A LEVEL 9702

PHYSICS

TOPICAL PAPER 1

2016 - 2022

Physics with SHAHZAD ZIA

Compiled and Arranged by:

Shahzad Zia

0300 4173806 / 0331 0408866

STUDENTS RESOURCE

Airport Road :
Shop 23-24,
Basement Faysal Bank,
Near Yasir Broast,
Airport Road, Lahore.
Mob: 0321-4567519
Tel: 042-35700707

DHA Ph-V:
Plaza No. 52-CCA, Ph-5
DHA Lahore Cantt.
Mob: 0321-4924519
Tel: 042-37180077

Johar Town :
Opp. Beaconhouse JTC
Adjacent Jamia Masjid PIA
Society Shadewal Chowk,
Johar Town Lahore.
Mob: 0313-4567519
Tel: 042-35227007

Bahria Town:
70 - Umer Block
Main Boulevard
Commercial Area
Bahria Town Lahore.
Mob: 0315-4567519
Tel: 042-35342995

studentsresource.net studentsresourc /students.resource /students.resource

Book Title: AS Level Physics Topical Paper 1 MCQs

Syllabus Code 9702

Compiler: Shahzad Zia +92-3004173806

Syllabus: Syllabus 2022-2024

Edition: 2023

Published by: STUDENTS RESOURCE **Airport Road** 0423-5700707

Price: 2300/-

Preface

A Level Physics Paper 1 Topical Pastpaper Questions provide complete practice and revision for students taking A Level Physics (9702) Examination to be held in 2022 and onwards.

It has been an established fact that the questions from past papers provide the students with the best practice. They are able to apply what they have learnt and therefore, can assess their knowledge of the subject.

This book contains

- more than **2000 Questions** carefully selected from 2016 to 2022 past papersincluding Feb/March series.
- The topics are listed according to new syllabus for 2022 and onwards.
- The questions and parts from abandoned topics have been removed.
- **Answer Key** is provided at the end of the book for reference.

Shahzad Zia
0300 4173806
0331 0408866

Acknowledgement

Contents

Data

acceleration of free fall	$g = 9.81\ \text{m s}^{-2}$
speed of light in free space	$c = 3.00 \times 10^{8}\ \text{m s}^{-1}$
elementary charge	$e = 1.60 \times 10^{-19}\ \text{C}$
unified atomic mass unit	$1\ \text{u} = 1.66 \times 10^{-27}\ \text{kg}$
rest mass of proton	$m_\text{p} = 1.67 \times 10^{-27}\ \text{kg}$
rest mass of electron	$m_\text{e} = 9.11 \times 10^{-31}\ \text{kg}$
Avogadro constant	$N_\text{A} = 6.02 \times 10^{23}\ \text{mol}^{-1}$
molar gas constant	$R = 8.31\ \text{J K}^{-1}\ \text{mol}^{-1}$
Boltzmann constant	$k = 1.38 \times 10^{-23}\ \text{J K}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11}\ \text{N m}^2\ \text{kg}^{-2}$
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\ \text{F m}^{-1}$ $\left(\frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^{9}\ \text{m F}^{-1}\right)$
Planck constant	$h = 6.63 \times 10^{-34}\ \text{J s}$
Stefan–Boltzmann constant	$\sigma = 5.67 \times 10^{-8}\ \text{W m}^{-2}\ \text{K}^{-4}$

Formulae

uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
hydrostatic pressure	$\Delta p = \rho g \Delta h$
upthrust	$F = \rho g V$
Doppler effect for sound waves	$f_\text{o} = \frac{f_\text{s} v}{v \pm v_\text{s}}$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

gravitational potential $\phi = -\frac{GM}{r}$

gravitational potential energy $E_P = -\frac{GMm}{r}$

pressure of an ideal gas $p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$

simple harmonic motion $a = -\omega^2 x$

velocity of particle in s.h.m. $v = v_0 \cos \omega t$

$v = \pm \omega \sqrt{(x_0^2 - x^2)}$

electric potential $V = \frac{Q}{4\pi\varepsilon_0 r}$

electrical potential energy $E_P = \frac{Qq}{4\pi\varepsilon_0 r}$

capacitors in series $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + ...$

capacitors in parallel $C = C_1 + C_2 + ...$

discharge of a capacitor $x = x_0 e^{-\frac{t}{RC}}$

Hall voltage $V_H = \frac{BI}{ntq}$

alternating current/voltage $x = x_0 \sin \omega t$

radioactive decay $x = x_0 e^{-\lambda t}$

decay constant $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

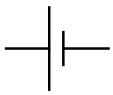
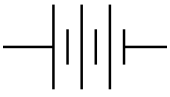
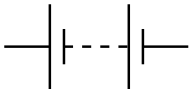
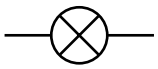
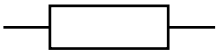
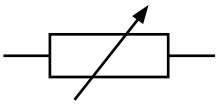
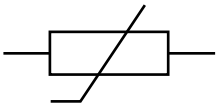
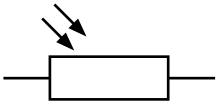
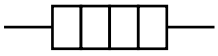
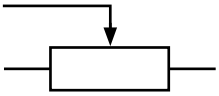
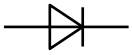
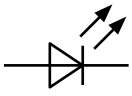
intensity reflection coefficient $\frac{I_R}{I_0} = \frac{(Z_1 - Z_2)^2}{(Z_1 + Z_2)^2}$

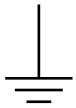
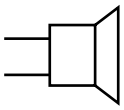
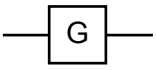
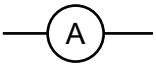
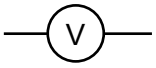
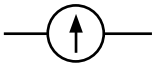
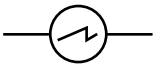
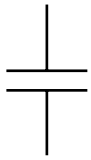
Stefan–Boltzmann law $L = 4\pi\sigma r^2 T^4$

Doppler redshift $\frac{\Delta\lambda}{\lambda} \approx \frac{\Delta f}{f} \approx \frac{v}{c}$

Circuit Symbols

The following table gives a guide to the circuit symbols that may be used in examination papers.

cell	
battery of cells	 or 
power supply	
a.c. power supply	
junction of conductors	
lamp	
fixed resistor	
variable resistor	
thermistor	
light-dependent resistor	
heater	
potentiometer	
diode	
light-emitting diode	

switch	
earth	
electric bell	
buzzer	
microphone	
loudspeaker	
motor	
generator	
ammeter	
voltmeter	
galvanometer	
oscilloscope	
capacitor	

Summary of Key Quantities, Symbols and Units

The list below is intended as a guide to the more important quantities which might be encountered in teaching and used in question papers.

