Week 1

IGCSE Physics

Homework bundle for this week

本周作业合集

exercises.lol

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IGCSE Physics Name: ____________ Score: ______

1. You measure water in a measuring cylinder. How should you read the scale?

☐ eye level with the bottom of the meniscus (the curved surface)

☐ eye above, looking down at the water

☐ eye below, looking up at the water

☐ at the very top of the cylinder

2. A runner covers 100 m in 8.0 s. What is the average speed, in m/s?

____________ m/s

3. An astronaut travels from Earth to the Moon. What happens to their **mass** and **weight**?

☐ mass stays the same; weight gets smaller

☐ both stay the same

☐ mass gets smaller; weight stays the same

☐ both get smaller by the same amount

4. A force of 8.0 N stretches a spring by 0.040 m (within the limit of proportionality). What is the spring constant, in N/m?

____________ N/m

5. Momentum is a vector.

☐ True ☐ False

6. Select **all** of these that are **energy stores**.

☐ kinetic

☐ chemical

☐ gravitational potential

☐ loud

☐ fast

Tick every correct option.

7. A box pushes down with a force of 200 N over an area of 0.50 m^2. What is the pressure, in Pa?

____________ Pa

8. A stack of 100 sheets of paper is 12 mm tall. How thick is one sheet, in mm?

____________ mm

9. A car speeds up from rest to 20 m/s in 4.0 s. What is its acceleration, in m/s^2?

________________ m/s^2

10. The resultant force on a moving car is zero. What does the car do?

☐ keeps moving at constant velocity (same speed, same direction)

☐ speeds up

☐ stops at once

☐ turns around

IGCSE Physics

1. **eye level with the bottom of the meniscus (the curved surface)**

   Read at the bottom of the meniscus with your eye level with it — looking from above or below gives a parallax error (a wrong reading).

2. **12.5 m/s**

   $v = \frac{s}{t} = \frac{100}{8.0} = 12.5$ m/s.

3. **mass stays the same; weight gets smaller**

   Mass (amount of matter) never changes. Weight is the force of gravity, and the Moon's gravity is weaker, so the weight is smaller.

4. **200 N/m**

   $k = \frac{F}{x} = \frac{8.0}{0.040} = 200$ N/m.

5. **True**

   Momentum is mass × velocity, and velocity has a direction, so momentum is a vector.

6. **kinetic; chemical; gravitational potential**

   Kinetic, chemical and gravitational potential are energy stores. "Loud" and "fast" describe things, but they are not energy stores.

7. **400 Pa**

   $p = \frac{F}{A} = \frac{200}{0.50} = 400$ Pa.

8. **0.12 mm**

   Measure many and divide: $12 \div 100 = 0.12$ mm. Dividing makes the small measurement much more accurate.

9. **5 m/s^2**

   $a = \frac{\Delta v}{\Delta t} = \frac{20 - 0}{4.0} = 5.0$ m/s^2.

10. **keeps moving at constant velocity (same speed, same direction)**

    Newton's first law: with zero resultant force, an object keeps moving at constant velocity (or stays at rest).

IGCSE PHYSICS • EXERCISE SHEET

1.1 Physical quantities and measurement

Name: ____________ Class: ________ Date: __________ **Total: 9 marks**

KEY WORDS vector 矢量 • scalar 标量 • resultant 合矢量 • physical quantities and measurement 物理量与测量 • scalars and vectors 标量与矢量

Objective

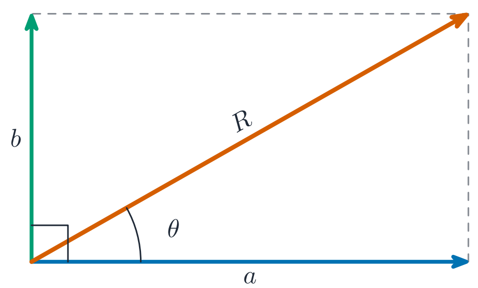
Build the skills to answer exam questions on **physical quantities and measurement 物理量与测量** — using instruments, measuring small quantities, and **scalars and vectors 标量与矢量**.

You must be able to:

- measure length, volume and time correctly (read the meniscus; avoid parallax)
- find a small length or short time by measuring many and dividing
- tell scalars from vectors and add two perpendicular vectors

1 Worked examples

Vectors at right angles



$R = \sqrt{a^2 + b^2}$

Two vectors at right angles add to a resultant R, the diagonal of the rectangle

- **scalar** = size only (distance, speed, mass, energy); **vector** = size **and** direction (force, velocity, momentum).
- two perpendicular vectors: $R = \sqrt{a^2 + b^2}$.
- **small quantity:** time 20 swings and divide by 20; measure 100 sheets and divide.

