Module 1: Mechanics

1.1.1: Physical Quantities, SI Units and Vectors

1 Which of the following quantities has no dimensions?

I. Magnification

II. Refractive index

III. Universal gravitational constant

IV. Relative density

(A) I and II only (A)

(B) I and III only (B)

(C) II and IV only (C)

(D) I, II and IV only (D)

2 The molar gas constant can be expressed in terms of

(A) $kg\ s^2\ m^{-2}\ mol^{-1}$ (A)

(B) $kg\ m^2\ s^{-2}\ K^{-1}\ mol^{-1}$ (B)

(C) $kg\ m^2\ K^{-1}\ mol^{-1}$ (C)

(D) $kg\ K^{-1}\ mol^{-1}$ (D)

3 Which of the following groups is comprised only of SI base units?

(A) Gram, metre (A)

(B) Newton, pascal (B)

(C) Mole, ampere (C)

(D) Kilogram, newton (D)

Item **4** refers to the following quantities together with their SI base units.

E: $\text{kg m}^2\ \text{s}^{-2}$ *F*: kg m s^{-2} *G*: kg s^{-1}

4 The quantity represented by $\frac{EG}{F}$ is

(A) displacement (A)

(B) pressure (B)

(C) momentum (C)

(D) velocity (D)

5 *F* is the force acting on an area, *A*, and doing an amount of work, *W*, on an object of density ρ. The expression $\frac{F^2}{WA\rho}$ has the unit of

(A) acceleration (A)

(B) speed (B)

(C) displacement (C)

(D) pressure (D)

6 The SI unit of pressure may be expressed as

(A) $\text{kg s}^{-2}\ \text{m}^{-2}$ (A)

(B) $\text{kg s}^{-2}\ \text{m}^{-1}$ (B)

(C) $\text{kg}^2\ \text{s}^{-2}\ \text{m}^{-1}$ (C)

(D) kg m^{-2} (D)

7 Given that *P* is 20.0 MJ and *Q* is 5.0 mJ, then the value of *P* is

(A) $4.0 \times 10^6\ Q$ (A)

(B) $2.5 \times 10^8\ Q$ (B)

(C) $4.0 \times 10^9\ Q$ (C)

(D) $2.5 \times 10^9\ Q$ (D)

Items **8–9** refer to Tia and her baby, mentioned below.

Tia stands on her bathroom scale which registers her mass as (42 ± 1) kg. She then lifts her baby and the new reading on the scale is (46 ± 1) kg.

8 The mass of her baby is

(A) (4 ± 1) kg Ⓐ

(B) (3 ± 1) kg Ⓑ

(C) (4 ± 2) kg Ⓒ

(D) (5 ± 1) kg Ⓓ

9 The percentage error (uncertainty) in the measurement of the baby's mass is

(A) 50% Ⓐ

(B) 25% Ⓑ

(C) 2.5% Ⓒ

(D) 5.0% Ⓓ

10 The diameter, d, of a small circular play area is 5.0 m ± 0.1 m. The area, A, is calculated using the equation $A = \pi \frac{d^2}{4}$. The percentage uncertainty in the result is

(A) 8% Ⓐ

(B) 4% Ⓑ

(C) 1% Ⓒ

(D) 2% Ⓓ

11 In which of the following cases will systematic error be reduced?

(A) Determining the force constant of a spring from the gradient of a force–extension graph produced from the plot of several pairs of readings of force and extension as the spring is loaded. (A)

(B) Setting the pointer of an ammeter to read exactly zero when no current flows through it. (B)

(C) Finding the mean time of a 100 m race using the values measured by three persons, each with a stop watch. (C)

(D) Determining the length of a drinking straw by finding the average value of three measurements of its length. (D)

12 Exactly 210 cm^3 of water of density 1.0 g cm^{-3} is placed in a measuring cylinder. A small object of mass 8.0 g floats when inserted into the cylinder. Determine the new volume reading.

(A) 218 cm^3 (A)

(B) 226 cm^3 (B)

(C) 210 cm^3 (C)

(D) 215 cm^3 (D)

13 The number of moles of uranium-235 atoms in 0.047 kg of uranium-235 is

(A) 2.0 (A)

(B) 0.2 (B)

(C) 5.0 (C)

(D) 0.5 (D)

14 The molar mass of carbon is 12 g. If the density of diamond is 3500 kg m^{-3}, then the number of carbon atoms in 2.0 cm^3 of diamond is

(A) 1.0×10^{23} (A)

(B) 3.5×10^{17} (B)

(C) 1.0×10^{24} (C)

(D) 3.5×10^{23} (D)