This list is for use in both AS Level and full A Level qualifications.

Quantity	Usual symbols	Usual unit
Base quantities		
mass	m	kg
length	l	m
time	t	s
electric current	I	A
thermodynamic temperature	T	K
amount of substance	n	mol
Other quantities		
acceleration	a	$m\,s^{-2}$
acceleration of free fall	g	$m\,s^{-2}$
activity of radioactive source	A	Bq
amplitude	x_0	m
angle	θ	°, rad
angular displacement	θ	°, rad
angular frequency	ω	$rad\,s^{-1}$
angular speed	ω	$rad\,s^{-1}$
angular velocity	ω	$rad\,s^{-1}$
area	A	m^2
atomic mass	m_a	kg, u
attenuation/absorption coefficient	μ	m^{-1}
Avogadro constant	N_A	mol^{-1}
Boltzmann constant	k	$J\,K^{-1}$
capacitance	C	F
Celsius temperature	θ	°C
decay constant	λ	s^{-1}
density	ρ	$kg\,m^{-3}$
displacement	s, x	m
distance	d	m
efficiency	η	
electric charge	q, Q	C
electric field strength	E	$N\,C^{-1}$, $V\,m^{-1}$
electric potential	V	V
electric potential difference	V	V
electromotive force	E	V
electron mass	m_e	kg, u
elementary charge	e	C

Quantity	Usual symbols	Usual unit
energy	E, U, W	J
force	F	N
frequency	f	Hz
gravitational constant	G	$\mathrm{N\,m^2\,kg^{-2}}$
gravitational field strength	g	$\mathrm{N\,kg^{-1}}$
gravitational potential	ϕ	$\mathrm{J\,kg^{-1}}$
half-life	$t_{\frac{1}{2}}$	s
Hall voltage	V_H	V
heating	q, Q	J
Hubble constant	H_0	$\mathrm{s^{-1}}$
intensity	I	$\mathrm{W\,m^{-2}}$
internal energy change	ΔU	J
kinetic energy	E_K	J
luminosity	L	W
magnetic flux	Φ	Wb
magnetic flux density	B	T
mean-square speed	$<c^2>$	$\mathrm{m^2\,s^{-2}}$
molar gas constant	R	$\mathrm{J\,mol^{-1}\,K^{-1}}$
moment of force	T	N m
momentum	p	N s
neutron mass	m_n	kg, u
neutron number	N	
nucleon number	A	
number	N, n, m	
number density (number per unit volume)	n	$\mathrm{m^{-3}}$
period	T	s
permeability of free space	μ_0	$\mathrm{H\,m^{-1}}$
permittivity of free space	ε_0	$\mathrm{F\,m^{-1}}$
phase difference	ϕ	°, rad
Planck constant	h	J s
potential energy	E_p	J
power	P	W
pressure	p	Pa
proton mass	m_p	kg, u
proton number	Z	
radiant flux intensity	F	$\mathrm{W\,m^{-2}}$
resistance	R	Ω
resistivity	ρ	Ω m

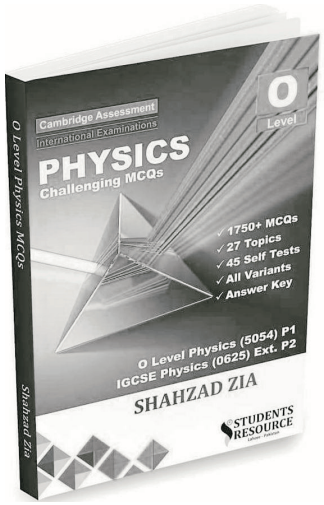
Quantity	Usual symbols	Usual unit
specific acoustic impedance	Z	$\mathrm{kg\,m^{-2}\,s^{-1}}$
specific heat capacity	c	$\mathrm{J\,kg^{-1}\,K^{-1}}$
specific latent heat	L	$\mathrm{J\,kg^{-1}}$
speed	u, v, w, c	$\mathrm{m\,s^{-1}}$
speed of electromagnetic waves	c	$\mathrm{m\,s^{-1}}$
spring constant	k	$\mathrm{N\,m^{-1}}$
Stefan–Boltzmann constant	σ	$\mathrm{W\,m^{-2}\,K^{-4}}$
strain	ε	
stress	σ	Pa
time constant	τ	s
torque	T	N m
velocity	u, v, w, c	$\mathrm{m\,s^{-1}}$
volume	V, v	$\mathrm{m^3}$
wavelength	λ	m
weight	W	N
work	w, W	J
work function energy	Φ	J
Young modulus	E	Pa

Command Words

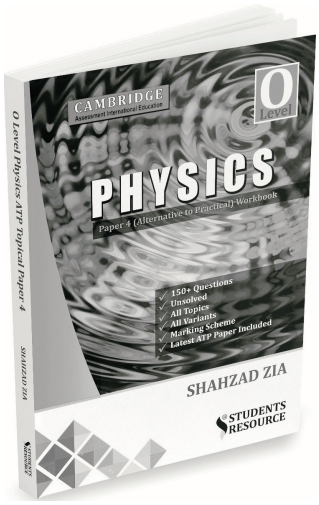
Command words and their meanings help candidates know what is expected from them in the exam. The table below includes command words used in the assessment for this syllabus. The use of the command word will relate to the subject context.