2 Practice

2.1 State the difference between a scalar and a vector. [1]

2.2 A student measures the time for 20 swings of a pendulum as 30 s. Find the period (time for one swing). [2]

3 Exam-style questions

3.1 Which is a vector quantity? [1]

- **A** mass
- **B** energy
- **C** velocity
- **D** temperature

3.2 Two forces of 3.0 N and 4.0 N act at right angles on a point.

(a) Find the magnitude of the resultant force. [2]

(b) State why a force is a vector. [1]

3.3 Describe how to measure the thickness of one sheet of paper accurately, using a ruler and a book. [2]

Solutions

2.1 a scalar has size only; a vector has size **and** direction.

2.2 period $= \frac{30}{20} = 1.5$ s.

3.1 C. Velocity has both size and direction.

3.2 (a) $R = \sqrt{3.0^2 + 4.0^2} = \sqrt{25} = 5.0$ N.
(b) it has both a size and a direction.

3.3 measure the total thickness of a known large number of sheets (e.g. 100) with the ruler; divide the total thickness by the number of sheets.

IGCSE Physics: **w25 21**

1 A student determines the diameter of a metal ball.

Which apparatus is needed to get an accurate measurement?

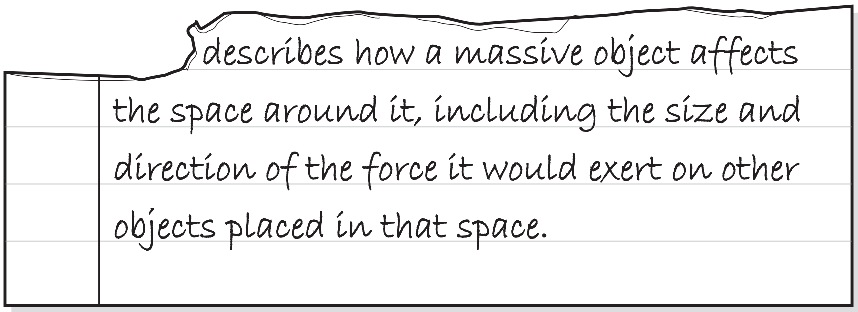
A a ruler and a protractor

B a ruler only

C a protractor and a set square

D a ruler and two rectangular blocks

3 A piece of paper torn out of an exercise book is shown.



What is being described?

A gravitational charge

B gravitational field

C gravitational mass

D gravitational potential energy

IGCSE Physics: **w25 22**

1 Which quantities are both vectors?

A acceleration and force

B acceleration and pressure

C density and force

D density and pressure

IGCSE Physics: **w25 23**

1 When a pendulum passes a marker, a timer displays 1 minute 30 seconds.

The pendulum passes the marker 12 more times from the same direction.

On the final pass, the timer displays a time of 2 minutes 18 seconds.

What is the time period of oscillation of the pendulum?

A 4.0 s **B** 4.4 s **C** 7.5 s **D** 12 s

1 **(a)** **(i)** State the difference between a scalar quantity and a vector quantity.

....

.... [1]

(ii) In the list below, draw a line under each of the quantities that is a scalar quantity.

acceleration **mass** **momentum** **electric field strength**

energy **temperature**

[2]

(b) A tennis player throws a tennis ball into the air. The mass of the tennis ball is 5.8×10^{-2} kg. The tennis ball leaves the tennis player's hand and reaches a maximum height of 5.0 m above the point of release.

(i) Show that the initial velocity of the tennis ball is 9.9 m/s upwards.

[3]

(ii) Calculate the momentum of the tennis ball as it leaves the tennis player's hand.

momentum = ... [2]

[Total: 8]

1 **(a)** Circle the vector quantities in the list.

acceleration **mass** **speed** **time** **velocity**

[1]

(b) Fig. 1.1 shows the speed–time graph for a train travelling from station A to station B.

