $\sqrt{2gh}$. [4]

b. Two smooth slides both start 4.9 m above the ground; one is inclined at 30°, the other at 60°. Find the time each takes from the top, and the speed at the foot. [3]

c. A stone dropped from the same height reaches the ground in how long? Compare. [1]

Answer: _____

7 Think [3]

Ritu drops a pebble into a well and hears the splash 3.0 s later. She says: "It fell for 3.0 s, so the water is $4.9 \times 3.0^2 = 44.1$ m down." Is the real depth more or less than 44.1 m? Taking sound to travel at 340 m/s, make one correction to her answer.

8 Activity: Measure g with a falling coin (not marked)

You need: a coin, a measuring tape and a phone that records slow-motion video (or a stopwatch and a friend). Drop the coin from rest from each height and time its fall; repeat three times and take the average.

Height h (m)	1.0	1.5	2.0
Time t (s), average			
$\frac{2h}{t^2}$ (m/s^2)			

Is $\frac{2h}{t^2}$ about the same for every height? How close does it come to 9.8 m/s^2?