Command word	What it means
Calculate	work out from given facts, figures or information
Comment	give an informed opinion
Compare	identify/comment on similarities and/or differences
Define	give precise meaning
Determine	establish an answer using the information available
Explain	set out purposes or reasons / make the relationships between things evident / provide why and/or how and support with relevant evidence
Give	produce an answer from a given source or recall/memory
Identify	name/select/recognise
Justify	support a case with evidence/argument
Predict	suggest what may happen based on available information
Show (that)	provide structured evidence that leads to a given result
Sketch	make a simple freehand drawing showing the key features
State	express in clear terms
Suggest	apply knowledge and understanding to situations where there are a range of valid responses in order to make proposals

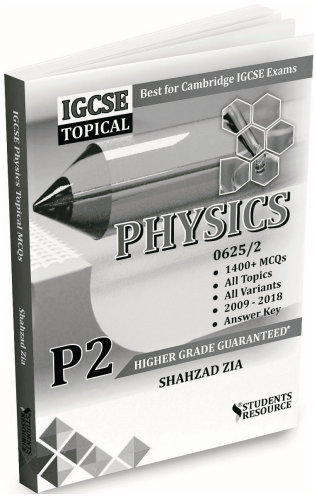
Other Resources by the Author



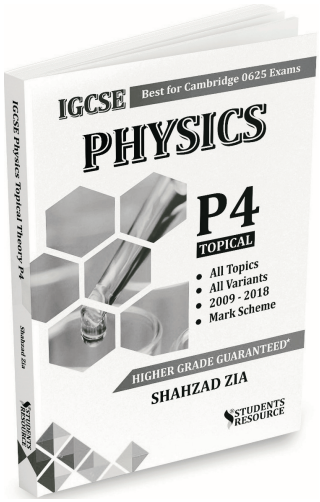
O Level Physics Topical MCQs Self Tests
Book Code: **717**
Published By: **Students Resource**



O Level Physics Topical (ATP)
Book Code: **714**
Published By: **Students Resource**



IGCSE Physics Topical MCQs (P2)
Book Code: **751**
Published By: **Students Resource**



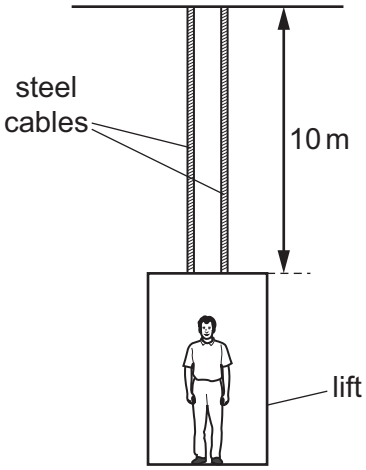
IGCSE Physics Topical Questions (P4)
Book Code: **752**
Published By: **Students Resource**

1 Physical Quantities and Units

1.1 Physical Quantities

2016

1 A lift is supported by two steel cables, each of length 10 m and diameter 0.5 cm.



NOT TO
SCALE

The cables extend by 1 mm when a man of mass 80 kg steps into the lift.
What is the best estimate of the value of the Young modulus of the steel?

A $2 \times 10^{10}\,\text{N m}^{-2}$ **C** $2 \times 10^{11}\,\text{N m}^{-2}$

B $4 \times 10^{10}\,\text{N m}^{-2}$ **D** $4 \times 10^{11}\,\text{N m}^{-2}$

(M/J/2016/P11/Q.3)

2 Which quantity with its unit is correct?

A acceleration of a bicycle = $1.4\,\text{m s}^{-1}$

B electric current in a lamp = $0.25\,\text{A s}^{-1}$

C electric potential difference across a battery = $8.0\,\text{J C}^{-1}$

D kinetic energy of a car = $4500\,\text{N m}^{-1}$

(M/J/2016/P12/Q.1)

2017

1 Which expression has the same SI base units as pressure?

A $\frac{\text{force}}{\text{length} \times \text{speed}}$ **B** $\frac{\text{force}}{\text{length} \times \text{time}}$ **C** $\frac{\text{mass}}{\text{length} \times (\text{time})^2}$ **D** $\frac{\text{mass} \times (\text{time})^2}{\text{length}}$

(F/M/2017/P12/Q.1)

2 What is an approximate value for the speed of sound in air?

A $30\,\text{m s}^{-1}$ **B** $300\,\text{m s}^{-1}$ **C** $30\,000\,\text{m s}^{-1}$ **D** $300\,000\,000\,\text{m s}^{-1}$

(F/M/2017/P12/Q.2)

3 A student creates a table to show reasonable estimates of some physical quantities.
Which row is **not** a reasonable estimate?

	quantity	value
A	current in a fan heater	12 A
B	mass of an adult person	70 kg
C	speed of an Olympic sprint runner	$10\,\text{m s}^{-1}$
D	water pressure at the bottom of a garden pond	10^6 Pa

(M/J/2017/P11/Q.1)

4 What is the approximate average speed of a winning female Olympic athlete running a 100 m race?

A $6\,\text{m s}^{-1}$ **B** $9\,\text{m s}^{-1}$ **C** $12\,\text{m s}^{-1}$ **D** $15\,\text{m s}^{-1}$

(M/J/2017/P12/Q.1)

5 What is the best estimate of the kinetic energy of a family car travelling at $50\,\text{km h}^{-1}$?

A 1.5×10^3 J **B** 1.5×10^5 J **C** 1.5×10^7 J **D** 1.5×10^9 J

(M/J/2017/P13/Q.1)

6 What is a typical value of the wavelength of a microwave travelling in a vacuum?

A 3 000 000 pm **B** 30 nm **C** 30 000 μm **D** 3000 mm

(O/N/2017/P11/Q.4)

2018

1 A sheet of gold leaf has a thickness of 0.125 μm. A gold atom has a radius of 174 pm.
Approximately how many layers of atoms are there in the sheet?