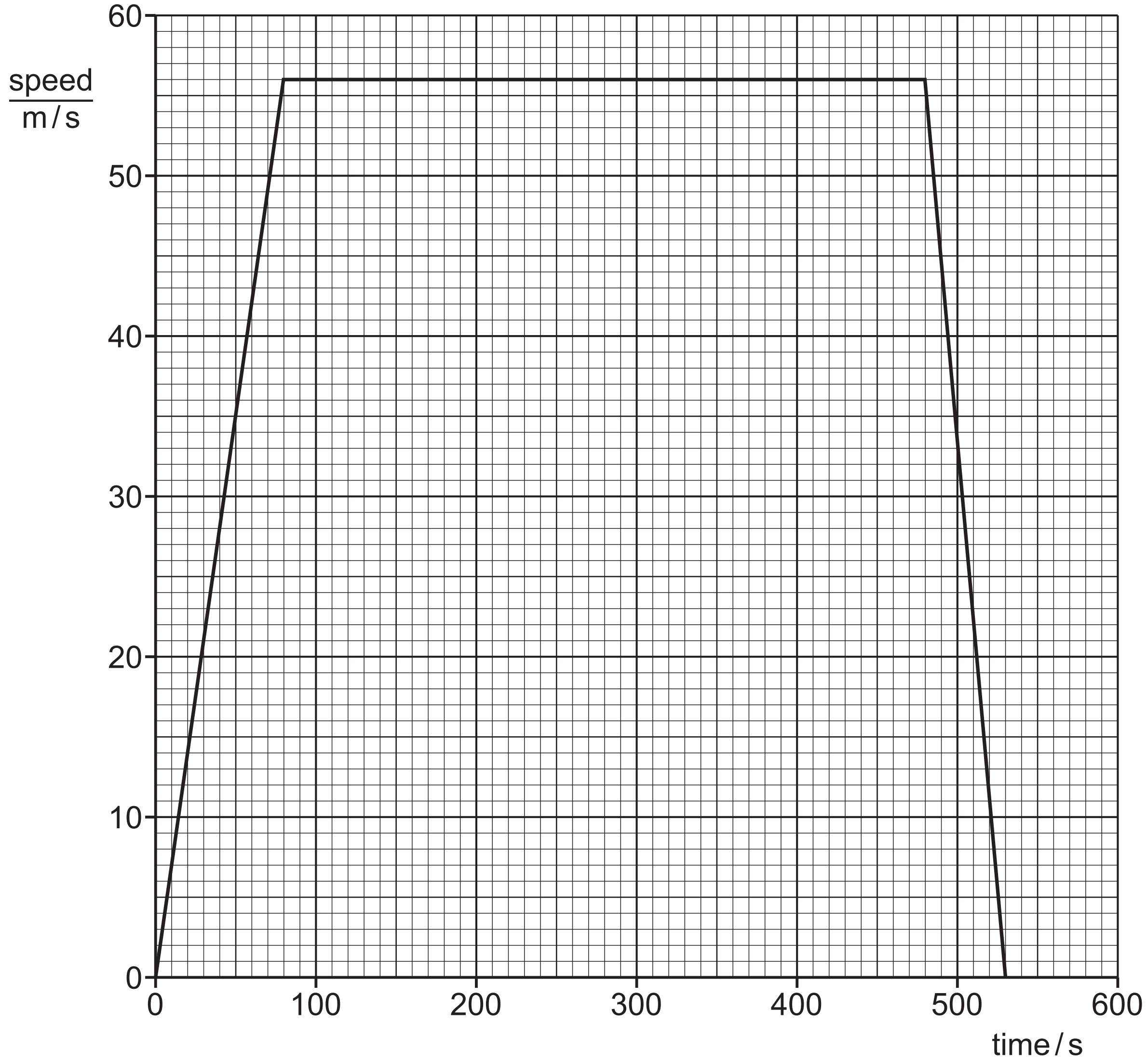


Fig. 1.1

(i) State the maximum speed of the train.

maximum speed = ... [1]

(ii) Describe the motion of the train between station A and station B.

....

....

.... [2]

(iii) Calculate the distance between station A and station B.

distance = ... [3]

(iv) On a different day, the train takes 650 s to travel between station A and station B.

Suggest **one** change to the motion of the train that leads to this longer journey time.

....

.... [1]

[Total: 8]

IGCSE Physics: **s24 21**

1 In which row are quantities correctly categorised into scalar quantities and vector quantities?

	scalar quantities	vector quantities
A	mass and energy	weight and acceleration
B	gravitational field strength and time	force and electric field strength
C	speed and momentum	distance and force
D	distance and energy	velocity and temperature

IGCSE Physics: **w23 21**

1 Which is a vector quantity?

A density

B mass

C pressure

D weight

IGCSE PHYSICS • EXERCISE SHEET

1.2 Motion

Name: ____________ Class: ________ Date: __________ **Total: 11 marks**

KEY WORDS speed–time graph 速度-时间图 • acceleration 加速度 • terminal velocity 终极速度 • distance–time gra
• speed 速率

