Base and derived quantities

Q1 (1/M/J/07/1):
Which is a pair of SI base units?

A	Ampere	joule
B	Coulomb	second
C	Kilogram	kelvin
D	Meter	newton

Q2 (1/O/N/13/12):
Which row shows an **SI** base quantity with its correct unit?

	SI base quantity	Unit
A	charge	coulomb
B	current	ampere
C	potential difference	volt
D	temperature	degree Celsius

Q3 (1/M/J/15/11):
Which is an **SI** base unit?

A current B gram
C kelvin D volt

Q4 (1/O/N/10/12):
Which row shows a base quantity with its correct **SI** unit?

	quantity	unit
A	current	A
B	mass	g
C	temperature	°C
D	weight	N

Q5 (1/O/N/05/1):
Which pair of units are both SI base units?

A ampere, degree Celsius B ampere, kelvin
C coulomb, degree Celsius D coulomb, kelvin

Q6. (2/O/N/18/12)
What is the unit of resistance when expressed in SI base units?

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

Q7 (1/M/J/16/13):
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

Q8 (2/O/N/04/1):
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.

Q9 (3/O/N/04/1):
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** $kg\,s^{-3}$

Q10 (2/M/J/04/1):
Which of the following could be measured in the same units as force?

A energy/distance
B energy*distance
C energy/time
D momentum*distance

Q11 (3/O/N/03/1):
The momentum of an object of mass m is p.
Which quantity has the same basic units as $\frac{p}{m}$

A energy **B** force
C power **D** velocity

Q12 (2/M/J/03/1):
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 $kg\,m^{-1}\,s^{2}$ **B** $kg\,m^{2}\,s^{-2}$ **C** $kg\,m^{2}\,s^{-1}$ **D** $kg\,s^{-2}$

Q13 (1/M/J/18/11):
What is a unit for stress?

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

Q14 (1/M/J/18/13):
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

Q15 (1/O/N/17/11):
Which SI unit, expressed in base units, is not correct?

A unit of force, $kg\,m\,s^{-2}$ B unit of momentum, $kg\,m\,s^{-1}$

C unit of pressure, $kg\,m^{-2}\,s^{-2}$ D unit of work, $kg\,m^{2}s^{-2}$

Q16 (1/O/N/17/12):
Which pair of units are not the same when expressed in SI base units?

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

C Pa and $N\,m^{-2}$ D $V\,m^{-2}$ and $N\,C^{-1}$

Q17 (3/M/J/17/12):
What correctly expresses the volt in terms of SI base units?

A $A\,\Omega$ B $W\,A^{-1}$

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

Q18 (1/O/N/15/11):
What is the unit of weight in terms of SI base unit(s)?

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

Q19. (2/O/N/18/13)
Three of these quantities have the same unit. Which quantity has a different unit?

A $\frac{\text{Energy}}{\text{distance}}$ B force

C power x time D rate of change of momentum

Q20 (2/M/J/16/11):
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

Q21 (1/M/J/16/12):
Which quantity with its unit is correct?

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

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

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

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

Q22 (1/O/N/06/1):
In the expressions below

a is acceleration, **f** is force,
m is mass, **t** is time,
v is velocity

Which expression represents energy?

A Ft **B** Fvt **C** $\frac{2mv}{t}$ **D** $\frac{at^2}{2}$

Q23 (1/O/N/15/13):
What is the unit of the Young modulus when expressed in SI base units?

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

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

Q24 (1/M/J/15/12):
Which definition 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.

Q25 (1/M/J/15/13):
Which statement includes a correct unit?

A energy = 7.8Ns B force = 3.8Ns

C momentum = 6.2Ns D torque = 4.7Ns

Q26 (2/M/J/15/13):
What is the joule (J) in SI base units?

A $kgms^{-1}$ B $kgm^{2}s^{-1}$ C $kgms^{-2}$ D $kgm^{2}s^{-2}$

Q27 (2/O/N/14/12):
What is equivalent to the unit of electric field strength?

A JCm^{-1} **B** NsA^{-1} **C** $kgms^{-3}A^{-1}$ **D** $kgm^{3}s^{-3}A^{-1}$

Q28 (1/M/J/14/11):
Which pair of units contains one derived unit and one SI base unit?

A	ampere	coulomb
B	kilogram	kelvin
C	metre	second
D	newton	pascal

Q29 (2/M/J/14/12):
What is the unit of resistance when expressed in SI base units?

A $kgm^{2}s^{-2}A^{-1}$ B $kgm^{2}s^{-3}A^{-2}$

C $kgms^{-2}A^{-1}$ D $kgms^{-3}A^{-1}$

Q30 (1/M/J/18/11)
What is a unit for stress?

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

Q31 (1/O/N/07/1):
The equation relating pressure and density is $p = \rho gh$
How can both sides of this equation be written in terms of base units?

A $[N\ m^{-1}] = [kg\ m^{-3}]\ [m\ s^{-1}]\ [m]$
B $[N\ m^{-2}] = [kg\ m^{-3}]\ [m\ s^{-2}]\ [m]$
C $[kg\ m^{-1}\ s^{-2}] = [kg\ m^{-3}]\ [m\ s^{-2}]\ [m]$
D $[kg\ m^{-1}s^{-1}] = [kg\ m^{-1}]\ [m\ s^{-2}]\ [m]$

Q32 (2/O/N/13/13):
Which unit is equivalent to the coulomb?

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

Q33 (2/M/J/13/12):
The unit of resistivity, expressed in terms of base units, is given by $\mathbf{kg\,x^3\,y^{-2}\,z^{-3}}$.
Which base units are x, y and z?

	X	y	z
A	ampere	metre	second
B	metre	ampere	second
C	metre	second	ampere
D	second	ampere	metre

Q34 (2/M/J/13/13):
What is the unit of power, expressed in SI base units?

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

Q35 (1/O/N/12/12):
Which quantity has the same base units as momentum?

A density × energy B density × volume × velocity
C pressure × area D weight ÷ area

Q36 (1/O/N/12/13):
The units of all physical quantities can be expressed in terms of SI base units.
Which pair contains quantities with the same base units?

A force and momentum B pressure and Young modulus
C power and kinetic energy D mass and weight

Q37 (1/M/J/10/11):

The SI unit for potential difference (the volt) is given, in base units, by

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

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

Q38 (2/M/J/12/11):

What is a possible unit for the product VI, where V is the potential difference across a resistor and I is the current through the same resistor?

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

C newton metre (Nm) D newton metre per second (Nms^{-1})

Q39 (1/M/J/12/12):

What is the unit watt in terms of SI base units?

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

Q40 (3/O/N/10/11):

Which physical quantity would result from a calculation in which a potential difference is multiplied by an electric charge?

A electric current B electric energy

C electric field strength D electric power

Q41 (1/M/J/11/12):

Stress has the same SI base units as

A $\frac{force}{mase}$ B $\frac{force}{length}$

C $\frac{force}{area}$ D energy

Q42 (2/M/J/11/12):

To check calculations, the units are put into the following equations together with the numbers. Which equation must be incorrect?

A force = 300 J / 6 m B power = 6000 J × 20 s

C time = 6 m / $30\,m\,s^{-1}$ D velocity = $4\,m\,s^{-2}$ × 30 s

Q43 (3/O/N/06/1):

Which row of the table shows a physical quantity and its correct unit?

	physical quantity	unit
A	electric field strength	$kg\,m\,s^{-2}\,C^{-1}$
B	specific heat capacity	$kg^{-1}\,m^2\,s^{-2}\,K^{-1}$
C	tensile strain	$kg\,m^{-1}\,s^{-2}$
D	the Young modulus	$kg\,m^{-1}\,s^{-3}$

Q44 (2/M/J/10/11):

The product of pressure and volume has the same SI base unit as.

A energy

B force

C $\frac{force}{area}$

D $\frac{force}{length}$

Finding unit of a quantity from a given expression

Q45 (2/M/J/16/12):

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 $W\,m^{-2}\,K^{-4}$.

What are SI base units of L?

A kgm^2s^{-1} B kgm^2s^{-2} C kgm^2s^{-3} D kgm^2s^{-4}

Q46 (2/M/J/16/13):

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

Q47 (2/O/N/15/11):

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 thermodynamic temperature and b is a constant characteristic of the solid.
The SI unit of specific heat capacity is $J\,kg^{-1}\,K^{-1}$.
What is the unit of constant b, expressed in SI base units?

A $m^2\,s^{-2}\,K^{-3}$ B $m^2\,s^{-2}\,K^{-4}$

C $kg\,m^2\,s^{-2}\,K^{-3}$ D $kg\,m^2\,s^{-2}\,K^{-4}$

Q48 (3/O/N/15/12):

The time T taken for a satellite to orbit the Earth on a circular path is given by the equation

$$T^2 = \frac{kr^3}{M}$$

where r is the radius of the orbit, M is the mass of the Earth and k is a constant. What

are the SI base units of k?

A $kg^{-1}m^{-3}s^2$ B $kg^{-1}m^3s^2$ C $kgm^{-3}s^2$ D kgm^3s^2

Q49 (2/M/J/05/1):

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** $kg\,m\,s^{-2}$

Q50 (2/O/N/16/11):
The force F between two point charges q_1 and q_2, a distance r apart, is given by the equation

$$F = k\frac{q_1 q_2}{r^2}$$

Where k is a constant.
What are the SI base units of k?

A $kgm^3s^{-4}A^2$ **B** $kgm^3s^{-4}A^{-2}$ **C** kgm^3A^2 **D** kgm^3A^{-2}

Q51 (2/O/N/15/13):
The Reynolds number R is a constant used in the study of liquids flowing through pipes. R is a pure number with no unit

$$R = \frac{\rho v D}{\mu}$$

where ρ is the density of the liquid, v is the speed of the liquid and D is the diameter of the pipe through which the liquid flows.
What are the SI base units of μ?

A $kgms$ B $kgm^{-1}s$ C $kgms^{-1}$ D $kgm^{-1}s^{-1}$

Q52 (3/M/J/15/11):
When a constant braking force is applied to a vehicle moving at speed v, the distance d moved by the vehicle in coming to rest is given by the expression

$$d = kv^2$$

Where k is a constant
When d is measured in meters and v is measured in meters per second the constant has a value of k_1. What is the value of the constant when the distance is measured in meters, and the speed is measured in kilometers per hour?

A 0.0772 k1 B 0.278 k1 C 3.60 k1 D 13.0 k1

Q53 (2/M/J/15/12):
The average kinetic energy E of a gas molecule is given by the equation

$$E = \frac{3}{2}kT$$

where T is the absolute (kelvin) temperature.
What are the SI base unit of k?

