1.1 Measurements in Physics

Question Paper

Course	DP IB Physics
Section	1. Measurement & Uncertainties
Topic	1.1 Measurements in Physics
Difficulty	Hard

Time allowed: 20

Score: /10

Percentage: /100

Question 1

The frictional force F on a sphere falling through a fluid is given by the formula:

$$F = 6\pi a\eta v$$

In this equation, a is the radius of the sphere, η is a constant relating to the fluid and v is the velocity of the sphere.

What are the units of η?

A. $kg\,m\,s^{-1}$

B. $kg\,m^{-1}\,s^{-1}$

C. $kg\,m\,s^{-3}$

D. $kg\,m^{-3}\,s^{-3}$

[1 mark]

Question 2

The speed v of a liquid leaving a tube depends on the change in pressure ΔP and the density ρ of the liquid. The speed is given by the equation:

$$v = k\left(\frac{\Delta P}{\rho}\right)^{n}$$

In this equation, k is a constant that has no units.

What is the value of n?

A. $\frac{1}{2}$

B. 1

C. $\frac{3}{2}$

D. 2

[1 mark]

Question 3

Which estimate is realistic?

A. The kinetic energy of a bus travelling on an motor way is 30 000 J

B. The power of a domestic light is 300 W

C. The temperature of a hot oven is 300 K

D. The volume of air in a car tyre is 0.03 m^3

[1 mark]

Question 4

The theory of gas flow through small diameter tubes at low pressures is an important consideration of high vacuum techniques.

One equation used in this theory is:

$$Q = \frac{kr^3(p_1 - p_2)}{L}\sqrt{\frac{M}{RT}}$$

Where k is a unitless constant, r is the radius of the tube, p_1 and p_2 are the pressures at each end of the tube, L is the length of the tube, M is the molar mass of the gas, R is the molar gas constant and T is the thermodynamic temperature of the gas.

What are the base units of Q?

A. kg s^{-1}

B. kg m s^{-1}

C. kg mol^{-1}

D. kg m s^{-2}

[1 mark]

Question 5

What is the correct value for the Gravitational constant?

A. 6.67×10^{-3} nN m^2 kg^{-2}

B. 6.67×10^{5} N mm^2 kg^{-2}

C. 6.67×10^{-20} kN mm^2 kg^{-2}

D. 6.67×10^{-17} N km^2 kg^{-2}

[1 mark]

Question 6

A boy jumps from a wall 5 m high. What is an estimate of the change in momentum of the boy when he lands without rebounding?

A. $4 \times 10^{0}\,\text{kg m s}^{-1}$

B. $4 \times 10^{1}\,\text{kg m s}^{-1}$

C. $4 \times 10^{2}\,\text{kg m s}^{-1}$

D. $4 \times 10^{3}\,\text{kg m s}^{-1}$

[1 mark]

Question 7

When a constant braking force is applied to a vehicle moving at speed v, the distance d moved by the vehicle as it comes to rest is given by the expression:

$$d = kv^2$$

In this equation, k is a constant.

When d is measured in metres and v is measured in metres per second, the constant has a value of k_1.

What is the value of the constant when the distance is measured in metres, and the speed is measured in kilometres per hour?

A. $\frac{k_1}{12.96}$

B. $\frac{k_1}{3.6}$

C. $3.6k_1$

D. $12.96k_1$

[1 mark]

Question 8

What is the unit for the gas constant in fundamental SI units?

A. $kg\,m\,s^{-2}\,K\,mol^{-1}$

B. $kg\,m^2\,s^{-2}\,K^{-1}\,mol^{-1}$

C. $kg^2\,m^2\,s^{-1}\,K^{-1}\,mol$

D. $kg\,m^2\,s^{-2}\,mol^{-1}$

[1 mark]

Question 9

Which of the following gives the correct unit for $\frac{g^3}{G}$?

A. $kg\,s^{-4}$

B. $kg^{-1}\,s^{-4}$

C. $kg\,m^3\,s^{-4}$

D. $kg\,s^{-8}$

[1 mark]

Question 10

The drag coefficient C_d is a number with no units. It is used to compare the drag on different cars at different speeds. It is given by the equation

$$C_d = \frac{2F}{\rho v^n A}$$

F is the drag force on the car, ρ is the density of the air, A is the cross-sectional area of the car and v is the speed of the car.

What is the value of n?

A. 1

B. 2

C. 3

D. 4

[1 mark]