Objective

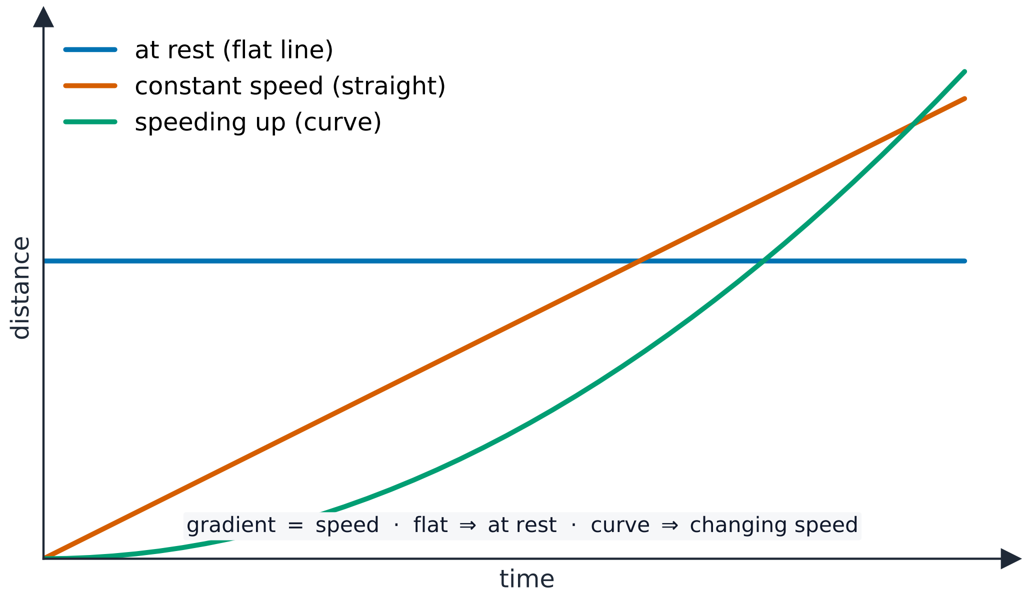
Build the skills to answer exam questions on **motion** 运动 — speed, velocity, **acceleration** 加速度, motion graphs, and **terminal velocity** 终极速度.

You must be able to:

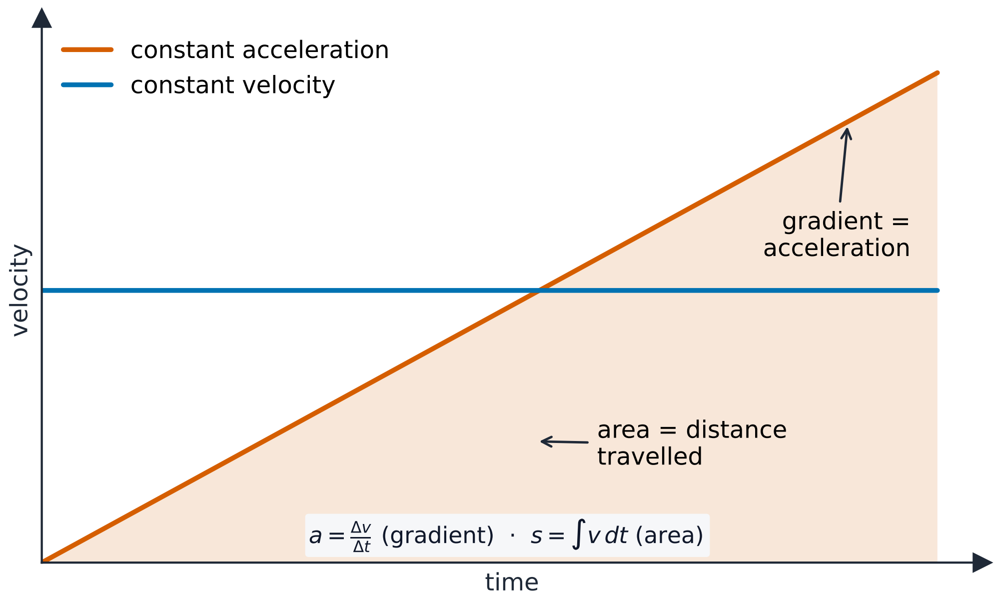
- use $v = \frac{s}{t}$ and $a = \frac{\Delta v}{\Delta t}$
- read distance–time and speed–time graphs (gradient and area)
- describe falling objects and terminal velocity

1 Worked examples

■ Graphs and acceleration



Distance–time: flat = at rest, straight slope = constant speed, rising curve = speeding up



Velocity–time: gradient = acceleration, area under the line = distance

Car $8 \to 20$ **m/s in** 4.0 **s:** $a = \dfrac{20-8}{4.0} = 3.0\ \mathrm{m/s^2}$.

2 Practice

2.1 A runner covers 100 m in 12.5 s. Find the average speed. [2]

2.2 State what the area under a speed–time graph represents. [1]

3 Exam-style questions

3.1 On a distance–time graph, a horizontal (flat) line means the object is: [1]

- **A** accelerating
- **B** at rest
- **C** at constant speed
- **D** decelerating

3.2 A car accelerates uniformly from rest to 24 m/s in 8.0 s.

(a) Find the acceleration. [2]

(b) Find the distance travelled (area under the speed–time graph). [2]

3.3 A skydiver falls and reaches terminal velocity. Explain, in terms of forces, why the speed becomes steady. [3]

Solutions

2.1 $v = \dfrac{100}{12.5} = 8.0 \text{ m/s}$.

2.2 the distance travelled.

3.1 **B**. A flat line on a distance–time graph means the distance is not changing — at rest.