A $kg^{-1}m^{-1}s^2K$ B $kg^{-1}m^{-2}s^2K$
C $kgms^{-2}K^{-1}$ D $kgm^2s^{-2}K^{-1}$

Q54 (1/O/N/14/13):
When the brakes are applied on a vehicle moving at speed v, the distance d moved by the vehicle in coming to rest is given by the expression

$$d = kv^2$$

where k is a constant.
What is the unit of k expressed in SI base units?

A $m^{-1}s^2$ B ms^{-2} C m^2s^{-2} D $m^{-1}s$

Q55 (2/O/N/16/12):

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, $\boldsymbol{\rho}$ is density and γ is the 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

Q56 (4/O/N/13/13):
The spring constant k of a coiled wire spring is given by the equation

$$k = \frac{Gr^4}{4nR^3}$$

where r is the radius of the wire, n is the number of turns of wire and *R* is the radius of each of the turns of wire. The quantity *G* depends on the material from which the wire is made.
What is a suitable unit for *G*?

A Nm^{-2} B Nm^{-1} C Nm D Nm^{2}

Q57 (2/M/J/13/11):
One property *Q* of a material is used to describe the behavior of sound waves in the material. Q is defined as the pressure P of the sound wave divided by the speed v of the wave and the surface area A of the material through which the wave travels:

$$Q = \frac{P}{vA}$$

What are the SI base units of *Q*?

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

Q58 (2/O/N/10/12):
The frictional force F on a sphere falling through a fluid is given by the formula

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

where 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 $kg\,m^{3}\,s^{-3}$

Q59 (2/O/N/10/11):
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 $kg\,m\,s^{-2}$

Prefixes

Q1 (2/M/J/07/1)
What is the ratio 1μm/1Gm?

A 10^{-3} **B** 10^{-9} **C** 10^{-12} **D** 10^{-15}

Q2 (1/O/N/06/1):
Which product-pair of metric prefixes has the greatest magnitude?

A pico × mega B nano × kilo
C micro × giga D milli × tera

Q3 (2/O/N/05/1):

The prefix 'centi' indicates 10^{-2}.

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

	x 10^{-12}	x 10^{-9}	x 10^{-6}
A	nano	micro	pico
B	nano	pico	micro
C	pico	nano	micro
D	pico	micro	nano

Q4 (1/M/J/05/1):
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}

Q5 (3/M/J/04/1):
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

Q6 (1/O/N/03/1):
A student measures a current as 0.5 A.
Which of the following correctly expresses this result?

A 50 mA **B** 50 MA **C** 500 mA **D** 500 MA

Q7 (1/O/N/15/12):
Which list shows increasing lengths from beginning to end?

A 1 cm 1 nm 1 mm 1 μm
B 1 μm 1 mm 1 nm 1 cm
C 1 nm 1 μm 1 mm 1 cm
D 1 mm 1 cm 1 μm 1 nm

Q8 (2/M/J/14/11):
What is equivalent to 2000 microvolts?

A 2 μJ C^{-1} B 2 mV C 2 pV D 2000 mV

Q9 (1/O/N/11/11):
Which statement using prefixes of the base unit metre (m) is not correct?

A 1pm = 10^{-12}m B 1nm = 10^{-9}m
C 1 Mm = 10^{6}m D 1 Gm = 10^{12}m

Q10 (2/O/N/11/12):

What is the ratio of $\frac{10^{-3} T\ Hz}{10^{3} k\ Hz}$?

A 10^{-9} B 10^{-6} C 10^{0} D 10^{3}

Q11 (1/O/N/10/11):

The signal has a frequency of 2.0MHz. What is the period of a signal?

A 2 μs B 5 μs C 200 ns D 500 ns

Q12 (1/M/J/11/11):
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 row 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}

Q13 (1/O/N/17/13):

How many cubic nanometres, nm^3, are in a cubic micrometre, μm^3?

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

Q14 (1/M/J/18/12):

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

Homogeneity

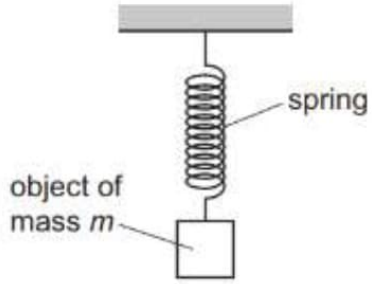
Q1 (3/M/J/07/1):

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** $v = \sqrt{\frac{g}{\rho}}$

Q2 (3/F/M/24/12):

An object of mass m is suspended by a spring from a fixed point.



The spring has spring constant k. The object is set into vertical oscillations of period T. Which equation for T is homogeneous with respect to base units?

A $T = 2\pi\left(\frac{k}{m}\right)$ **B** $T = 2\pi\left(\frac{m}{k}\right)$ **C** $T = 2\pi\sqrt{\frac{k}{m}}$ **D** $T = 2\pi\sqrt{\frac{m}{k}}$

Q3 (3/O/N/13/12):

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.

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

Where F is the drag force on the car, **ρ** is the density of the air, A is thr 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

Q4 (3/M/J/14/11):

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

Q5 (2/O/N/20/12)
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	$\frac{1}{2}$	$\frac{1}{2}$

Q6 (6/O/N/15/13):
A cylindrical tube rolling down a slope of inclination θ moves a distance L in time T. The equation relating these quantities is

$$L\left(3 + \frac{a^2}{P}\right) = QT^2 sin\theta$$

Where a is the interval radius of the tube and P and Q are constants. Which row gives the correct units for P and for Q?

	P	Q
A	m^2	$m^2 s^{-2}$
B	m^2	$m s^{-2}$
C	m^2	$m^3 s^{-2}$
D	m^3	$m s^{-2}$

Reasonable Estimation

Q1 (3/M/J/05/1):
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 4×10^2 J **B** 4×10^3 J **C** 4×10^4 J **D** 4×10^5 J

Q2 (2/M/J/06/1):
For which quantity is the magnitude a reasonable estimate?

A frequency of a radio wave 500 pHz
B mass of an atom 500μg
C the young modulus of a matter 500 kPa
D wavelength of green light 500nm

Q3 (2/O/N/07/1):
What is a reasonable estimate of the diameter of an alpha particle?

A 10^{-15}m B 10^{-12}m
C 10^{-9}m D 10^{-6}m

Q4 (1/O/N/18/12)
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

Q5 (4/O/N/17/11):
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

Q6 (1/M/J/17/11):
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	$10\,m\,s^{-1}$
D	water pressure at the bottom of a garden pond	10^6 Pa

Q7 (1/M/J/17/12):
What is the approximate average speed of a winning female Olympic athlete running a 100 m race?

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

Q8 (1/M/J/17/13):
What is the best estimate of the kinetic energy of a family car travelling at $50\,km\,h^{-1}$?

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

Q9 (1/O/N/16/11):
What is the order of magnitude of the Young modulus for a metal such as copper?

A 10^{-11} Pa B 10^{-4} Pa C 10^4 Pa D 10^{11} Pa

Q10 (1/O/N/18/13):
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.

Q11 (3/O/N/15/11):
In making reasonable estimates of physical quantities, which statement is not correct?

A The frequency of sound can be of the order of GHz.
B The wavelength of light can be of the order of 600 nm.
C The Young modulus of a metal can be of the order of 10^{11} Pa.
D Beta particles are associated with one unit of negative charge.

Q12 (4/O/N/15/12):
Which row gives reasonable estimates for the mass and the speed of an adult running?

	mass / kg	speed / m s^{-1}
A	6×10^0	5×10^1
B	6×10^1	5×10^0
C	6×10^1	5×10^1
D	6×10^2	5×10^0

Q13 (1/O/N/13/13)
Which estimate is realistic?

A The kinetic energy of a bus travelling on an expressway is 30000J
B The power of a domestic light is 300W.
C The temperature of a hot oven is 300K.
D The volume of air in a car tyre is 0.03 m^3

Q14 (3/M/J/13/13):
Which statement is incorrect by a factor of 100 or more?

A Atmospheric pressure is about 1×10^5 Pa.
B Light takes 5×10^2 s to reach us from the Sun.
C The frequency of ultra-violet light is 3×10^{12} Hz
D The life-span of a man is about 2×10^9 s

Q15 (3/O/N/12/11):
What is the approximate temperature of a red-hot ring on an electric cooker?

A 100 °C B 200 °C C 400 °C D 800 °C

Q16 (1/O/N/12/12):
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

Q17 (3/O/N/12/13):
A 1.5 V cell supplies 0.20 A to a lamp for seven hours before the lamp goes out.
What is a sensible estimate for the initial chemical energy content of the cell?

A 1×10^2 J B 1×10^4 J C 1×10^6 J D 1×10^8 J

Q18 (3/M/J/12/11):
What is a reasonable estimate of the average kinetic energy of an athlete during a 100 m race that takes 10 s?

A 40 J B 400 J C 4000 J D 40000J

Q19 (1/O/N/18/11):

The radius of the Earth is approximately 6.4 x10^6 m, and the radius of the Moon is approximately 1.7 x10^6 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

Q20 (1/F/M/21/12)

What is a reasonable estimate for the density of sand?

A 2 x 10^2 g cm^{-3} **B** 2 x 10^3 g cm^{-3}

C 2 x 10^1 kg m^{-3} **D** 2 x 10^3 kg m^{-3}

Scalars and vectors

Q1 (2/M/J/18/11):
Physical quantities can be classed as vectors or as scalars.
Which pair of quantities consists of two vectors?

A kinetic energy and force
B momentum and time
C velocity and electric field strength
D weight and temperature

Q2 (2/O/N/15/12):
Which equation contains only scalar quantities?

A $accelereation = \frac{force}{mass}$
B $power = \frac{work}{time}$
C $pressure = \frac{force}{area}$
D $velocity = \frac{displacement}{time}$

Q3 (3/O/N/15/13):
When a force F moves its point of application through a displacement s in the direction of the force, the work W done by the force is given by

$$W = F.s.$$

How many vector quantities and scalar quantities does this equation contain?

A one scalar quantity and two vector quantities
B one vector quantity and two scalar quantities
C three scalar quantities
D three vector quantities

Q4 (3/O/N/11/11):
Which group of quantities contains only vectors?

A acceleration, displacement, speed
B acceleration, work, electric field strength
C displacement, force, velocity
D power, electric field strength, force

Q5 (2/O/N/14/13):
Which list contains one vector quantity and two scalar quantities?

A displacement, weight, velocity
B force, acceleration, time
C momentum, mass, speed
D work, density, energy

Q6 (3/O/N/11/12):
The following physical quantities can be either positive or negative.
s : displacement of a particle along a straight line
θ : temperature on the Celsius scale
q : electric charge
V : readings on a digital voltmeter

Which of these quantities are vectors?

A s, θ, q, V B s, q, V only C θ, V only D s only

Q7 (1/M/J/13/11):
Which pair of quantities contains one vector and one scalar quantity?

A displacement; force
B kinetic energy; power
C acceleration; momentum
D velocity; distance

Q8 (4/O/N/12/11):
Which list contains only scalar quantities?

