1)

Which of the following is a scalar quantity?

A acceleration

B mass

C momentum

D velocity

2)

Which pair contains one vector and one scalar quantity?

A displacement : acceleration

B force : kinetic energy

C momentum : velocity

D power : speed

3)

Which pair of units are both SI base units?

A ampere, degree celsius

B ampere, kelvin

C coulomb, degree celsius

D coulomb, kelvin

4)

The prefix 'centi' indicates x 10^{-2}. That is, 1 centimetre is equal to 1×10^{-2} metre.

Which line in the table correctly indicates the prefixes micro, nano and pico?

	$\times 10^{-12}$	$\times 10^{-9}$	$\times 10^{-6}$
A	nano	micro	pico
B	micro	pico	nano
C	pico	nano	micro
D	pico	micro	nano

5)

The notation μs is used as an abbreviation for a certain unit of time.

What is the name and value of this unit?

	name	value
A	microsecond	10^{-6} s
B	microsecond	10^{-3} s
C	millisecond	10^{-6} s
D	millisecond	10^{-3} s

6)

Which line of the table gives values that are equal to a time of 1 ps (one picosecond) and a distance of 1 Gm (one gigametre)?

	time of 1 ps	distance of 1 Gm
A	10^{-9} s	10^{9} m
B	10^{-9} s	10^{12} m
C	10^{-12} s	10^{9} m
D	10^{-12} s	10^{12} m

7)

Decimal sub-multiples and multiples of units are indicated using a prefix to the unit. For example, the prefix milli (m) represents 10^{-3}.

Which of the following gives the sub-multiples or multiples represented by pico (p) and giga (G)?

	pico (p)	giga (G)
A	10^{-9}	10^{9}
B	10^{-9}	10^{12}
C	10^{-12}	10^{9}
D	10^{-12}	10^{12}

8)

Which of the following pairs of units are both SI base units?

A ampere, degree celsius

B ampere, kelvin

C coulomb, degree celsius

D coulomb, kelvin

9)

Which formula could be correct for the speed v of ocean waves in terms of the density ρ of sea-water, the acceleration of free fall g, the depth h of the ocean and the wavelength λ?

A $v = \sqrt{g\lambda}$ **B** $v = \sqrt{\frac{g}{h}}$ **C** $v = \sqrt{\rho g h}$ **D** $v = \sqrt{\frac{g}{\rho}}$

10)

The unit of work, the joule, may be defined as the work done when the point of application of a force of 1 newton is moved a distance of 1 metre in the direction of the force.

Express the joule in terms of the base units of mass, length and time, the kg, m and s.

A $\text{kg m}^{-1}\text{s}^{2}$ **B** $\text{kg m}^{2}\text{s}^{-2}$ **C** $\text{kg m}^{2}\text{s}^{-1}$ **D** kg s^{-2}

11)

The momentum of an object of mass m is p.

Which quantity has the same base units as $\frac{p^2}{m}$?

A energy

B force

C power

D velocity

12)

Which of the following definitions is correct and uses only quantities rather than units?

A Density is mass per cubic metre.

B Potential difference is energy per unit current.

C Pressure is force per unit area.

D Speed is distance travelled per second.

13)

When a beam of light is incident on a surface, it delivers energy to the surface. The intensity of the beam is defined as the energy delivered per unit area per unit time.

What is the unit of intensity, expressed in SI base units?

A $kg\,m^{-2}\,s^{-1}$ **B** $kg\,m^{2}\,s^{-3}$ **C** $kg\,s^{-2}$ **D** $kg\,s^{-3}$

14)

A metal sphere of radius r is dropped into a tank of water. As it sinks at speed v, it experiences a drag force F given by $F = krv$, where k is a constant.

What are the SI base units of k?

A $kg\,m^{2}s^{-1}$ **B** $kg\,m^{-2}s^{-2}$ **C** $kg\,m^{-1}s^{-1}$ **D** $kg\,m\,s^{-2}$

15)

An Olympic athlete of mass 80 kg competes in a 100 m race.

What is the best estimate of his mean kinetic energy during the race?

A $4 \times 10^{2}\,J$ **B** $4 \times 10^{3}\,J$ **C** $4 \times 10^{4}\,J$ **D** $4 \times 10^{5}\,J$

16)

Which expression involving base units is equivalent to the volt?

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

B $kg\,m\,s^{-2}A$

C $kg\,m^{2}s^{-1}A$

D $kg\,m^{2}s^{-3}A^{-1}$

17)

(a) (i) Define *density*.

.....

.....

(ii) State the base units in which density is measured.

.....

[2]

(b) The speed v of sound in a gas is given by the expression

$$v = \sqrt{\left(\frac{\gamma p}{\rho}\right)},$$

where p is the pressure of the gas of density ρ. γ is a constant.

Given that p has the base units of $\text{kg m}^{-1}\text{ s}^{-2}$, show that the constant γ has no unit. [3]

18)

Complete Fig. 1.1 to show each quantity and its unit.

quantity	*unit*
speed	m s^{-1}
density	.....
.....	s^{-1}
electric field strength	.....
.....	kg m s^{-1}

Fig. 1.1

19)

(a) **(i)** Define *pressure*.

.....

..... [1]

(ii) State the units of pressure in base units.

..... [1]

(b) The pressure p at a depth h in an incompressible fluid of density ρ is given by

$$p = \rho g h,$$

where g is the acceleration of free fall.
Use base units to check the homogeneity of this equation.

.....

.....

.....

..... [3]

20)

(a) Derive the SI base unit of force.

SI base unit of force = ... [1]

(b) A spherical ball of radius r experiences a resistive force F due to the air as it moves through the air at speed v. The resistive force F is given by the expression

$$F = crv,$$

where c is a constant.

Derive the SI base unit of the constant c.

SI base unit of c = ... [1]

21)

(a) The current in a wire is I. Charge Q passes one point in the wire in time t. State

(i) the relation between I, Q and t,

..... [1]

(ii) which of the quantities I, Q and t are base quantities.

.....

..... [2]

(b) The current in the wire is due to electrons, each with charge q, that move with speed v along the wire. There are n of these electrons per unit volume.
For a wire having a cross-sectional area S, the current I is given by the equation

$$I = nSqv^k,$$

where k is a constant.

(i) State the units of I, n, S, q and v in terms of the base units.

I .....

n .....

S .....

q .....

v .....
[3]

(ii) By considering the homogeneity of the equation, determine the value of k.

k = ... [2]

22)

(a) Two of the SI base quantities and their units are mass (kg) and length (m).

Name three other SI base quantities and their units.

1. quantity ..... unit .....

2. quantity ..... unit .....

3. quantity ..... unit .....

[3]

(b) The pressure p due to a liquid of density ρ is related to the depth h by the expression

$$p = \rho g h,$$

where g is the acceleration of free fall.

Use this expression to determine the derived units of pressure. Explain your working.

[5]