3.2 (a) $a = \dfrac{24 - 0}{8.0} = 3.0 \text{ m/s}^2$.
(b) distance = area = $\frac{1}{2} \times 8.0 \times 24 = 96$ m.

3.3 as the diver speeds up, air resistance increases; when air resistance equals the weight, the resultant force is zero; so there is no acceleration and the speed stays constant (terminal velocity).

2 An athlete runs at a speed of 8 m / s for 10 s, and then at a speed of 6 m / s for 12 s.

Which calculation gives the average speed of the athlete in m / s?

A $\dfrac{8+6}{2}$

B $\dfrac{(8\times10)+(6\times12)}{22}$

C $\dfrac{(8\div10)+(6\div12)}{22}$

D $\dfrac{(10\div8)+(12\div6)}{22}$

2 How is the deceleration of an object calculated from a speed–time graph?

A It is the area under the graph.

B It is the gradient of the graph.

C It is the difference between two readings on the horizontal (*x*) axis.

D It is the difference between two readings on the vertical (*y*) axis.

2 A car driver applies the brakes to bring a car to rest with a constant deceleration of 4.0 m/s^2 in a time of 8.0 s.

What is the average speed of the car during this time?

A 4.0 m / s **B** 8.0 m / s **C** 16 m / s **D** 32 m / s

3 An object is falling in a uniform gravitational field.

After a certain time, it reaches terminal velocity.

Which row is correct?

	velocity of object	acceleration of object
A	increases then decreases	positive then negative
B	increases then decreases	positive then zero
C	increases then constant	positive then negative
D	increases then constant	positive then zero

1 **(a)** A hard ball is dropped vertically downwards.

Fig. 1.1 shows the speed–time graph for the ball from when it is dropped until it hits the ground.

Air resistance is ignored.

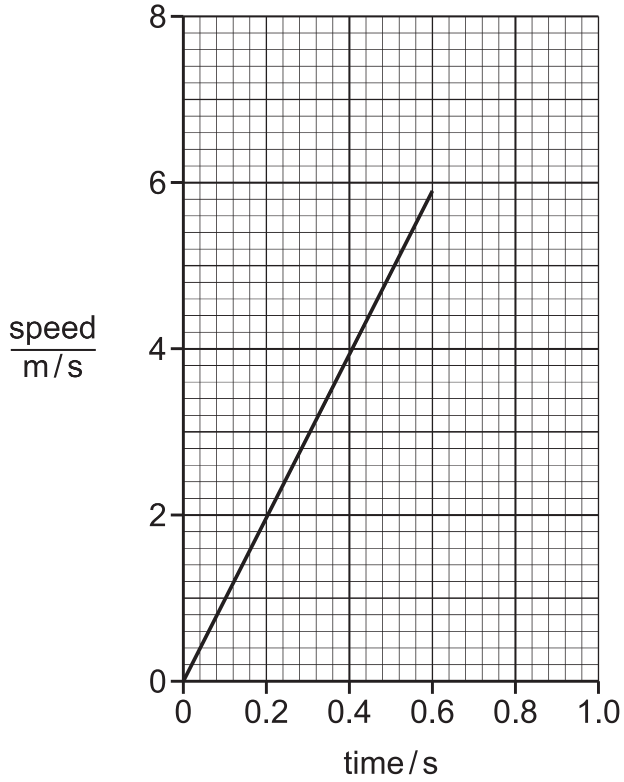


Fig. 1.1

(i) Describe the motion of the ball in Fig. 1.1.

....

.... [1]

(ii) Show that the distance travelled by the ball is 1.8 m.

[2]

(iii) The mass of the ball is 0.54 kg. Calculate the gravitational potential energy stored in the ball immediately before it is dropped.

gravitational potential energy = ... [2]

(iv) Determine the kinetic energy of the ball when it has fallen half way to the ground.

kinetic energy = ... [1]

(b) The same ball is dropped from an aeroplane. Air resistance acts on the ball.

Explain how the vertical motion of the ball changes, from when it is dropped to just before it hits the ground.

Use the idea of forces in your answer.

....

....

....

....

.... [3]

(c) A soft ball is dropped by a student so that it bounces on the ground.

Fig. 1.2 shows the height–time graph for the ball. The height is measured from the ground.

The ball bounces four times.