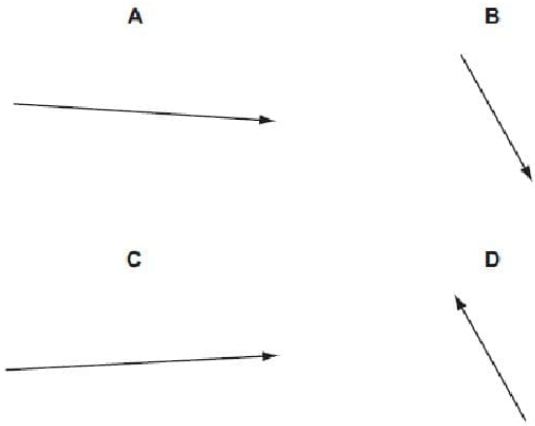
A area, length, displacement
B kinetic energy, speed, power
C potential energy, momentum, time
D velocity, distance, temperature

Q9 (4/O/N/12/12):
Physical quantities can be classed as vectors or as scalars.
Which pair of quantities are both vectors?

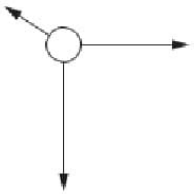
A kinetic energy and elastic force
B momentum and time
C velocity and electric field strength
D weight and temperature

Q10 (2/O/N/12/12):
Vectors P and Q are drawn to scale.

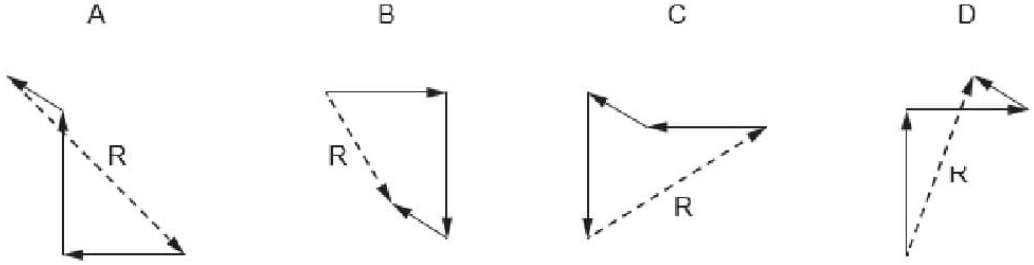
Which diagram represents the vector (P + Q)?



Q11 (1/M/J/16/11):
Three wires each exert a horizontal force on a vertical pole, as shown.



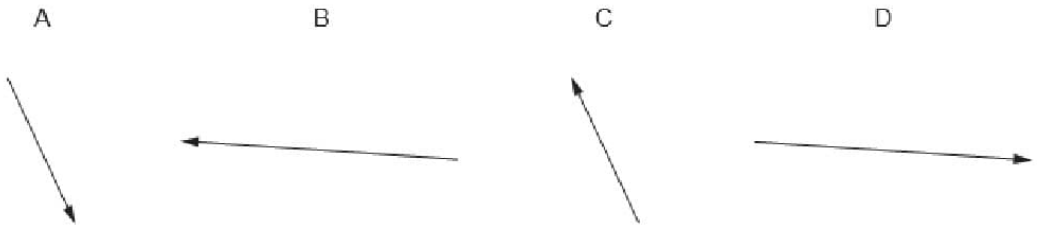
which vector diagram shows the resultant force R acting on the pole?



Q12 (3/M/J/16/13):

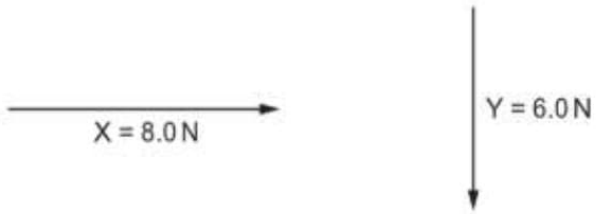
Vector P and Q are drawn on scale.

Which diagram represents the vector (P – Q)?



Q13 (2/M/J/17/13):

The diagram shows two vectors X and Y. The vectors are perpendicular to one another.

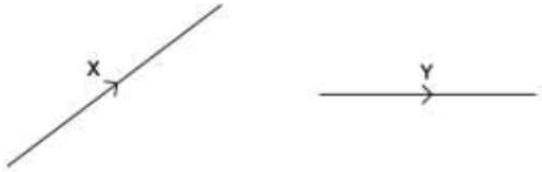


What is the magnitude and direction of vector (X – Y)?

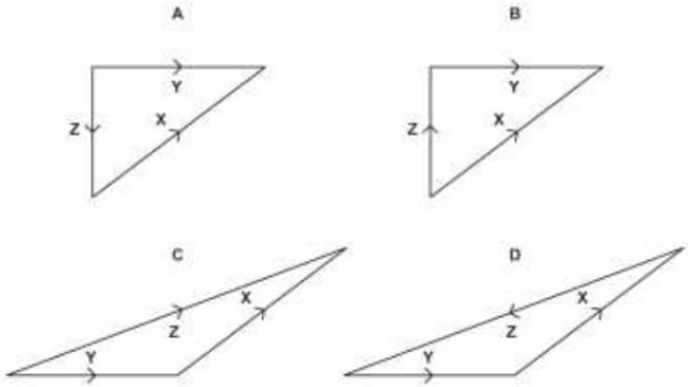
A 10.0 N at an angle of 37° downwards from the direction of X
B 10.0 N at an angle of 37° upwards from the direction of X
C 14.0 N at an angle of 53° downwards from the direction of X
D 14.0 N at an angle of 53° upwards from the direction of X

Q14 (3/O/N/07/1):

The diagram shows two vectors **X** and **Y**.



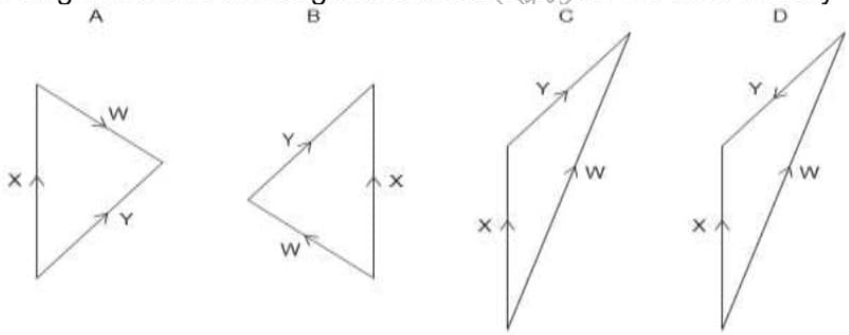
In which vector triangle does the vector **Z** show the magnitude and direction of vector **X–Y**?



Q15 (3/O/N/16/11):

An aeroplane can fly at a velocity X when moving through still air. When flying in wind the aeroplane's velocity relative to the ground is Y.

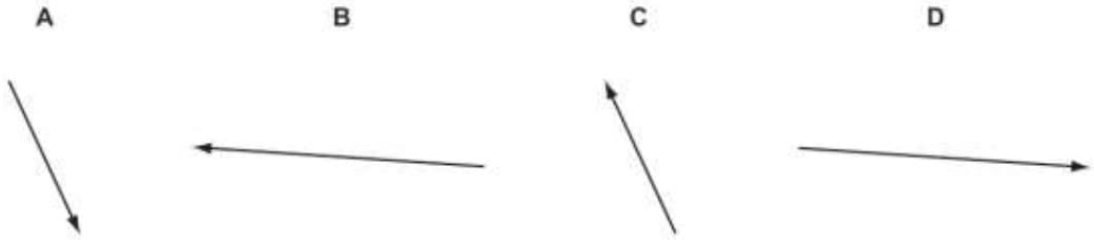
Which vector diagram shows the magnitude and direction of the wind velocity W ?



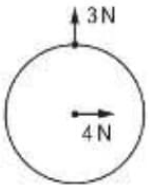
Q16 (2/O/N/12/11):

Vectors P and Q are drawn to scale.

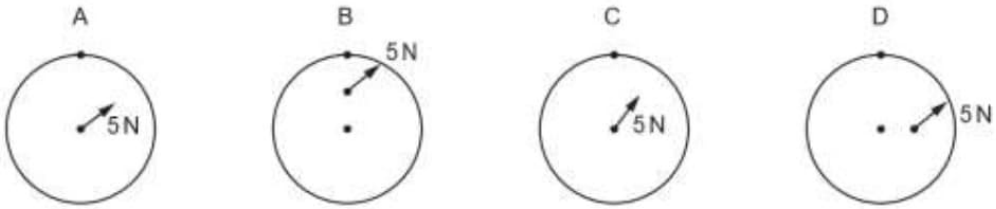
Which diagram represents the vector (P – Q)?



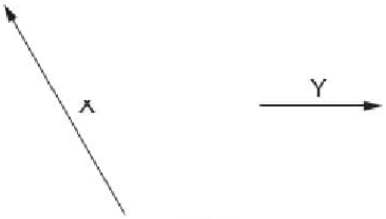
Q17 (2/M/J/17/12):
Two forces act on a circular disc as shown.



Which diagram shows the line of action of the resultant force?



Q18 (3/M/J/16/12):
The diagram shows two vectors X and Y, drawn to scale



If X = Y – Z, which diagram best represents the vector Z?

Q19 (3/O/N/16/12):
The motion of an object moving from rest with a constant acceleration a may be represented by the equation shown.

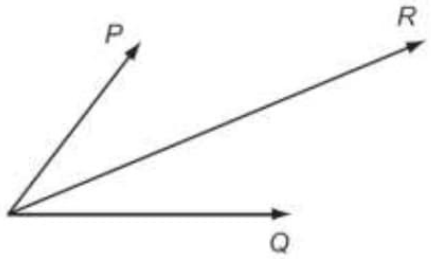
$$v^2 = 2as$$

Which row describes the quantities represented by the symbols v and s?

	v	s
A	scalar	scalar
B	scalar	vector
C	vector	scalar
D	vector	vector

Q20 (2/O/N/12/13):

Two physical quantities P and Q are added. The sum of P and Q is R, as shown.



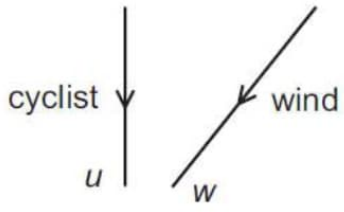
Which quantity could be represented by P and by Q?

