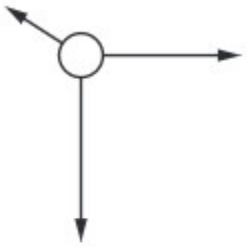
AS Physics

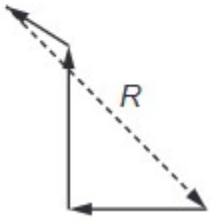
P1 – 20 Marks

1. Three wires each exert a horizontal force on a vertical pole, as shown.

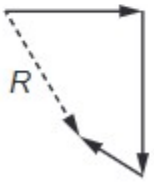


Which vector diagram shows the resultant force *R* acting on the pole?

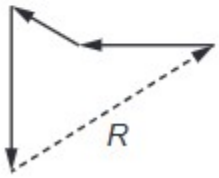
A



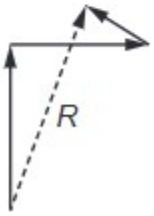
B



C



D



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?

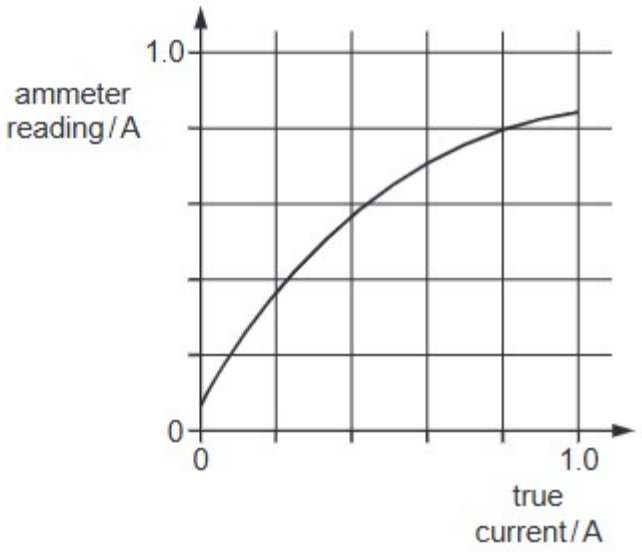
A adjusting a voltmeter needle pointer to the zero position before using it to measure a potential difference

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

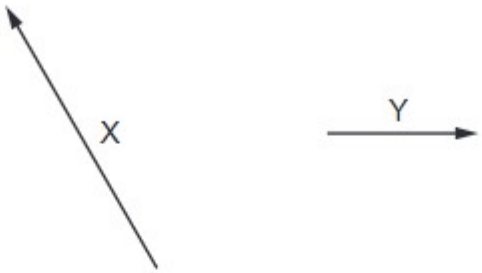
3. A calibration graph is produced for a faulty ammeter.



Which ammeter reading will be nearest to the true current?

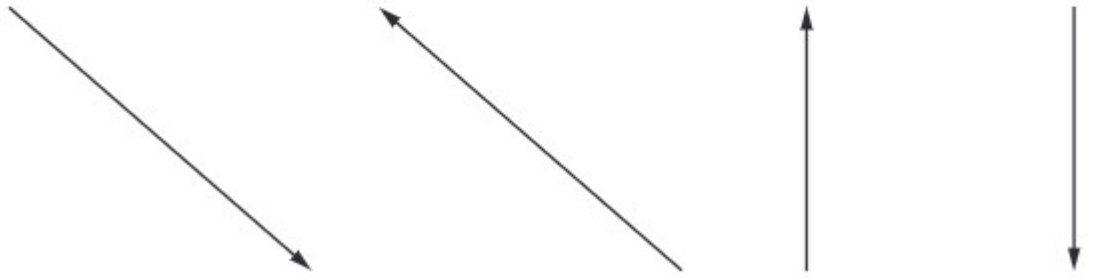
A 0.2 A **B** 0.4 A **C** 0.6 A **D** 0.8 A

4. The diagram shows two vectors X and Y, drawn to scale.



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

A **B** **C** **D**



5. 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 $\rho = \dfrac{4m}{\pi d^2 l}$.