A 4 **B** 7 **C** 400 **D** 700

(M/J/2018/P12/Q.1)

2 What is the best way of describing a physical quantity?

A a quantity with a magnitude and a direction but no unit

B a quantity with a magnitude and a unit

C a quantity with a magnitude but no direction

D a quantity with a unit but no magnitude

(M/J/2018/P13/Q.1)

3 The radius of the Earth is approximately 6.4×10^6 m, and the radius of the Moon is approximately 1.7×10^6 m. A student wishes to build a scale model of the Solar System in the classroom, using a football of radius 0.12 m to represent the Earth.
Which object would best represent the Moon?

A basketball **B** cherry **C** golf ball **D** tennis ball

(O/N/2018/P11/Q.1)

4 A car is travelling at a speed of 20 m s^{-1}. The table contains values for the kinetic energy and the momentum of the car.
Which values are reasonable estimates?

	kinetic energy / J	momentum / kg m s^{-1}
A	3×10^5	3×10^4
B	3×10^5	5×10^6
C	2×10^7	3×10^4
D	2×10^7	5×10^6

(O/N/2018/P12/Q.1)

5 Which statement is **not** a reasonable estimate?

A Atmospheric pressure at sea level is about 1×10^5 Pa.

B Light takes 5×10^2 s to reach us from the Sun.

C The frequency of ultraviolet light is 3×10^{12} Hz.

D The lifespan of a man is about 2×10^9 s.

(O/N/2018/P13/Q.1)

2019

1 What is equivalent to 2000 microvolts?

A $2\,\mu J\,C^{-1}$ **B** $2\,mV$ **C** $2\,pV$ **D** $2000\,mV$

(M/J/2019/P12/Q.1)

2 Osmium, a naturally occurring element, has a density of $23\,000\,kg\,m^{-3}$.
What is also a value of the density of osmium?

A $2.3 \times 10^{4}\,\mu g\,cm^{-3}$

B $2.3 \times 10^{4}\,g\,cm^{-3}$

C $2.3\,kg\,cm^{-3}$

D $2.3 \times 10^{-2}\,kg\,cm^{-3}$

(M/J/2019/P13/Q.2)

3 What is the approximate kinetic energy of an Olympic athlete when running at maximum speed during a 100 m race?

A 400 J **B** 4000 J **C** 40 000 J **D** 400 000 J

(M/J/2019/P13/Q.4)

4 For which quantity is the magnitude a reasonable estimate?

A frequency of a radio wave 500 pHz

B mass of an atom 500 μg

C the Young modulus of a metal 500 kPa

D wavelength of green light 500 nm

(O/N/2019/P11/Q.1)

5 A cyclist has a speed of $5\,m\,s^{-1}$ and a small car has a speed of $12\,m\,s^{-1}$.
Which statement does **not** give a reasonable estimate?

A The kinetic energy of the cyclist is 1×10^{3} J.

B The kinetic energy of the car is 7×10^{4} J.

C The momentum of the cyclist is $4 \times 10^{2}\,kg\,m\,s^{-1}$.

D The momentum of the car is $2 \times 10^{5}\,kg\,m\,s^{-1}$.

(O/N/2019/P12/Q.1)

6 Which expression gives an SI base quantity?

A charge per unit time

B force per unit area

C mass per unit volume

D work done per unit distance

(O/N/2019/P12/Q.2)

2020

1 The table shows some measurable quantities.
Which row gives the correct order of magnitude of the measurable quantity in the stated unit?

	measurable quantity	order of magnitude	unit
A	mass of a coin	10^{-4}	kg
B	thickness of a sheet of paper	10^{-2}	m
C	weight of an apple	10^{0}	N
D	temperature of a person's body	10^{1}	K

(F/M/2020/P12/Q.1)

2 What is a reasonable estimate of the kinetic energy of a car travelling at a speed of $30\,m\,s^{-1}$?

A $10^{2}\,J$ **B** $10^{4}\,J$ **C** $10^{6}\,J$ **D** $10^{8}\,J$

(M/J/2020/P11/Q.1)

3 What is a reasonable estimate of the mass of a raindrop?

A $10^{1}\,kg$ **B** $10^{-1}\,kg$ **C** $10^{-3}\,kg$ **D** $10^{-5}\,kg$

(M/J/2020/P12/Q.1)

4 A man is running a race in a straight line.
What is an approximate value of his kinetic energy?

A 10 J **B** 100 J **C** 1000 J **D** 10 000 J

(M/J/2020/P13/Q.1)

5 Which quantity is a physical quantity?

A atomic number **C** number density of charge carriers

B efficiency **D** strain

(O/N/2020/P11/Q.1)

6 A student uses the volume of a metal coin in order to determine the density of the metal.
What is **not** needed in order to determine an estimate of the volume of the coin?

A estimate of the diameter **C** estimate of the thickness

B estimate of the mass **D** use of the formula for the volume of a cylinder

(O/N/2020/P12/Q.1)

7 What is a reasonable estimate of the volume of a fully inflated standard football?

A $600\,cm^{3}$ **B** $6000\,cm^{3}$ **C** $60\,000\,cm^{3}$ **D** $600\,000\,cm^{3}$

(O/N/2020/P13/Q.1)

2021

1 What is a reasonable estimate for the density of sand?

A $2 \times 10^2\,\text{g cm}^{-3}$ **B** $2 \times 10^3\,\text{g cm}^{-3}$ **C** $2 \times 10^1\,\text{kg m}^{-3}$ **D** $2 \times 10^3\,\text{kg m}^{-3}$

(F/M/2021/P12/Q.1)

2 What is a reasonable estimate of the volume of an adult person?

A $0.10\,\text{m}^3$ **B** $0.50\,\text{m}^3$ **C** $1.0\,\text{m}^3$ **D** $2.0\,\text{m}^3$

(M/J/2021/P11/Q.1)

3 What is **not** a reasonable estimate of the physical property indicated?

A $2 \times 10^3\,\text{W}$ for the power dissipated by the heating element of an electric kettle

B $4 \times 10^2\,\text{m}^3$ for the volume of water in a swimming pool

C $5 \times 10^5\,\text{N s}$ for the momentum of a lorry moving along a road

D $6 \times 10^2\,\text{N}$ for the weight of a fully grown racehorse

(M/J/2021/P12/Q.1)