A kinetic energy B power

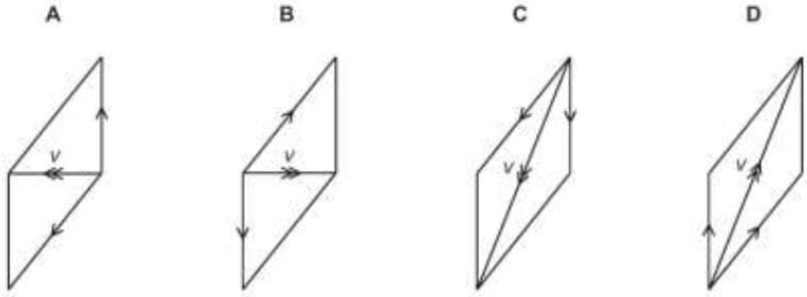
C speed D velocity

Q21 (4/M/J/13/13):

A cyclist is travelling due south with velocity u. The wind is blowing from the north-east with velocity w.



The wind has a velocity v relative to the cyclist, where v = w – u.
Which vector diagram shows the magnitude and direction of velocity v?



Q22 (3/O/N/13/13):

Two forces of equal magnitude are represented by two coplanar vectors. One is directed eastwards and the other is directed northwards. What is the direction of a single force that will balance these two forces?

A toward the north east B toward the north west

C toward the south east D toward the south west

Q23 (3/M/J/15/13):

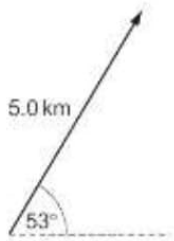
The speed of an aeroplane in still air is 200 km h^{-1}. The wind blows from the west at a speed of 85.0kmh^{-1}. In which direction must the pilot steer the aeroplane in order to fly due north?

A 23.0° east of north B 23.0° west of north

C 25.2° east of north D 25.2° west of north

Resolving Vectors

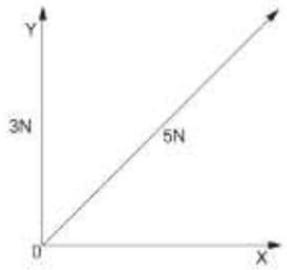
Q1 (1/M/J/13/13):
The diagram shows a displacement vector.



What is the vertical component of this displacement vector?

A 3.0 km B 4.0 km C 5.0 km D 6.6 km

Q2 (2/O/N/03/1):
A force of 5 N may be represented by two perpendicular components OY and OX as shown in the diagram, which is **not** drawn to scale.

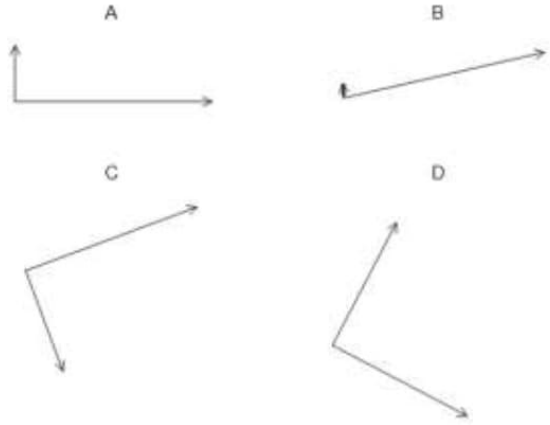


OY is of magnitude 3 N. What is the magnitude of OX?

A 2 N **B** 3 N **C** 4 N **D** 5 N

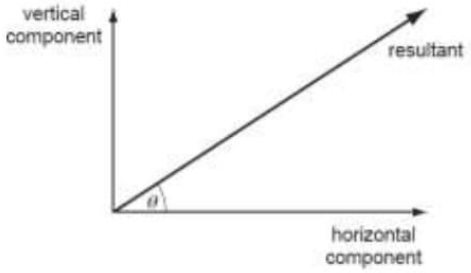
Q3 (4/M/J/15/12):
The arrow represents the vector R.

which diagram does not represent R as two perpendicular components?



Q4 (4/M/J/09/1):

The diagram shows a resultant force and its horizontal and vertical components.

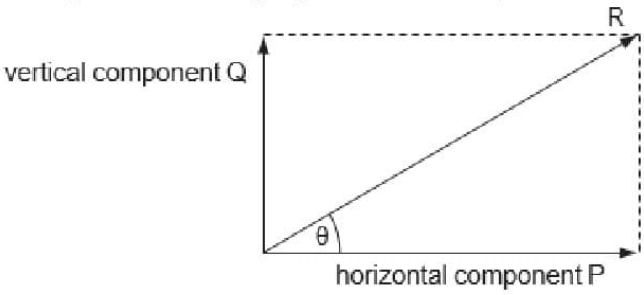


The horizontal component is 20.0 N and θ = 30°. What is the vertical component?

A 8.7 N B 10.0 N C 11.5 N D 17.3 N

Q5 (3/M/J/12/12):

A vector has magnitude R and perpendicular components P and Q, as shown in the diagram.

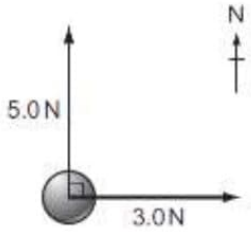


Which row correctly describes the perpendicular components?

	vertical component	horizontal component
A	Q	R sinθ
B	R cosθ	P
C	Rcosθ	R sinθ
D	Rsinθ	R cosθ

Q6 (3/M/J/11/11):

A force of 5.0 N pushes a ball due north and another force of 3.0 N pushes it due east.

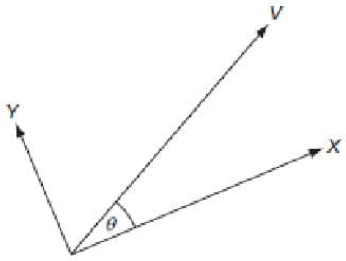


What is the magnitude of the net force acting on the ball?

A 2.8 N B 4.0 N C 5.8 N D 8.0 N

Q7 (5/M/J/10/11):

A vector quantity V is resolved into two perpendicular components X and Y. The angle between V and component X is θ.



The angle between component X and the vector V is increased from 0° to 90°.
How do the magnitudes of X and Y change as the angle θ is increased in this way?

	X	Y
A	increase	increase
B	increase	decrease
C	decrease	increase
D	decrease	decrease

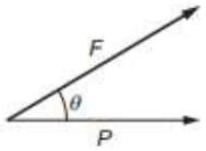
Q8 (4/O/N/08/1):

The table shows the x-component and y-component of four force vectors.
Which force vector has the largest magnitude?

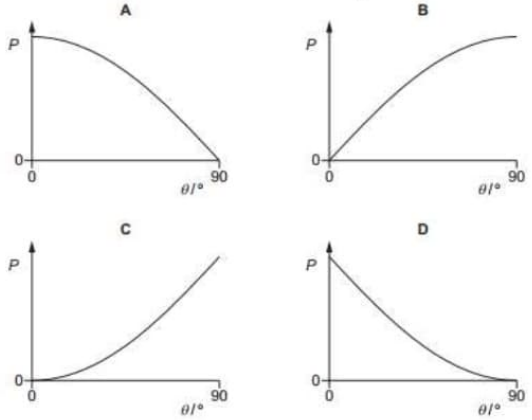
	x-component / N	y-component / N
A	2	9
B	3	8
C	4	7
D	5	6

Q9(3/O/N/20/12)

The diagram shows a force *F*. *P* is the horizontal component of *F*, at an angle ☐ to *F*.

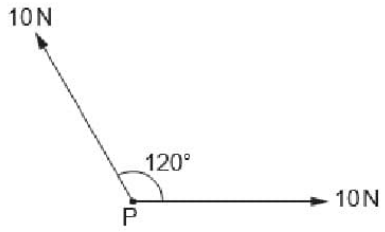


Which graph best shows the variation with Θ of the magnitude of *P* ?



Q9 (2/O/N/17/11):

Two forces, each of 10 N, act at a point P as shown. The angle between the directions of the forces is 120°.

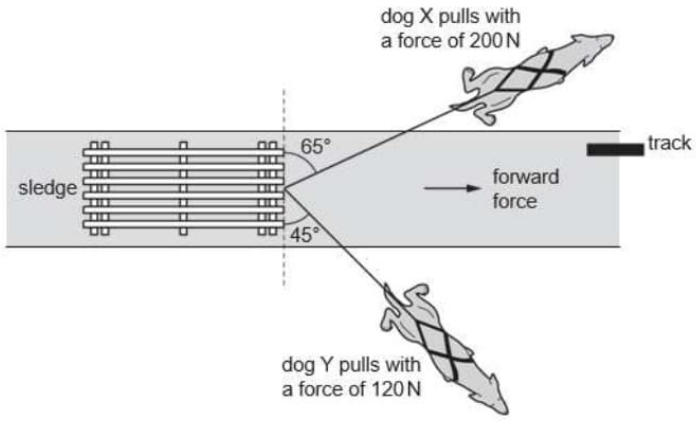


What is the magnitude of the resultant force?

A 5 N B 10 N C 17 N D 20 N

Q10 (3/M/J/18/11):

Two dogs pull a sledge along an icy track, as shown.



Dog X pulls with a force of 200 N at an angle of 65° to the front edge of the sledge. Dog Y pulls with a force of 120 N at an angle of 45° to the front edge of the sledge.

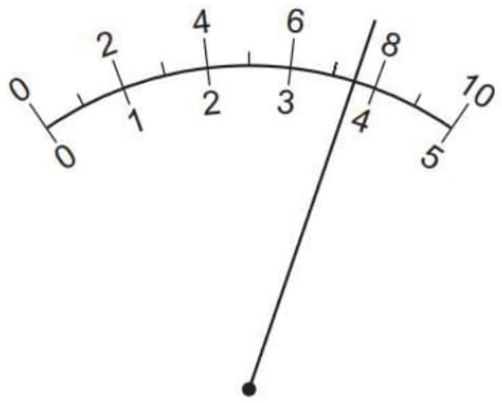
What is the resultant forward force on the sledge exerted by the two dogs?

A 80 N B 170 N C 270 N D 320 N

Reading an analogue scale

Q1 (4/O/N/18/13):

An ammeter is calibrated so that it shows a full-scale deflection when it measures a current of 2.0 A. The diagram shows the display of this ammeter when it is measuring

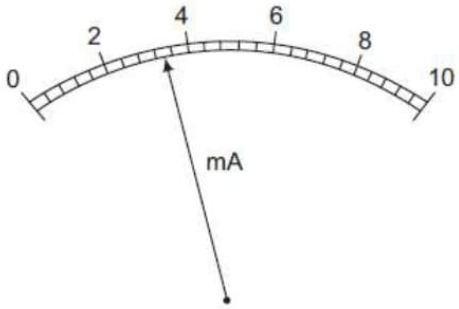


Which current is the ammeter measuring?

A 0.75 A **B** 1.5 A **C** 3.8 A **D** 7.5 A

Q2 (4/M/J/04/1):

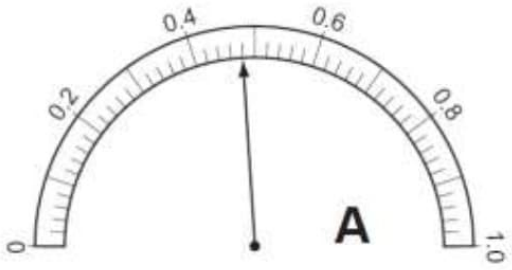
What is the reading shown on this milliammeter?