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

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

6. Which list contains only SI base units?

A ampere, kelvin, joule, gram

B kilogram, newton, metre, ampere

C metre, coulomb, second, kelvin

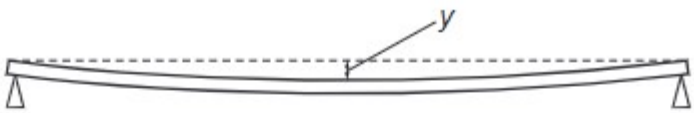
D second, kelvin, ampere, kilogram

7. Vectors P and Q are drawn to scale.

Which diagram represents the vector (P – Q)?

A **B** **C** **D**

8. 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:

$L = (80.0 \pm 0.2)\,\text{cm}$

$M = (60 \pm 1)\,\text{g}$

$t = (6.0 \pm 0.1)\,\text{mm}$

$w = (23.0 \pm 0.5)\,\text{mm}$.

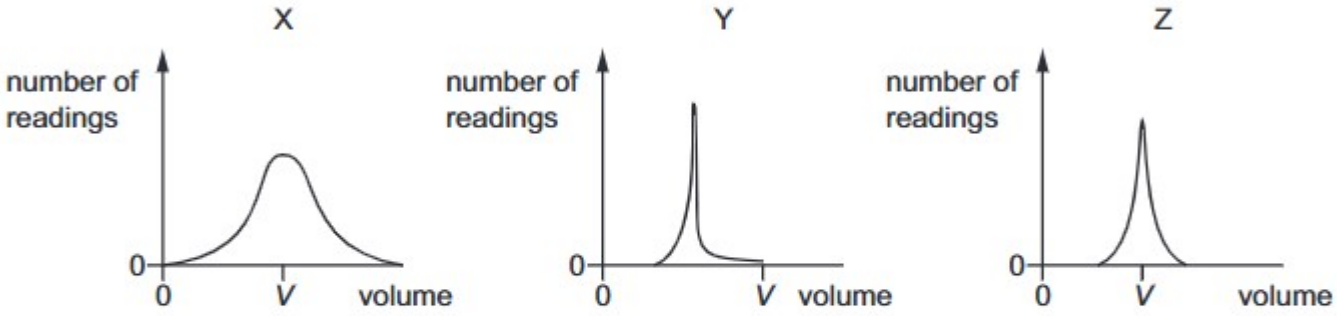
Which measurement contributes most to the uncertainty in the calculated value of y?

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

9. Students take readings of the volume of a liquid using three different pieces of measuring equipment X, Y and Z.

The true value of the volume of the liquid is *V*.

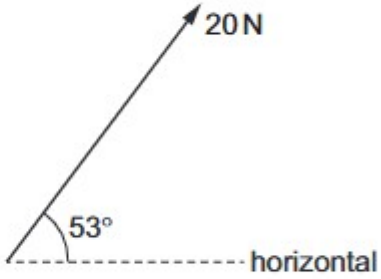
The students' results are shown.



How many pieces of equipment are precise and how many are accurate?

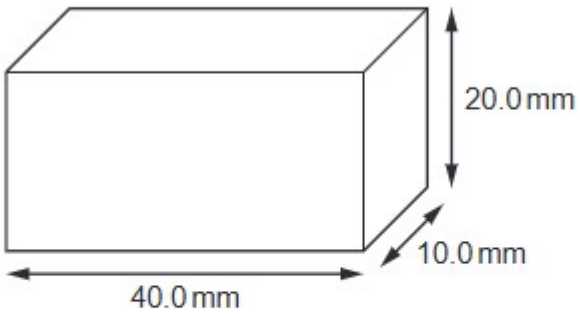
	number of precise pieces of equipment	number of accurate pieces of equipment
A	1	1
B	1	2
C	2	1
D	2	2

10. What is the horizontal component of the force shown?



A 12 N **B** 16 N **C** 25 N **D** 27 N

11. The sides of a wooden block are measured with calipers. The lengths of the sides are measured as 20.0 mm, 40.0 mm and 10.0 mm.



The calipers can measure with an absolute uncertainty of ± 0.1 mm.

What is the percentage uncertainty in the calculated volume of the block?

A 0.3% **B** 1.8% **C** 3.8% **D** 30%

12. The diameter of a circular disc is measured as (7.0 ± 0.1) mm.

What is the area of the disc and the absolute uncertainty in the area?

	area of disc / mm^2	absolute uncertainty / mm^2
A	38.5	±0.5
B	38	±1
C	154	±2
D	154	±4

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

Which statement is correct?