4 What is a reasonable estimate of the kinetic energy of an Olympic athlete sprinting in a 100 m race?

A 40 J **B** 400 J **C** 4000 J **D** 40 000 J

(M/J/2021/P13/Q.1)

5 What is essential when recording a measurement of a physical quantity?

A the measurement has an SI unit

B the measurement has a unit and a number

C the measurement has a unit given as a base unit

D the measurement is from an analogue scale

(O/N/2021/P11/Q.1)

6 Which row shows what all physical quantities must have?

	magnitude	direction	unit
A	✓	✓	✓
B	✓	✓	✗
C	✓	✗	✓
D	✗	✗	✓

(O/N/2021/P12/Q.1)

7 A paperback book contains 210 sheets of paper (pages). Its thickness is measured with a ruler, as shown.

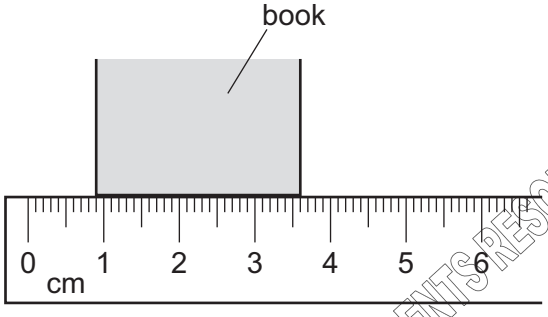
What is the average thickness of one sheet one sheet of the paper in the book?

A 0.013 mm

B 0.017 mm

C 0.13 mm

D 0.17 mm



(O/N/2021/P13/Q.1)

2022

1 Which term represents a physical quantity?

A metre
B percentage uncertainty
C quark flavour
D spring constant

(M/J/2022/P11/Q.1)

2 Which estimate is reasonable?

A 1×10^{-3} kg for the mass of a grain of sand
B 1×10^{-2} m^3 for the volume of a tennis ball
C 1×10^{0} J for the work done lifting an apple from waist height to head height
D 1×10^{4} W for the power of a light bulb in a house

(M/J/2022/P12/Q.1)

3 Which pair of quantities are physical quantities?

A charge and ampere
B efficiency and kilogram
C pascal and strain
D period and potential difference

(M/J/2022/P13/Q.1)

4 What is needed to accurately represent all physical quantities?

A a base unit and a number
B a unit and a number expressed in standard form (scientific notation)
C a unit and a numerical magnitude
D an SI unit and a numerical magnitude

(O/N/2022/P11/Q.1)

5 Which quantity is a physical quantity?

A flavour **B** kelvin **C** minute **D** potential difference

(O/N/2022/P12/Q.1)

6 A train of mass 600 000 kg moves with a speed of 100 km h^{-1}.
What is the order of magnitude of the kinetic energy of the train?

A 10^6 J **B** 10^8 J **C** 10^{10} J **D** 10^{12} J

(O/N/2022/P13/Q.1)

1.2 SI Units

2016

1 The prefixes nano (n), micro (μ) and pico (p) are often used with units.
Which row shows their correct values?

	n	μ	p
A	10^{-6}	10^{-9}	10^{-12}
B	10^{-6}	10^{-12}	10^{-9}
C	10^{-9}	10^{-6}	10^{-12}
D	10^{-12}	10^{-9}	10^{-6}

(F/M/2016/P12/Q.1)

2 The SI unit of specific heat capacity is $\mathrm{J\,kg^{-1}\,K^{-1}}$.
What is the unit of specific heat capacity expressed in SI base units?

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

(F/M/2016/P12/Q.3)

3 Which pair of quantities do **not** have the same SI base units?

A electromotive force and electric potential difference
B pressure and stress
C spring constant and moment of a force
D torque and work

(M/J/2016/P11/Q.2)

4 The luminosity L of a star is given by

$$L = 4\pi r^2 \sigma T^4$$

where
r is the radius of the star,
T is the temperature of the star,
σ is a constant with units $\mathrm{W\,m^{-2}\,K^{-4}}$.

What are the SI base units of L?

A $\mathrm{kg\,m^2\,s^{-1}}$ **B** $\mathrm{kg\,m^2\,s^{-2}}$ **C** $\mathrm{kg\,m^2\,s^{-3}}$ **D** $\mathrm{kg\,m^2\,s^{-4}}$

(M/J/2016/P12/Q.2)

5 Which list contains only SI base units?

A ampere, kelvin, joule, gram
B kilogram, newton, metre, ampere
C metre, coulomb, second, kelvin
D second, kelvin, ampere, kilogram

(M/J/2016/P13/Q.1)

6 The stress σ needed to fracture a particular solid is given by the equation

$$\sigma = k\sqrt{\frac{\gamma E}{d}}$$

where E is the Young modulus, d is the distance between planes of atoms, and k is a constant with no units. What are the SI base units of γ?

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

(M/J/2016/P13/Q.2)

7 The force F between two point charges q_1 and q_2, a distance r apart, is given by the equation

$$F = \frac{kq_1q_2}{r^2}$$

where k is a constant.

What are the SI base units of k?

A $kg\,m^3\,s^{-4}\,A^2$ **B** $kg\,m^3\,s^{-4}\,A^{-2}$ **C** $kg\,m^3\,A^2$ **D** $kg\,m^3\,A^{-2}$

(O/N/2016/P13/Q.2) (O/N/2016/P11/Q.2)

8 The speed v of sound in a gas is given by the equation

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

where P is the pressure of the gas, ρ is its density and γ is a constant.

What are the SI base units of γ?