A 2.35 mA B 2.7 mA C 3.4 mA D 3.7 mA

Q3 (4/M/J/09/1):

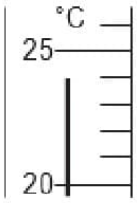
The diagrams show digital voltmeter and analogue ammeter readings from a circuit in which electrical heating is occurring.



What is the electrical power of the heater?

A 0.53 W B 0.58 W C 530 W D 580 W

Q4 (4/O/N/14/13):
The diagram shows part of a thermometer

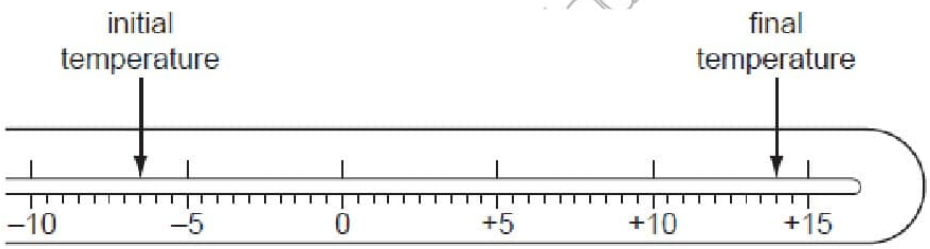


What is the correct reading on the thermometer and the uncertainty in this reading?

	reading / °C	uncertainty in reading / °C
A	24	±1
B	24	±0.5
C	24	±0.2
D	24.0	±0.5

Q5 (3/M/J/09/1):

The diagram shows the stem of a Celsius thermometer marked to show initial and final temperature values.



What is the temperature change expressed to an appropriate number of significant figures?

A 14 °C B 20.5 °C C 21 °C D 22.0 °C

Q6 (7/M/J/10/11):
A micrometer screw gauge is used to measure the diameter of a copper wire.The reading with the wire in position is shown in diagram 1. The wire is removed and the jaws of the micrometer are closed. The new reading is shown in diagram 2.

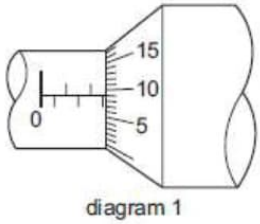


diagram 1

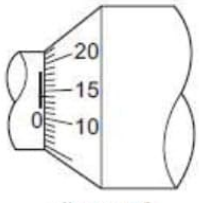


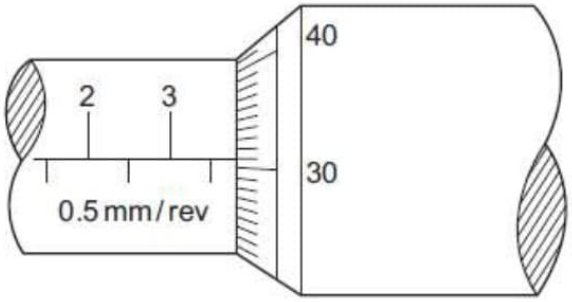
diagram 2

What is the diameter of the wire?

A 1.90 mm B 2.45 mm C 2.59 mm D 2.73 mm

Q7 (5/M/J/17/12):

The diameter of a cylindrical metal rod is measured using a micrometer screw gauge.
The diagram below shows an enlargement of the scale on the micrometer screw gauge when taking the measurement.



What is the cross-sectional area of the rod?

A $3.81\,mm^2$ B $11.4\,mm^2$ C $22.8\,mm^2$ D $45.6\,mm^2$

Q8 (4/O/N/10/12):
A metre rule is used to measure the length of a piece of wire. It is found to be 70 cm long to the nearest millimeter. How should this result be recorded in a table of results?

A 0.7 m B 0.70 m C 0.700 m D 0.7000 m

Q9 (5/M/J/03/1):

A student makes measurements from which she calculates the speed of sound as $327.66\,m\,s^{-1}$.
She estimates that her result is accurate to ±3 %.
Which of the following gives her result expressed to the appropriate number of significant figures?

A $327.7\,m\,s^{-1}$ **B** $328\,m\,s^{-1}$ **C** $330\,m\,s^{-1}$ **D** $300\,m\,s^{-1}$

Q10 (5/O/N/15/13):
The density of the material of a coil of thin wire is to be found.
Which set of instruments could be used to do this most accurately?

A metre rule, protractor, spring balance
B micrometer, metre rule, top-pan balance
C stopwatch, newton-meter, vernier calipers
D tape measure, vernier calipers, lever balance

Q11 (4/M/J/15/13):
A student is given a reel of wire of diameter less than 0.2 mm and is asked to find the density of the metal.
Which pair of instruments would be most suitable for finding the volume of the wire?

A balance and micrometer B metre rule and micrometer
C metre rule and Vernier calipers D micrometer and Vernier calipers

Random and Systematic errors

Q1 (5/O/N/06/1):

The measurement of a physical quantity may be subject to random errors and to systematic errors. Which statement is correct?

A Random errors can be reduced by taking the average of several measurements.
B Random errors are always caused by the person taking the measurement.
C A systematic error cannot be reduced.
D A systematic error results in a different reading each time the measurement is taken.

Q2 (4/M/J/03/1):

Which experimental technique reduces the systematic error of the quantity being investigated?

A adjusting an ammeter to remove its zero error before measuring a current
B measuring several internodal distances on a standing wave to find the mean internodal distance
C measuring the diameter of a wire repeatedly and calculating the average
D timing a large number of oscillations to find a period

Q3 (4/M/J/18/13):

What will reduce the systematic errors when taking a measurement?

A adjusting the needle on a voltmeter so that it reads zero when there is no potential difference across it
B measuring the diameter of a wire at different points and taking the average
C reducing the parallax effects by using a marker and a mirror when measuring the amplitude of oscillation of a pendulum
D timing 20 oscillations, rather than a single oscillation, when finding the period of a pendulum

Q4 (5/O/N/17/13):

Four possible sources of error in a series of measurements are listed.

1 an analogue meter whose scale is read from different angles
2 a meter which always measures 5% too high
3 a meter with a needle that is not frictionless, so the needle sometimes sticks slightly
4 a meter with a zero error

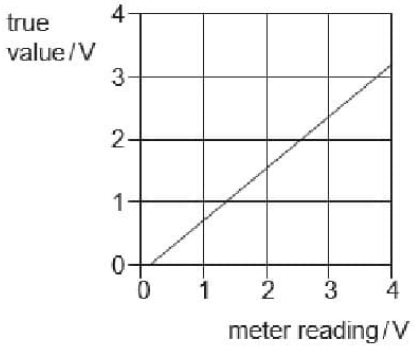
Which errors are random and which are systematic?

	random error	systematic error
A	1 and 2	3 and 4
B	1 and 3	2 and 4
C	2 and 4	1 and 3
D	3 and 4	1 and 2

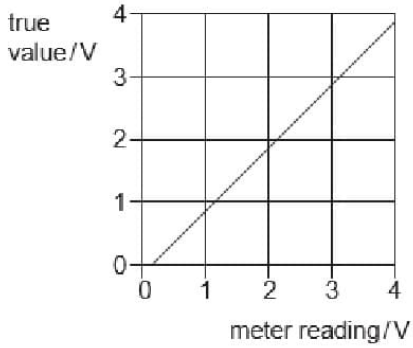
Q5 (4/O/N/16/11):

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?

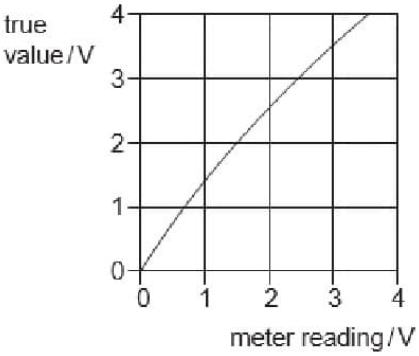
A



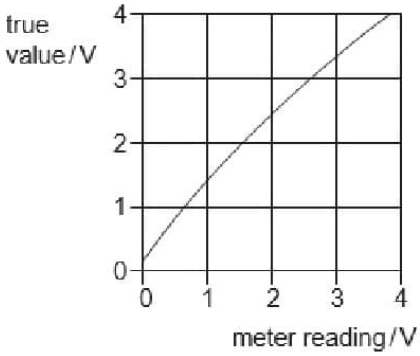
B



C



D



Q6 (4/M/J/16/11):
When performing an experiment, a student should minimize the uncertainty of any measurement.
In which case is the student reducing the systematic error in a measurement?

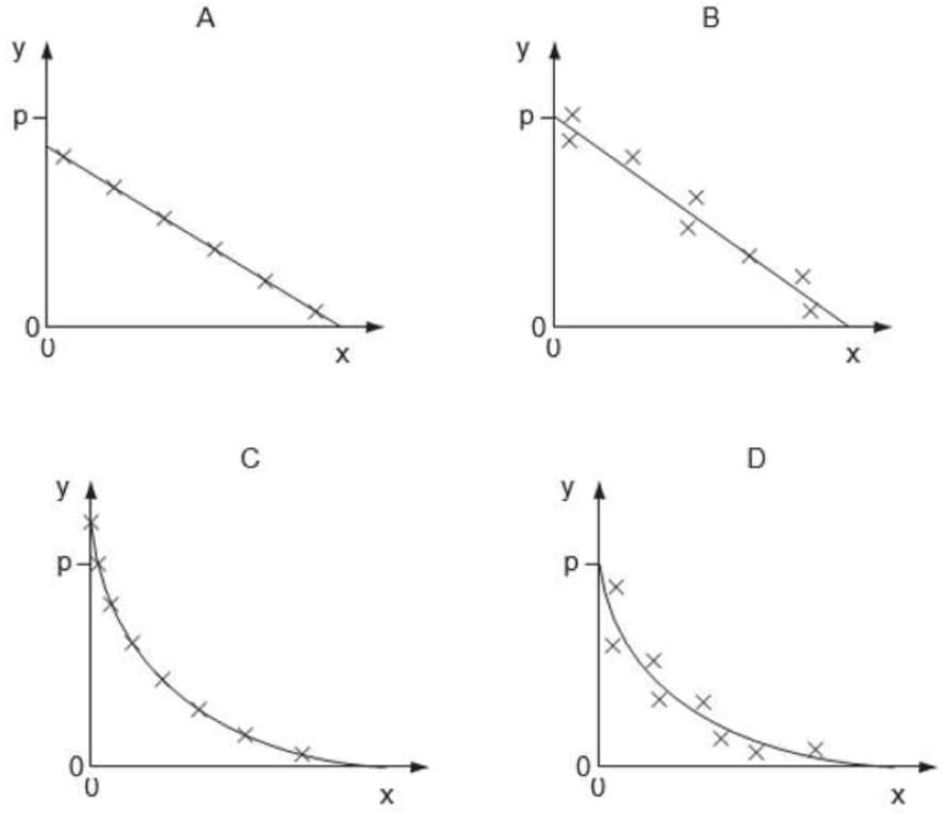
A adjusting a voltmeter needle pointer to the zero position before using it to measure a potential difference
B measuring the diameter of a wire at several points and orientations
C measuring the mass of 100 paperclips to determine the mass of one paperclip
D timing 20 oscillations of a mass on a spring to determine the period of one oscillation

Q7 (5/O/N/11/12):
The speedometer in a car consists of a pointer which rotates. The pointer is situated several millimeters from a calibrated scale.
What could cause a random error in the driver's measurement of the car's speed?