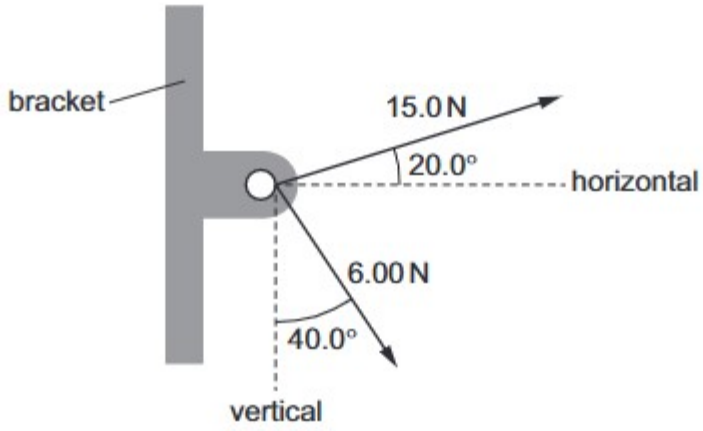
A The value is accurate but not precise.

B The value is both precise and accurate.

C The value is neither precise nor accurate.

D The value is precise but not accurate.

14. Two cables are attached to a bracket and exert forces as shown.



What are the magnitudes of the horizontal and vertical components of the resultant of the two forces?

	horizontal component / N	vertical component / N
A	9.73	0.534
B	9.73	10.2
C	18.0	0.534
D	18.0	10.2

15. Which statement about systematic errors is **not** correct?

A A systematic error can be caused by using an incorrectly calibrated instrument.

B One particular type of systematic error can affect all the measurements by the same amount.

C The effect of a systematic error can be reduced by repeating and averaging the measurements.

D Zero error is a type of systematic error.

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

$\rho = (13600 \pm 100)\,\text{kg m}^{-3}$,

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

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

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

17. 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** 0.75% **C** 12% **D** 16%

18. A school has a piece of aluminium 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.

19. 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

20. Vectors P and Q are drawn to scale.

Which diagram represents the vector (P + Q)?

A

B

C

D

P2 – 30 Marks

1. **(a)** Two forces, with magnitudes 5.0 N and 12 N, act from the same point on an object. Calculate the magnitude of the resultant force *R* for the forces acting

(i) in opposite directions,

R = ... N [1]

(ii) at right angles to each other.

R = ... N [1]

(b) An object X rests on a smooth horizontal surface. Two horizontal forces act on X as shown in Fig. 1.1.

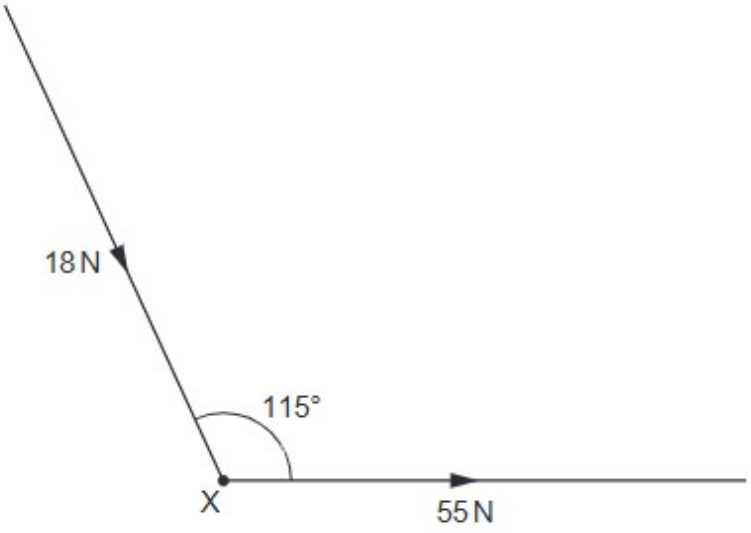


Fig. 1.1 (not to scale)

A force of 55 N is applied to the right. A force of 18 N is applied at an angle of 115° to the direction of the 55 N force.

(i) Use the resolution of forces or a scale diagram to show that the magnitude of the resultant force acting on X is 65 N.