A $m^{-1}\,s$ **B** $m^3\,s^{-3}$ **C** $m^{-4}\,s^{-4}$ **D** no units

(O/N/2016/P12/Q.2)

2017

1 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

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

where 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

(M/J/2017/P11/Q.3)

2 What correctly expresses the volt in terms of SI base units?

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

(M/J/2017/P12/Q.3)

3 Which expression using SI base units is equivalent to the volt?

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

(M/J/2017/P13/Q.3)

4 Which SI unit, expressed in base units, is **not** correct?

A unit of force, $\mathrm{kg\,m\,s^{-2}}$
B unit of momentum, $\mathrm{kg\,m\,s^{-1}}$
C unit of pressure, $\mathrm{kg\,m^{-2}\,s^{-2}}$
D unit of work, $\mathrm{kg\,m^2\,s^{-2}}$

(O/N/2017/P11/Q.1)

5 Which pair of units are **not** the same when expressed in SI base units?

A $\mathrm{m\,s^{-2}}$ and $\mathrm{N\,kg^{-1}}$
B $\mathrm{N\,s}$ and $\mathrm{kg\,m\,s^{-1}}$
C Pa and $\mathrm{N\,m^{-2}}$
D $\mathrm{V\,m^{-2}}$ and $\mathrm{N\,C^{-1}}$

(O/N/2017/P12/Q.1)

6 The units of specific heat capacity are $\mathrm{J\,kg^{-1}\,K^{-1}}$.
What are the SI base units of specific heat capacity?

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

(O/N/2017/P12/Q.3)

7 How many cubic nanometres, $\mathrm{nm^3}$, are in a cubic micrometre, $\mu\mathrm{m^3}$?

A 10^3 **B** 10^6 **C** 10^9 **D** 10^{12}

(O/N/2017/P13/Q.1)

8 The maximum theoretical power P of a wind turbine is given by the equation

$$P = k\rho A v^n$$

where ρ is the density of air, A is the area swept by the turbine blades, v is the speed of the air and k is a constant with no units.
What is the value of n?

A 1 **B** 2 **C** 3 **D** 4

(O/N/2017/P13/Q.2)

2018

1 Which unit is equivalent to the coulomb?

A ampere per second
B joule per volt
C watt per ampere
D watt per volt

(F/M/2018/P12/Q.1)

2 Which row shows a quantity and an **incorrect** unit?

	quantity	unit
A	efficiency	no unit
B	moment of force	$\mathrm{N\,m^{-1}}$
C	momentum	N s
D	work done	J

(F/M/2018/P12/Q.2)

3 What is a unit for stress?

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

(M/J/2018/P11/Q.1)

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

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

where 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

(M/J/2018/P12/Q.2)

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

(O/N/2018/P11/Q.2)

6 What is the unit of resistance when expressed in SI base units?

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

(O/N/2018/P12/Q.2)

7 Three of these quantities have the same unit.
Which quantity has a different unit?

A $\frac{\text{energy}}{\text{distance}}$ **B** force **C** power × time **D** rate of change of momentum

(O/N/2018/P13/Q.2)

2019

1 At temperatures close to 0 K, the specific heat capacity c of a particular solid is given by $c = bT^3$, where T is the temperature and b is a constant, characteristic of the solid.
The SI unit of specific heat capacity is $\text{J kg}^{-1}\text{ K}^{-1}$.
What is the unit of constant b, expressed in SI base units?

A $\text{m}^2\text{ s}^{-2}\text{ K}^{-3}$ **B** $\text{m}^2\text{ s}^{-2}\text{ K}^{-4}$ **C** $\text{kg m}^2\text{ s}^{-2}\text{ K}^{-3}$ **D** $\text{kg m}^2\text{ s}^{-2}\text{ K}^{-4}$

(F/M/2019/P12/Q.2)

2 Which unit can be expressed in base units as $\text{kg m}^2\text{ s}^{-2}$?

A joule **B** newton **C** pascal **D** watt

(M/J/2019/P11/Q.1)

3 The luminosity L of a star is given by

$$L = 4\pi r^2 \sigma T^4$$

where

r is the radius of the star,
T is the temperature of the star and
σ is a constant with units $\text{W m}^{-2}\text{ K}^{-4}$.

What are the SI base units of L?

A $\text{kg m}^2\text{ s}^{-1}$ **B** $\text{kg m}^2\text{ s}^{-2}$ **C** $\text{kg m}^2\text{ s}^{-3}$ **D** $\text{kg m}^2\text{ s}^{-4}$

(M/J/2019/P11/Q.2)

4 What is the number of SI base units required to express electric field strength and power?

	electric field strength	power
A	3	3
B	3	2
C	4	2
D	4	3

(M/J/2019/P12/Q.2)

5 The Planck constant h has SI units J s.
Which equation could be used to calculate the Planck constant?

A $h = \dfrac{DE}{v}$ where D is distance, E is energy and v is velocity

B $h = \dfrac{v}{D}$ where v is velocity and D is distance

C $h = \dfrac{1}{4\pi E}$ where E is electric field strength

D $h = \dfrac{Fr^2}{m}$ where F is force, r is radius and m is mass

(M/J/2019/P12/Q.3)

6 Which is an SI base unit?

A current **B** gram **C** kelvin **D** volt

(M/J/2019/P13/Q.1)

7 The speed of a wave in deep water depends on its wavelength L and the acceleration of free fall g.

What is a possible equation for the speed v of the wave?

A $v = \sqrt{\left(\frac{gL}{2\pi}\right)}$ **B** $v = \frac{gL}{4\pi^2}$ **C** $v = 2\pi\sqrt{\left(\frac{g}{L}\right)}$ **D** $v = \frac{2\pi g}{L}$

(O/N/2019/P11/Q.2)

8 Which quantity with its unit is correct?

A acceleration of a bicycle = $1.4\,\text{m s}^{-1}$

B electric current in a lamp = $0.25\,\text{A s}^{-1}$

C electric potential difference across a battery = $8.0\,\text{J C}^{-1}$

D kinetic energy of a car = $4500\,\text{N m}^{-1}$

(O/N/2019/P13/Q.1)

9 Which two units are **not** equivalent to each other?

A N m and $\text{kg m}^2\,\text{s}^{-2}$

B N s and kg m s^{-1}

C J s^{-1} and $\text{kg m}^2\,\text{s}^{-3}$

D Pa and kg m s^{-2}

(O/N/2019/P13/Q.2)