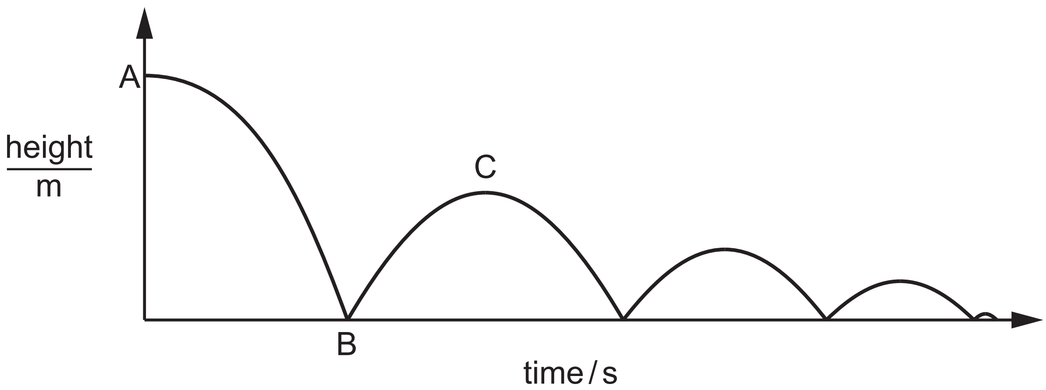


Fig. 1.2

Explain why the change in height of the ball between B and C is less than the change in height between A and B.

....

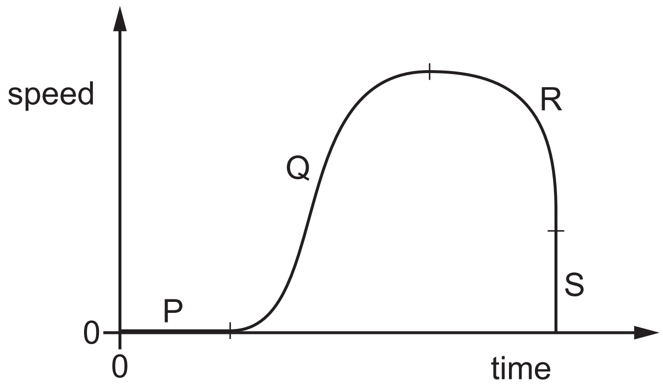
....

....

.... [2]

[Total: 11]

1 The speed–time graph for a racing car is divided into four sections, P, Q, R and S. The car starts the race but soon crashes into a wall of tyres.



Which sections of the graph show that there is an acceleration that is changing?

A P, Q, R and S

B Q, R and S only

C Q and R only

D R and S only

IGCSE Physics: **s24 21**

7 A stone is dropped from a tall tower and falls a distance of 50 m to the ground.

The stone has a mass of 3.0 kg.

At which speed does the stone hit the ground?

A 17 m/s **B** 31 m/s **C** 54 m/s **D** 150 m/s

1 A long tube contains oil. A small ball is held at rest at the surface of the oil. At time $t = 0$, the ball is released and begins to fall vertically through the oil.

Fig. 1.1 shows the ball falling through the oil.

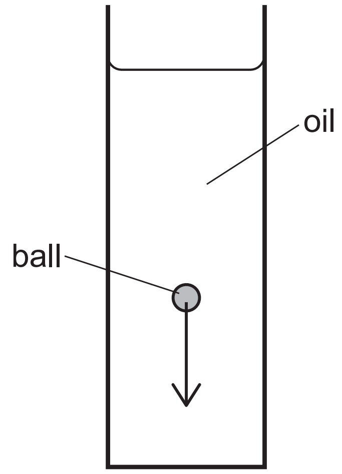


Fig. 1.1

As the ball begins to fall through the oil, it accelerates.

(a) Define acceleration.

....

.... [1]

(b) The mass of the ball is 0.0075 kg.

Calculate the resultant force acting on the ball when it is accelerating downwards at $2.8\,\text{m/s}^2$.

resultant force = ... [2]

(c) As the ball falls, its speed v is recorded. Fig. 1.2 is the speed–time graph for the falling ball.

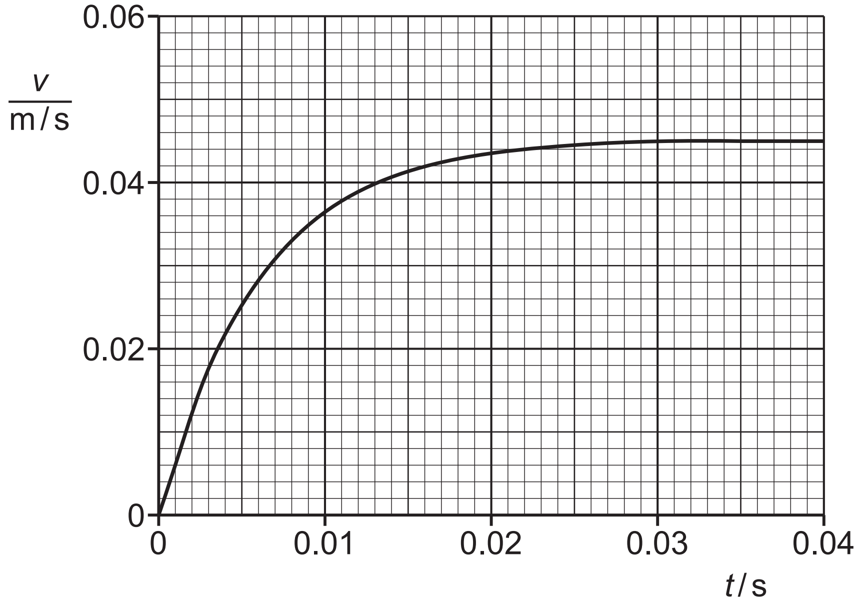


Fig. 1.2

(i) Describe what happens to the acceleration between $t = 0$ and $t = 0.040\,s$.