[2]

(ii) Determine the angle between the resultant force and the 55 N force.

angle = ... ° [2]

(c) A third force of 80 N is now applied to X in the opposite direction to the resultant force in **(b)**.

The mass of X is 2.7 kg.

Calculate the magnitude of the acceleration of X.

acceleration = ... ms^{-2} [3]

[Total: 9]

2. **(a)** Define *velocity*.

.....

.....[1]

(b) The speed v of a sound wave through a gas of pressure P and density ρ is given by the equation

$$v = \sqrt{\frac{kP}{\rho}}$$

where k is a constant that has no units.

An experiment is performed to determine the value of k. The data from the experiment are shown in Fig. 1.1.

quantity	value	uncertainty
v	$3.3 \times 10^2\,\text{m s}^{-1}$	± 3%
P	$9.9 \times 10^4\,\text{Pa}$	± 2%
ρ	$1.29\,\text{kg m}^{-3}$	± 4%

Fig. 1.1

(i) Use data from Fig. 1.1 to calculate k.

k = ... [2]

(ii) Use your answer in **(b)(i)** and data from Fig. 1.1 to determine the value of k, with its absolute uncertainty, to an appropriate number of significant figures.

k = ... ± ..... [3]

[Total: 6]

3. **(a)** A property of a vector quantity, that is not a property of a scalar quantity, is direction. For example, velocity has direction but speed does not.

(i) State **two** other scalar quantities and **two** other vector quantities.

scalar quantities: ..... and .....

vector quantities: ..... and .....

[2]

(ii) State **two** properties that are possessed by both scalar and vector physical quantities.

1. .....

2. .....

[2]

(b) A ship at sea is travelling with a velocity of $13\,m\,s^{-1}$ in a direction 35° east of north in still water, as shown in Fig. 1.1.

Fig. 1.1

(i) Determine the magnitudes of the components of the velocity of the ship in the north and the east directions.

north component of velocity = ... $m\,s^{-1}$

east component of velocity = ... $m\,s^{-1}$

[2]

(ii) The ship now experiences a tidal current. The water in the sea moves with a velocity of $2.7\,m\,s^{-1}$ to the west.

Calculate the resultant velocity component of the ship in the east direction.

resultant east component of velocity = ... $m\,s^{-1}$ [1]

(iii) Use your answers in **(b)(i)** and **(b)(ii)** to determine the magnitude of the resultant velocity of the ship.

magnitude of resultant velocity = ... $m\,s^{-1}$ [2]

(iv) Use your answers in **(b)(i)** and **(b)(ii)** to determine the angle between north and the resultant velocity of the ship.

angle = ...° [2]

[Total: 11]

4. **(b)** Fig. 1.1 shows a horizontal beam clamped at one end with a block attached to the other end.

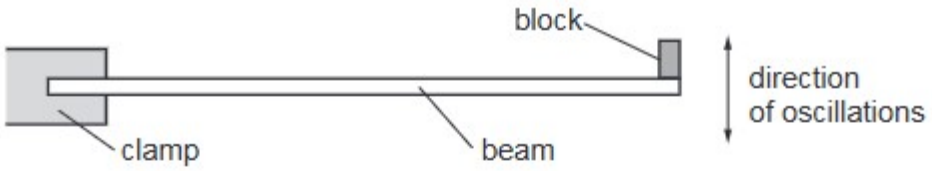


Fig. 1.1

The block is made to oscillate vertically.

The Young modulus E of the material of the beam is given by

$$E = \frac{kM}{T^2}$$

where M is the mass of the block,
T is the period of the oscillations
and k is a constant.

A student determines the values and percentage uncertainties of k, M and T.
Table 1.1 lists the percentage uncertainties.

Table 1.1

quantity	percentage uncertainty
k	±2.1%
M	±0.6%
T	±1.5%

The student uses the values of k, M and T to calculate the value of E as 8.245×10^9 Pa.

(i) Calculate the percentage uncertainty in the value of E.

percentage uncertainty = ... % [2]

(ii) Use your answer in **(b)(i)** to determine the value of E, with its absolute uncertainty, to an appropriate number of significant figures.

E = (..... ± .....) × 10^9 Pa [2]

[Total: 4]