2020

1 A byte (b) comprises 8 bits.
How many bits are there in 1 terabyte (1Tb)?

A 1×10^9 **B** 8×10^9 **C** 1×10^{12} **D** 8×10^{12}

(F/M/2020/P12/Q.2)

2 The frequency f of vibration of a mass m supported by a spring with spring constant k is given by the equation

$$f = Cm^p k^q$$

where C is a constant with no units.
What are the values of p and q?

	p	q
A	$-\frac{1}{2}$	$-\frac{1}{2}$
B	$-\frac{1}{2}$	$\frac{1}{2}$
C	$\frac{1}{2}$	$-\frac{1}{2}$
D	$\frac{1}{2}$	$\frac{1}{2}$

(M/J/2020/P11/Q.2)

3 Which time interval is the shortest?

A 0.05 ms **B** 50 ns **C** 500 000 ps **D** 0.5 μs

(O/N/2020/P11/Q.2)

4 The speed v of waves on a stretched wire is given by the equation

$$v = T^p \mu^q$$

where T is the tension in the wire and μ is the mass per unit length of the wire.
What are the values of p and q?

	p	q
A	$-\frac{1}{2}$	$-\frac{1}{2}$
B	$-\frac{1}{2}$	$\frac{1}{2}$
C	$\frac{1}{2}$	$-\frac{1}{2}$
D	$\frac{1}{2}$	$\frac{1}{2}$

(O/N/2020/P12/Q.2)

5 What is **not** an SI base unit?

A coulomb **B** kelvin **C** kilogram **D** second

(O/N/2020/P12/Q.3)

2021

1 Which physical quantity could have units of $\mathrm{N\,s^2\,m^{-1}}$?

A acceleration **B** force **C** mass **D** momentum

(F/M/2021/P12/Q.2)

2 Which combination of units could be used for expressing the power dissipated in a resistor?

A newton per second ($\mathrm{N\,s^{-1}}$)

B newton second ($\mathrm{N\,s}$)

C newton metre ($\mathrm{N\,m}$)

D newton metre per second ($\mathrm{N\,m\,s^{-1}}$)

(M/J/2021/P11/Q.2)

3 Which quantity could have units of $\mathrm{N\,m\,V^{-1}}$?

A acceleration **B** charge **C** current **D** resistance

(M/J/2021/P12/Q.2)

4 What is a unit of momentum?

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

(M/J/2021/P13/Q.2)

5 The mobility μ of electrons travelling through a metal conductor can be calculated using the equation

$$\mu = \left(\frac{e}{m}\right)\tau$$

where *e* is the charge on an electron and *m* is its mass. The average time between the collisions of an electron with the atoms in the metal is τ.

What are the SI base units of μ?

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

(O/N/2021/P11/Q.2)

6 What is an alternative way of expressing an energy of 43 dJ?

A $4.3 \times 10^3\,\mathrm{mJ}$ **B** $4.3 \times 10^3\,\mathrm{MJ}$ **C** $4.3 \times 10^{-3}\,\mathrm{mJ}$ **D** $4.3 \times 10^{-3}\,\mathrm{MJ}$

(O/N/2021/P12/Q.2)

7 What is the unit of resistance when expressed in SI base units?

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

(O/N/2021/P13/Q.2)

2022

1 What could **not** be a measurement of a physical quantity?

A $10\,\text{K}$ **B** $11\,\text{J N}^{-1}\,\text{m}^{-1}$ **C** $17\,\text{Pa m}^3\,\text{N}^{-1}$ **D** $25\,\text{T m}$

(F/M/2022/P12/Q.1)

2 A computer memory stick is labelled as having a storage capacity of 128 GB.
The letter B stands for byte, which is a unit. What is the equivalent storage capacity?

A $1.28 \times 10^8\,\text{B}$ **B** $1.28 \times 10^{11}\,\text{B}$ **C** $1.28 \times 10^{14}\,\text{B}$ **D** $1.28 \times 10^{17}\,\text{B}$

(F/M/2022/P12/Q.2)

3 Which two units are identical when expressed in terms of SI base units?

A J C^{-1} and $\text{kg m}^2\,\text{A}^{-1}\,\text{s}^{-2}$
B J s and $\text{kg m}^2\,\text{s}^{-1}$
C N m and $\text{kg m}^3\,\text{s}^{-2}$
D N s and kg m s^{-3}

(M/J/2022/P11/Q.2)

4 What is the symbol for the SI base unit of temperature?

A C **B** K **C** °C **D** °K

(M/J/2022/P12/Q.2)

5 Which list of unit prefixes decreases in magnitude from left to right?

A centi, deci, milli
B deci, milli, centi
C pico, kilo, milli
D kilo, milli, pico

(M/J/2022/P13/Q.2)

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

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

where 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

(M/J/2022/P13/Q.3)

7 A voltmeter connected across a resistor in a circuit reads 3.6 V.
What could be the current in the resistor and the resistance of the resistor?

	current	resistance
A	150 mA	0.24 kΩ
B	15 mA	2.4 kΩ
C	1.5 mA	0.24 MΩ
D	15 μA	240 kΩ

(O/N/2022/P11/Q.2)

8 What is a power of 3.7 MW when expressed in kilowatts?

A $3.7 \times 10^{-3}\,\text{kW}$ **B** $3.7 \times 10^{-3}\,\text{KW}$ **C** $3.7 \times 10^3\,\text{kW}$ **D** $3.7 \times 10^3\,\text{KW}$

(O/N/2022/P12/Q.2)

9 What are the SI base units of electromotive force (e.m.f.)?

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

(O/N/2022/P13/Q.2)

1.3 Errors and Uncertainties

2016

1 Quantity X has a fractional uncertainty of x. Quantity Y has a fractional uncertainty of y.

What is the fractional uncertainty in $\frac{X}{Y^2}$?

A $x + y$ **B** $x - y$ **C** $x + 2y$ **D** $x - 2y$

(F/M/2016/P12/Q.4)

2 When performing an experiment, a student should minimise the uncertainty of any measurement. In which case is the student reducing the systematic error in a measurement?