Explain why this happens.

....

....

....

.... [4]

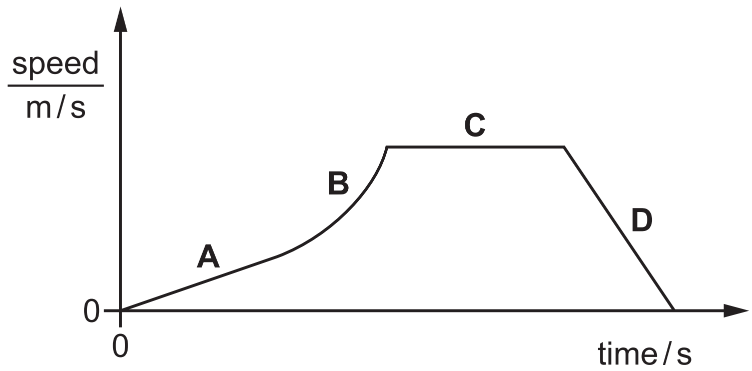
(ii) By drawing a tangent on Fig. 1.2, determine a value for the acceleration of the ball at $t = 0.010\,s$.

acceleration = ... [3]

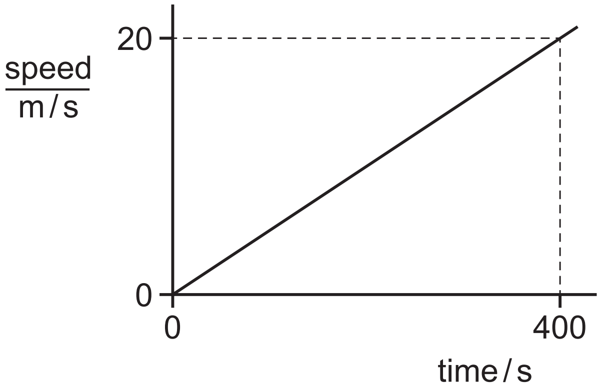
[Total: 10]

2 The graph shows the speed of a car travelling through a town.

Which section of the graph represents a period when the car is decelerating?



3 The graph represents the motion of a vehicle.



What is the distance travelled by the vehicle in 400 s?

A 20 m **B** 400 m **C** 4000 m **D** 8000 m

2 Fig. 2.1 shows a motorcyclist accelerating along a straight horizontal section of track.

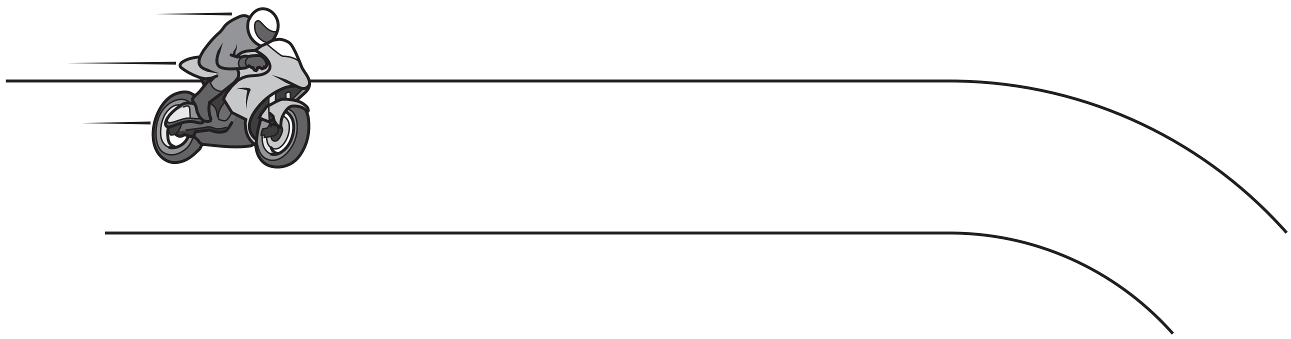


Fig. 2.1

The motorcyclist and motorcycle have a combined mass of 240 kg.

(a) On the straight horizontal section of the track, the motorcyclist accelerates from rest at $7.2\,m/s^2$.

(i) The motorcyclist reaches the end of the straight section of track in 5.3 s.

Calculate the speed of the motorcyclist at the end of the straight section.

speed = ... [2]

(ii) Calculate the resultant force on the motorcyclist and motorcycle on the straight section of track.

resultant force = ... [2]

(b) At the end of the straight section, the track remains horizontal but bends to the right, as shown in Fig. 2.1.