A The car's speed is affected by the wind direction.
B The driver's eye is not always in the same position in relation to the pointer.
C The speedometer does not read zero when the car is at rest.
D The speedometer reads 10 % higher than the car's actual speed.

Q8 (7/O/N/15/13):

Variables x and y are related by the equation $y = p – qx$ where p and q are constants.
Values of x and y are measured experimentally. The results contain a systematic error. Which graph best represents these results?



Q9 (4/M/J/13/12):

A student carried out an experiment in which an electric current was known to decrease with time. The readings he found, from first to last, were 3.62 mA, 2.81 mA, 1.13 mA, 1.76 mA and 0.90 mA. Which statement could not explain the anomalous 1.13 mA reading?

A He has reversed the third and fourth readings in the results table.
B He read the ammeter incorrectly; the reading should have been 2.13 mA.
C He took the current reading at the wrong time.
D There was a systematic error in the readings from the ammeter.

Q10 (7/O/N/12/11):

The measurement of a physical quantity may be subject to random errors and to systematic errors.
Which statement is correct?

A Random errors can be reduced by taking the average of several measurements.
B Random errors are always caused by the person taking the measurement.
C A systematic error cannot be reduced by adjusting the apparatus.
D A systematic error results in a different reading each time the measurement is taken.

Q11 (6/O/N/12/13):
What will reduce the systematic errors when taking a measurement?

A adjusting the needle on a voltmeter so that it reads zero when there is no potential difference across it
B measuring the diameter of a wire at different points and taking the average
C reducing the parallax effects by using a marker and a mirror when measuring the amplitude of oscillation of a pendulum
D timing 20 oscillations, rather than a single oscillation, when finding the period of a pendulum

Q12 (5/M/J/12/12):
A mass is dropped from rest and falls through a distance of 2.0 m in a vacuum. An observer records the time taken for the mass to fall through this distance using a manually operated stopwatch and repeats the measurements a further two times. The average result of these measured times, displayed in the table below, was used to determine a value for the acceleration of free fall. This was calculated to be $9.8\,m\,s^{-2}$

	first measurement	second measurement	third measurement	average
time / s	0.6	0.73	0.59	0.64

Which statement best relates to the experiment?

A The measurements are precise and accurate with no evidence of random errors.
B The measurements are not accurate and not always recorded to the degree of precision of the measuring device but the calculated experimental result is accurate.
C The measurements are not always recorded to the degree of precision of the measuring device but are accurate. Systematic errors may be present.
D The range of results shows that there were random errors made but the calculated value is correct so the experiment was successful

Precision and Accuracy

Q1 (4/O/N/05/1):

A steel rule can be read to the nearest millimeter. It is used to measure the length of a bar whose true length is 895 mm. Repeated measurements give the following readings.

Length / mm 892, 891, 892, 891, 891, 892

Are the readings accurate and precise to within 1 mm?

	results are accurate to within 1 mm	results are precise to within 1 mm
A	no	no
B	no	yes
C	yes	no
D	yes	yes

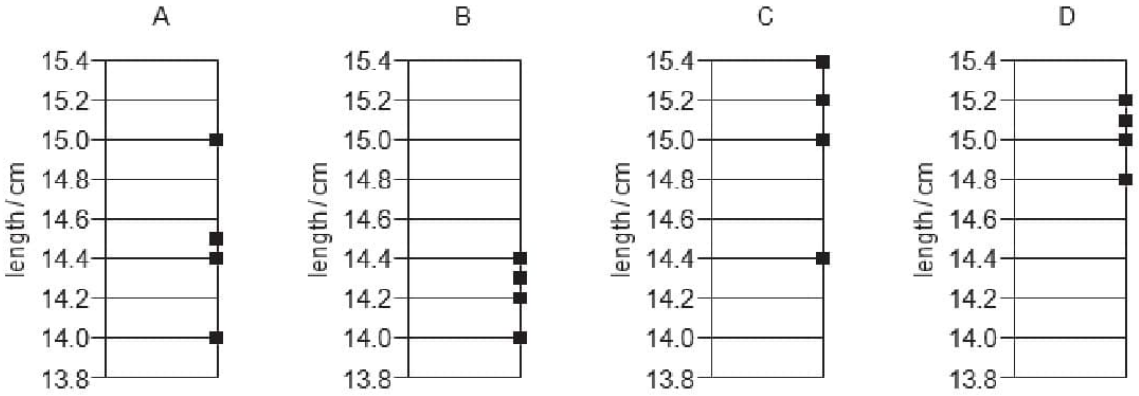
Q2 (4/O/N/07/1):

A series of measurements of the acceleration of free fall g is shown in the table.
Which set of results is precise but not accurate?

	g / m s^{-2}				
A	9.81	9.79	9.84	9.83	9.79
B	9.81	10.12	9.89	8.94	9.42
C	9.45	9.21	8.99	8.76	8.51
D	8.45	8.46	8.50	8.41	8.47

Q3 (5/M/J/15/13):

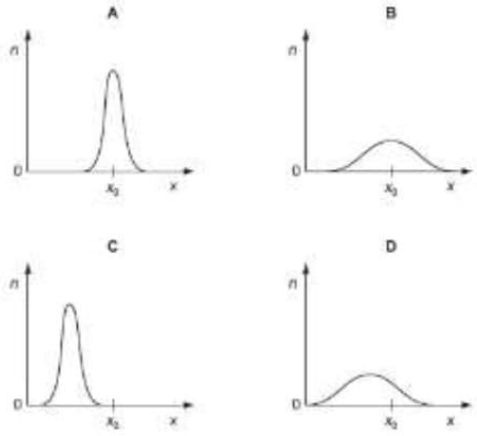
Four different students use a ruler to measure the length of a 15.0 cm pencil. Their measurements are recorded on four different charts.
Which chart shows measurements that are precise but not accurate?



Q4 (6/O/N/10/11):

A fixed quantity x_0 is measured many times in an experiment that has experimental uncertainty. A graph is plotted to show the number n of times that a particular value x is obtained.

Which graph could be obtained if the measurement of x_0 has a large systematic error but a small random error?



Q5 (4/O/N/17/13):

A school has a piece of aluminum that it uses for radioactivity experiments. Its thickness is marked as 3.2 mm. A student decides to check this value. He has vernier calipers which give measurements to 0.1 mm and a micrometer which gives measurements to 0.01 mm. Which statement must be correct?

A The micrometer gives a more accurate measurement.
B The micrometer gives a more precise measurement.
C The vernier calipers give a more accurate measurement.
D The vernier calipers give a more precise measurement.

Q6 (4/M/J/17/13):

A voltage is carefully measured with a high-quality instrument and found to be 2.321 V.

Two students, using two different methods, conclude that the voltage is 2.33 V and 2.344 V respectively. Which statement is correct?

A 2.33V is less accurate and less precise than 2.344V
B 2.33V is less accurate and more precise than 2.344V
C 2.33V is more accurate and less precise than 2.344V
D 2.33V is more accurate and less more than 2.344V

Q7 (5/O/N/16/12):

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

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.

Q8 (4/O/N/15/13):

Measurements are subjects to systematic error and random error. Which measurement has high accuracy and low precision?

A high random error and high systematic error
B high random error and low systematic error
C low random error and high systematic error
D low random error and low systematic error

Errors and uncertainties

Q1 (5/O/N/14/13):
The resistance R of a resistor is to be determined. The current **I** in the resistor and the potential difference **V** across it are measured.
The results, with their uncertainties, are

$$I = (2.0 \pm 0.2)\ A \qquad V = (15.0 \pm 0.5)\ V$$

The value of R is calculated to be 7.5 Ω.
What is the uncertainty in this value for R?

A ±0.3 Ω B ±0.5 Ω C ±0.7 Ω D ±1 Ω

Q2 (6/O/N/06/1):
An experiment is done to measure the resistance of a wire.
The current in the wire is 1.0 ± 0.2 A and the potential difference across the wire is 8.0 ± 0.4 V. What is the resistance of the wire and its uncertainty?

A (8.0 ± 0.2) Ω **B** (8.0 ± 0.6) Ω

C (8 ± 1) Ω **D** (8 ± 2) Ω

Q3 (6/M/J/06/1):
The resistance R of an unknown resistor is found by measuring the potential difference V across the resistor and the current I through it and using the equation

$$R = \frac{V}{I}$$

The voltmeter reading has a 3 % uncertainty and the ammeter reading has a 2 % uncertainty. What is percentage error in R.

A 1.5 % B 3 % C 5 % D 6 %

Q4 (6/M/J/04/1):
In a simple electrical circuit, the current in a resistor is measured as (2.50 ± 0.05) mA. The resistor is marked as having a value of 4.7 Ω ± 2 %.
If these values were used to calculate the power dissipated in the resistor, what would be the percentage uncertainty in the value obtained?

A 2 % B 4 % C 6 % D 8 %

Q5 (5/M/J/18/11):
The sides of a cube are measured with calipers.
The measured length of each side is (30.0 ± 0.1) mm.
The measurements are used to calculate the volume of the cube.
What is the percentage uncertainty in the calculated value of the volume?

A 0.01% B 0.3% C 1% D 3%

Q6 (4/O/N/08/1):
A student uses a digital ammeter to measure a current. The reading of the ammeter is found to fluctuate between 1.98 A and 2.02 A. The manufacturer of the ammeter states that any reading has a systematic uncertainty of ± 1 %. Which value of current should be quoted by the student?

A (2.00 ± 0.01) A B (2.00 ± 0.02) A
C (2.00 ± 0.03) A D (2.00 ± 0.04) A

Q7 (11/F/M/25/12):

A student takes measurements to calculate the density of a liquid in a beaker.

The height of the liquid in the beaker is 0.20 m ± 2%

The internal diameter of the beaker is 0.05 m ± 3%. The

mass of the liquid is 0.36 kg ± 10%.

What is the percentage uncertainty in the calculated density of the liquid?

A 2% **B** 5% **C** 15% **D** 18%

Q8 (5/O/N/05/1):

The density of the material of a rectangular block is determined by measuring the mass and linear dimensions of the block. The table shows the results obtained, together with their uncertainties.