A adjusting a voltmeter needle pointer to the zero position before using it to measure a potential difference

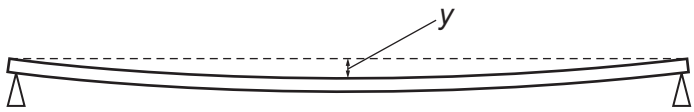
B measuring the diameter of a wire at several points and orientations

C measuring the mass of 100 paperclips to determine the mass of one paperclip

D timing 20 oscillations of a mass on a spring to determine the period of one oscillation

(M/J/2016/P11/Q.4)

3 A metre rule is supported horizontally by two pivots as shown.



The vertical displacement y at the centre of the rule is given by the equation

$$y = \frac{kML^3}{wt^3}$$

where

k is a constant,
L is the distance between the pivots,
M is the mass of the rule,
t is the thickness of the rule and
w is the width of the rule.

In an experiment, the following results are obtained:

$L = (80.0 \pm 0.2)\,\text{cm}$ $t = (6.0 \pm 0.1)\,\text{mm}$

$M = (60 \pm 1)\,\text{g}$ $w = (23.0 \pm 0.5)\,\text{mm}$.

Which measurement contributes most to the uncertainty in the calculated value of y?

A L **B** M **C** t **D** w

(M/J/2016/P13/Q.4)

4 A student determines the density ρ of steel by taking measurements from a steel wire.

mass $m = 6.2 \pm 0.1\,\text{g}$

length $l = 25.0 \pm 0.1\,\text{cm}$

diameter $d = 2.00 \pm 0.01\,\text{mm}$

He uses the equation $\rho = \frac{4m}{\pi d^2 l}$.

What is the percentage uncertainty in his calculated value of density?

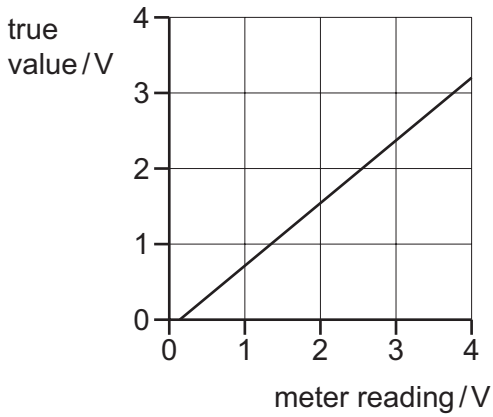
A 1.1% **B** 1.8% **C** 2.5% **D** 3.0%

(M/J/2016/P12/Q.5)

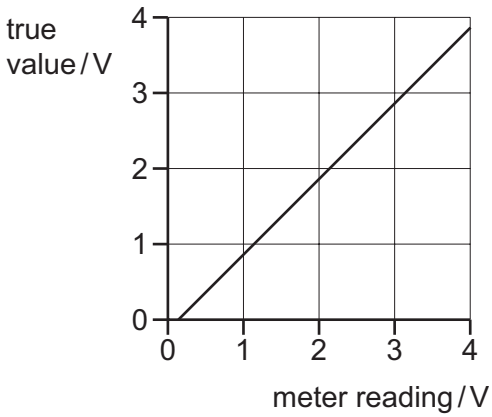
5 A voltmeter gives readings that are larger than the true values and has a systematic error that varies with voltage.

Which graph shows the calibration curve for the voltmeter?

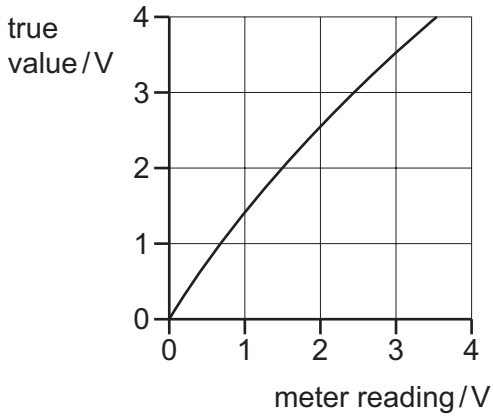
A



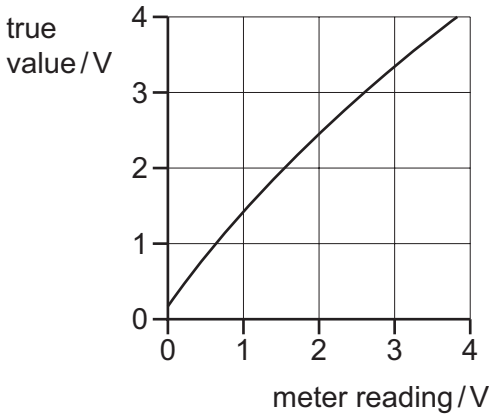
B



C



D



(O/N/2016/P11/Q.4) (O/N/2016/P13/Q.4)

6 A value for the acceleration of free fall on Earth is given as $(10 \pm 2)\,\text{m s}^{-2}$.

Which statement is correct?

A The value is accurate but not precise.

B The value is both precise and accurate.

C The value is neither precise nor accurate.

D The value is precise but not accurate.

(O/N/2016/P12/Q.5)

7 An experiment to determine atmospheric pressure P uses the equation $P = \rho gh$ where

$\rho = (13\,600 \pm 100)\,\text{kg m}^{-3}$,

$g = (9.81 \pm 0.02)\,\text{m s}^{-2}$,

$h = (0.762 \pm 0.005)\,\text{m}$.

What is the value of P, with its uncertainty, when stated to an appropriate number of significant figures?

A $(1.0166 \pm 0.0162) \times 10^5\,\text{Pa}$

B $(1.017 \pm 0.016) \times 10^5\,\text{Pa}$

C $(1.017 \pm 1.6\%) \times 10^5\,\text{Pa}$

D $(1.02 \pm 0.02) \times 10^5\,\text{Pa}$

(O/N/2016/P12/Q.6)