

**Question 1)** A student uses a simple pendulum of exactly 1m length to determine  $g$ , the acceleration due to gravity. He uses a stopwatch with the least count of 1 sec for this and records 40 seconds for 20 oscillations. For this observation, which of the following statement(s) is (are) true?

- (A) Error  $\Delta T$  in measuring  $T$ , the time period is 0.05 seconds
- (B) Error  $\Delta T$  in measuring  $T$ , the time period is 1 second
- (C) Percentage error in the determination of  $g$  is 5%
- (D) Percentage error in the determination of  $g$  is 2.5%

**Answer: (A) and (C)**

**Solution:**

The relative error in the measurement of time,

$$\Delta t/t = 1\text{s}/40\text{s} = 1/40$$

Time period,  $T = 40\text{s}/20 = 2\text{s}$

Error in the measurement of the time period,  $\Delta T = T \times (\Delta t/t)$

$$= 2\text{s} \times (1/40) = 0.05\text{s}$$

The time period of a simple pendulum is,  $T = 2\pi\sqrt{l/g}$

Therefore,  $T^2 = (4\pi^2 l)/g$

$$\Rightarrow g = (4\pi^2 l)/T^2$$

Therefore,  $(\Delta g/g) = 2\Delta T/T$

$$= 2 \times (0.05/2)$$

$$= 0.05$$

$$(\Delta g/g) \times 100 = 0.05 \times 100 = 5\%$$