Mass = (25.0 ± 0.1) g
Length = (5.00 ± 0.01) cm
Breadth = (2.00 ±0.01) cm
Height = (1.00 ± 0.01) cm

The density is calculated to be 2.50 g cm^{-3}.

What is the uncertainty in dencity?

A ± 0.01 g cm^{-3} B ± 0.02 g cm^{-3} C ± 0.05 g cm^{-3} D ± 0.13 g cm^{-3}

Q9 (4/M/J/05/1):

In an experiment, a radio-controlled car takes 2.50 ± 0.05 s to travel 40.0 ± 0.1 m.

What is the car's average speed and the uncertainty in this value?

A 16 ± 1 m s^{-1} B 16.0 ± 0.2 m s^{-1}
C 16.0 ± 0.4 m s^{-1} D 16.00 ± 0.36 m s^{-1}

Q10 (3/M/J/18/12):

A student measures the current through a resistor and the potential difference (p.d.) across it. There is a 4% uncertainty in the current reading and a 1% uncertainty in the p.d. reading. The student calculates the resistance of the resistor.

What is the percentage uncertainty in the calculated resistance?

A 0.25% B 3% C 4% D 5%

Q11 (4/M/J/18/12):

A student applies a potential difference V of (4.0 ± 0.1) V across a resistor of resistance R of (10.0 ± 0.3) Ω for a time t of (50 ± 1) s.

The student calculates the energy E dissipated using the equation below.

$$E = \frac{V^2 t}{R} = \frac{4.0^2 * 50}{10.0} = 80J$$

What is the absolute uncertainty in the calculated energy value?

A 1.5 J B 3 J C 6 J D 8 J

Q12 (5/M/J/18/13):

In an experiment to determine the Young modulus E of the material of a wire, the measurements taken are shown.

Mass hung on end of wire m = 2.300 ± 0.002 kg
Original length of wire l = 2.864 ± 0.005 m
Diameter of wire d = 0.82 ± 0.01 mm
Extension of wire e = 7.6 ± 0.2mm
The Young modulus is calculated using

$$E = \frac{4mgl}{\pi d^2 e}$$

where g is the acceleration of free fall.
The calculated value of E is 1.61×10^{10} N m^{-2}.
How should the calculated value of E and its uncertainty be expressed?

A $(1.61 \pm 0.04) \times 10^{10}$ N m^{-2} B $(1.61 \pm 0.05) \times 10^{10}$ N m^{-2}

C $(1.61 \pm 0.07) \times 10^{10}$ N m^{-2} D $(1.61 \pm 0.09) \times 10^{10}$ N m^{-2}

Q13 (3/M/J/18/12)

A student measures the current through a resistor and the potential difference (p.d.) across it. There is a 4% uncertainty in the current reading and a 1% uncertainty in the p.d. reading. The student calculates the resistance of the resistor.

What is the percentage uncertainty in the calculated resistance?
A 0.25% **B** 3% **C** 4% **D** 5%

Q14 (6/M/J/10/11):

A student finds the density of a liquid by measuring its mass and its volume. The following is a summary of his measurements.

Mass of empty beaker = (20 ± 1) g
Mass of beaker+ liquid = (70 ± 1) g
Volume of liquid = (10.0 ±0.6) cm^{-3}

He correctly calculates the density of the liquid as 5.0gcm^{-3}.
What is the uncertainty in this value?

A 0.3 gcm^{-3} B 0.5 gcm^{-3} C 0.6gcm^{-3} D 2.6 gcm^{-3}

Q15 (6/O/N/16/12):

An experiment to determine atmospheric pressure P uses the equation P = ρgh where

ρ= (13600 ±100) kgm^{-3}

g=(9.81 ±0.02)ms^{-2}

h=(0.762 ± 0.005)m

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

A (1.0166±0.0162)*10^5 Pa **B** (1.017±0.016)*10^5 Pa

C (1.017±1.6)*10^5 Pa **D** (1.02±0.02)*10^5 Pa

Q16 (5/M/J/16/12):

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

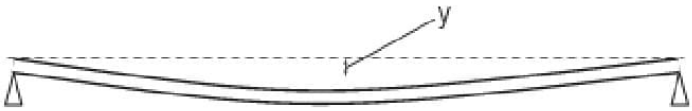
mass m = 6.2 ± 0.1 g length l = 25.0 ± 0.1 cm
diameter d=2.00 ± 0.01mm

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%

Q17 (4/M/J/16/13):
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 constant,
l is the distance between the pivot
M is the mass of the rule
t is the thickness of the rule
w is the width of the rule
In an experiment, the following results are obtained:

L = (80.0 ± 0.2) cm M = (60 ± 1) g
t = (6.0 ± 0.1) mm w = (23.0 ± 0.5) mm.
Which measurement contributes most to the uncertainty in the calculated value of y?

A L B M C t D w

Q18 (5/O/N/15/12):
A student measures the time T for one complete oscillation of a pendulum of length l.
Her results are shown in the table.

l / m	T / s
0.420 ± 0.001	1.3 ± 0.1

She uses the formula.

$$T = 2\pi\sqrt{\frac{l}{g}}$$

to calculate the acceleration of free fall g.
What is the best estimate of the percentage uncertainty in the value of g?

A 0.02% B 4% C 8% D 16%

Q19 (6/M/J/15/11):
The strain energy W of a spring is determined from its spring constant k and extension x. The spring obeys Hooke's law and the value of W is calculated using the equation shown.

$$W = \frac{1}{2}kx^2$$

The spring constant is $100 \pm 2\,\text{N m}^{-1}$ and the extension is $0.050 \pm 0.002\,\text{m}$.
What is the percentage uncertainty in the calculated value of W?

A 6% B 10% C 16% D 32%

Q20 (6/M/J/15/12):
A single sheet of aluminium foil is folded twice to produce a stack of four sheets. The total thickness of the stack of sheets is measured to be (0.80 ± 0.02) mm. This measurement is made using a digital caliper with a zero error of (−0.20 ± 0.02) mm.
What is the percentage uncertainty in the calculated thickness of a single sheet?

A 1.0% B 2.0% C 4.0% D 6.7%

Q21 (6/M/J/15/13):
In a simple electrical circuit, the current in a resistor is measured as (2.50 ± 0.05) mA. The resistor is marked as having a value of 4.7 Ω ± 2%.
If these values were used to calculate the power dissipated in the resistor, what would be the percentage uncertainty in the value obtained?

A 2% B 4% C 6% D 8%

Q22 (5/O/N/10/12):
A quantity x is to be determined from the equation

$$x = P - Q$$

P is measured as 1.27 ± 0.02 m.
Q is measured as 0.83 ± 0.01 m.
What is the percentage uncertainty in x to one significant figure?

A 0.4% B 2% C 3% D 7%

Q23 (5/O/N/14/13):
The resistance R of a resistor is to be determined. The current **I** in the resistor and the potential difference V across it are measured.
The results, with their uncertainties, are

I = (2.0 ± 0.2) A V = (15.0 ± 0.5) V.

The value of R is calculated to be 7.5 Ω.
What is the uncertainty in this value for R?

A ±0.3 Ω B ±0.5 Ω C ±0.7 Ω D ±1 Ω

Q24 (4/M/J/14/11):
An experiment is carried out to measure the resistance of a wire.
The current in the wire is (1.0 ± 0.2) A and the potential difference across the wire is (8.0 ± 0.4) V.
What is the resistance of the wire and its uncertainty?

A (8.0 ± 0.2) Ω B (8.0 ± 0.6) Ω

C (8 ± 1) Ω D (8 ± 2) Ω

Q25 (5/M/J/14/11):

The Young modulus of the material of a wire is to be found. The Young modulus E is given by the equation below.

$$E = \frac{4Fl}{\pi d^2 x}$$

The wire is extended by a known force and the following measurements are made.

Which measurement has the largest effect on the uncertainty in the value of the calculated Young modulus?

	Measurement	symbol	value
A	length of wire before force applied	l	2.043 ± 0.002 m
B	diameter of wire	d	0.54 ± 0.02 mm
C	force applied	F	19.62 ± 0.01 N
D	extension of wire with force applied	x	5.2 ± 0.2 mm

Q26 (4/M/J/14/12):

A quantity y is to be determined from the equation shown.

$$y = \frac{px}{q^2}$$

The percentage uncertainties in p, x and q are shown.

	percentage uncertainty
p	6%
x	2%
q	4%

What is the percentage uncertainty in y?

A 0.5 % B 1 % C 16 % D 192 %

Q27 (5/M/J/14/12):

A thermometer can be read to an accuracy of ± 0.5 °C. This thermometer is used to measure a temperature rise from 40 °C to 100 °C.

What is the percentage uncertainty in the measurement of the temperature rise?

A 0.5 % B 0.8 % C 1.3 % D 1.7 %

Q28 (5/O/N/13/12):

A micrometer screw gauge is used to measure the diameter of a small uniform steel sphere. The micrometer reading is 5.00 mm ± 0.01 mm.

What will be the percentage uncertainty in a calculation of the volume of the sphere, using these values?

A 0.2% B 0.4% C 0.6% D 1.2%

Q29 (6/O/N/13/13):
A student wishes to determine the density ρ of lead. She measures the mass and diameter of a small sphere of lead:

mass = (0.506±0.005)g
diameter = (2.20±0.02)mm

What is the best estimate of the percentage uncertainty in her value of ρ?

A 1.9% B 2.0% C 2.8% D 3.7%

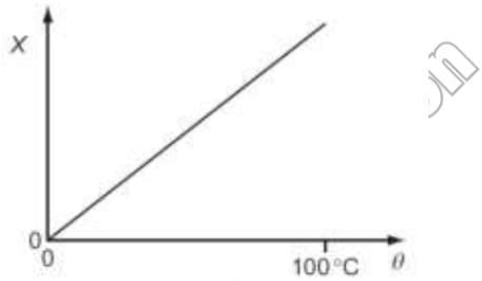
Q30 (5/M/J/13/11):
In an experiment to determine the acceleration of free fall g, the period of oscillation T and length *l* of a simple pendulum were measured. The uncertainty in the measurement of *l* is estimated to be 4%, and the uncertainty in the measurement of T is estimated to be 1%.
The value of g is determined using the formula

$$g = \frac{4\pi^2 l}{T^2}$$

What is the uncertainty in the calculated value for g?

A 2% B 3% C 5% D 6%

Q31 (6/O/N/12/11):
A quantity X varies with temperature θ as shown.



θ is determined from the corresponding values of X by using this graph.
X is measured with a percentage uncertainty of ±1 % of its value at all temperatures.
Which statement about the uncertainty in θ is correct?

A The percentage uncertainty in θ is least near 0 °C.
B The percentage uncertainty in θ is least near 100 °C.
C The actual uncertainty in θ is least near 0 °C.
D The actual uncertainty in θ is least near 100 °C.

Q32 (7/O/N/12/12):
The speed of a car is calculated from measurements of the distance travelled and the time taken.
The distance is measured as 200m, with an uncertainty of ±2m.
The time is measured as 10.0s, with an uncertainty of ±0.2s.
What is the percentage uncertainty in the calculated speed?

A ±0.5% B ±1% C ±2% D ±3%

Q33 (7/O/N/12/13):
In an experiment to determine the acceleration of free fall g, the time t taken for a ball to fall through distance s was measured. The uncertainty in the measurement of s is estimated to be 2%. The uncertainty in the measurement of t is estimated to be 3%.
The value of g is determined using the equation

$$g = \frac{2s}{t^2}$$

What is the uncertainty in the calculated value of g?

A 1% B 5% C 8% D 11%

Q34 (5/M/J/12/11):
In an experiment, a radio-controlled car takes 2.50 ± 0.05 s to travel 40.0 ± 0.1 m.
What is the car's average speed and the uncertainty in this value?

A $16 \pm 1\,m\,s^{-1}$ B $16.0 \pm 0.2\,m\,s^{-1}$

C $16.0 \pm 0.4\,m\,s^{-1}$ D $16.00 \pm 0.36\,m\,s^{-1}$

Q35 (5/O/N/11/11):
The Young modulus of the material of a wire is to be found. The Young modulus E is given by the equation below.

$$E = \frac{4Fl}{\pi d^2 x}$$

The wire is extended by a known force and the following measurements are made.
Which measurement has the largest effect on the uncertainty in the value of the calculated Young modulus?

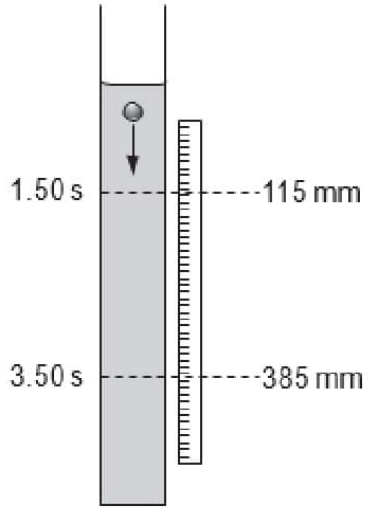
	Measurement	symbol	value
A	length of wire before force applied	l	2.043 ± 0.002 m
B	diameter of wire	d	0.54 ± 0.02 mm
C	force applied	F	19.62 ± 0.01 N
D	extension of wire with force applied	x	5.2 ± 0.2 mm

Q36 (4/O/N/11/12):
A micrometer is used to measure the diameters of two cylinders.
Diameter of first cylinder is12.78±0.02mm
Diameter of second cylinder is 16.24±0.03mm
The difference in the diameter is calculated.
What is the uncertainty in this difference?

A ±0.01 mm B ±0.02 mm C ±0.03 mm D ±0.05 mm

Q37 (5/M/J/11/11):

The diagram shows an experiment to measure the speed of a small ball falling at constant speed through a clear liquid in a glass tube.



There are two marks on the tube. The top mark is positioned at 115 ± 1 mm on the adjacent rule and the lower mark at 385 ± 1mm. The ball passes the top mark at 1.50 ± 0.02 s and passes the lower mark at 3.50 ± 0.02s. The constant speed of the ball is calculated by

$$\frac{385-115}{3.50-1.50}=\frac{270}{2.0}=135\ mms^{-1}$$

Which expression calculates the fractional uncertainty in the value of this speed?

A $\frac{2}{270}+\frac{0.04}{2.0}$ B $\frac{2}{270}-\frac{0.04}{2.0}$

C $\frac{1}{270}*\frac{0.02}{2.0}$ D $\frac{1}{270}\div\frac{0.02}{2.0}$

Q38 (4/M/J/11/12):

The uncertainty in the value of the momentum of a trolley passing between two points X and Y varies with the choice of measuring devices.

Measurements for the same trolley made by different instruments were recorded.

1 distance between X and Y using metre rule with cm division=0.55m
2 distance between X and Y using a metre rule with mm divisions = 0.547 m
3 timings using a wristwatch measuring to the nearest 0.5 s at X = 0.0 s and at Y = 4.5 s
4 timings using light gates measuring to the nearest 0.1 s at X = 0.0 s and at Y = 4.3 s
5 mass of trolley using a balance measuring to the nearest g = 6.4×10^{-2} kg
6 mass of trolley using a balance measuring to the nearest 10 g = 6×10^{-2} kg

Which measurements, one for each quantity measured, lead to the least uncertainty in the value of the momentum of the trolley?

A 1, 3 and 6 B 1, 4 and 6 C 2, 3 and 6 D 2, 4 and 5

Q39 (5/O/N/18/11)

A digital meter has an accuracy of ±1%.

The meter is used to measure the current in an electrical circuit. The reading on the meter varies between 04 A and 3.08 A. What is the value of the current, with its uncertainty?

A (3.06 ±0.02) A **B** (3.06 ±0.04) A

C (3.06 ±0.05) A **D** (3.06 ±0.07) A

Q40 (5/O/N/18/13)

The width of a table is measured as (50.3 ±0.1) cm. Its length is measured as (1.40 ±0.01) m.

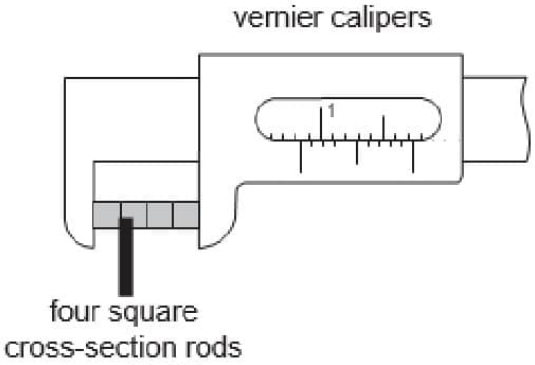
What is the area of the table and its absolute uncertainty?

A (0.7 ±0.1) m^2 **B** (0.704 ±0.006) m^2

C (0.704 ±0.011) m^2 **D** (70.4 ±0.6) m^2

Q41 (5/O/N/15/11):

Four identical rods have a square cross-section. The rods are placed side by side and their total width is measured with vernier calipers, as shown.



The measurement is (8.4 ± 0.1) mm and the zero reading on the calipers is (0.0 ± 0.1) mm. What is the width of one rod?

A (2.10 ± 0.025) mm B (2.10 ± 0.05) mm

C (2.1 ± 0.1) mm D (2.1 ± 0.2) mm

Q42 (4/M/J/18/12):

A student applies a potential difference V of (4.0 ±0.1) V across a resistor of resistance R of (10.0 ±0.3) ohm for a time t of (50 ±1) s.

The student calculates the energy E dissipated using the equation below

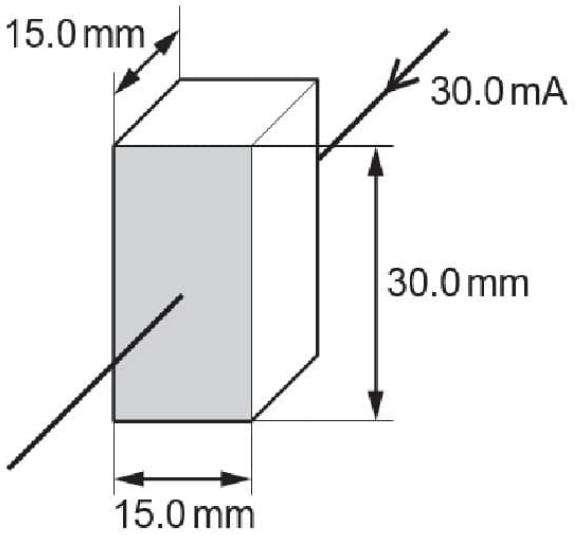
$$E = \frac{V^2 t}{R}$$

What is the absolute uncertainty in the calculated energy value?

A 1.5 J **B** 3 J **C** 6 J D

Q43 (4/M/J/17/12):

The current in a block of semiconductor is 30.0 mA when there is a potential difference (p.d.) of 10.0 V across it. The dimensions of the block and the direction of the current in it are shown.



The electrical meters used are accurate to ± 0.1 mA and ± 0.1 V. The dimensions of the block are accurate to ± 0.2 mm.

What is the resistivity of the semiconductor?

A 10.0 ± 0.2 Ω m

B 10.0 ± 0.3 Ω m

C 10.0 ± 0.5 Ω m

D 10.0 ± 0.8 Ω m

Base and derived Quantities

1	C	31	C
2	B	32	B
3	C	33	B
4	A	34	A
5	B	35	B
6	B	36	B
7	D	37	D
8	C	38	D
9	D	39	C
10	A	40	B
11	D	41	C
12	B	42	B
13	A	43	A
14	B	44	A
15	C	45	C
16	D	46	B
17	D	47	B
18	B	48	C
19	C	49	C
20	C	50	B
21	C	51	D
22	B	52	D
23	A	53	D
24	C	54	A
25	C	55	D
26	D	56	A
27	C	57	C
28	A	58	B
29	B	59	C
30	A		

Prefixes

1	D	11	D
2	D	12	C
3	C	13	C
4	C	14	C
5	A		
6	C		
7	C		
8	B		
9	D		
10	D		

Homogeneity

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

Reasonable Estimation

1	B	11	A
2	D	12	B
3	A	13	D
4	A	14	C
5	C	15	D
6	D	16	B
7	B	17	B
8	B	18	C
9	D	19	D
10	C	20	D

Scalars and Vectors

1	C	11	B	21	A
2	B	12	C	22	A
3	A	13	B	23	D
4	C	14	B		
5	C	15	A		
6	D	16	C		
7	D	17	A		
8	B	18	A		
9	C	19	D		
10	A	20	D		

Resolving Vectors

1	B	8	A
2	C	9	A
3	C	10	B
4	C	11	C
5	D		
6	C		
7	C		

Reading an analog scale

1	B	9	C
2	C	10	B
3	B	11	B
4	D		
5	B		
6	B		
7	B		
8	C		

Random and Systematic errors

1	A	11	A
2	A	12	B
3	A		
4	B		
5	B		
6	A		
7	B		
8	A		
9	D		
10	A		

Precision and Accuracy

1	B	5	B
2	D	6	C
3	B	7	A
4	C	8	B

Errors and uncertainty.

1	D	16	D	31	C
2	D	17	C	32	D
3	C	18	D	33	C
4	C	19	B	34	C
5	C	20	C	35	B
6	D	21	C	36	D
7	C	22	D	37	A
8	C	23	D	38	D
9	C	24	D	39	C
10	D	25	B	40	B
11	D	26	C	41	B
12	D	27	D	42	D
13	D	28	C	43	C
14	B	29	D		
15	D	30	D		