When the motorcyclist reaches the bend, she travels around the bend in a circular path at a constant speed.

(i) Velocity is a vector quantity.

State how a vector quantity differs from a scalar quantity.

....

.... [1]

(ii) Describe what happens to the velocity of the motorcyclist as she travels around the bend at constant speed.

....

.... [1]

(iii) Explain why there must be a resultant force on the motorcyclist as she travels around the bend.

....

....

.... [2]

[Total: 8]

IGCSE PHYSICS • EXERCISE SHEET

1.3 Mass and weight

Name: ______________ Class: __________ Date: ____________ **Total: 10 marks**

KEY WORDS gravitational field strength 重力场强度 • mass and weight 质量与重力 • mass 质量 • weight 重力 • matter 物质

Objective

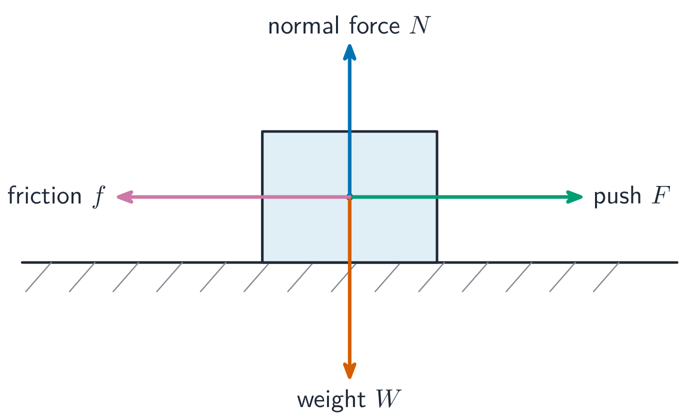
Build the skills to answer exam questions on **mass and weight 质量与重力** — the difference between them, $W = mg$, and **gravitational field strength 重力场强度**.

You must be able to:

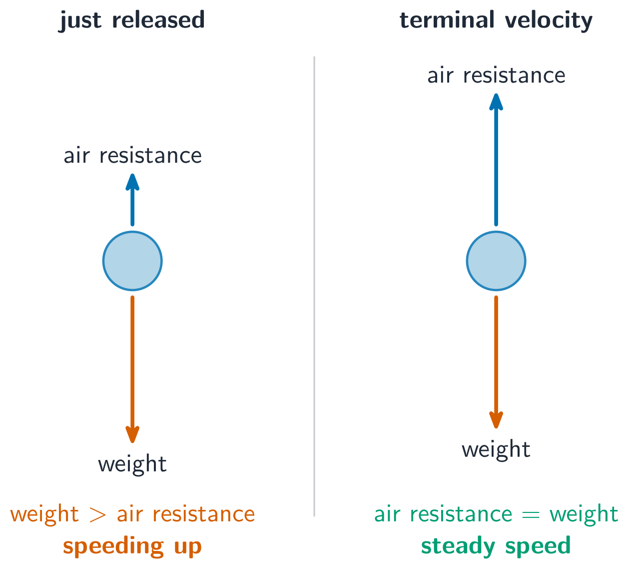
- distinguish mass (kg, constant) from weight (N, depends on gravity)
- use $W = mg$ and $g = \dfrac{W}{m}$
- explain why weight differs on the Moon

1 Worked examples

Mass vs weight



Weight is the downward force of gravity on a mass: $W = mg$



Weight is the downward force, balanced by drag at terminal velocity

- **mass** = amount of matter (kg), the **same** everywhere.
- **weight** = force of gravity (N); $W = mg$; smaller on the Moon (weaker gravity).
- **gravitational field strength** $g = \dfrac{W}{m}$ ($\approx$ 10 N/kg on Earth).

2 Practice

2.1 Find the weight of a 6.0 kg bag on Earth ($g = 10$ N/kg). [2]

2.2 State the unit of weight and the unit of mass. [1]

3 Exam-style questions

3.1 When an astronaut goes to the Moon, their: [1]

- **A** mass and weight both decrease
- **B** mass stays the same but weight decreases
- **C** mass decreases but weight stays the same
- **D** mass and weight both stay the same

3.2 An object has a weight of 48 N on Earth, where $g = 10$ N/kg.

(a) Find its mass. [2]

(b) Find its weight on the Moon, where $g = 1.6$ N/kg. [2]

3.3 Explain why mass does not change when an object is taken to the Moon, but weight does. [2]

Solutions

2.1 $W = mg = 6.0 \times 10 = 60$ N.

2.2 weight in newtons (N); mass in kilograms (kg).

3.1 B. Mass is unchanged; weight is less because the Moon's gravity is weaker.

3.2 (a) $m = \dfrac{W}{g} = \dfrac{48}{10} = 4.8$ kg.
(b) $W = mg = 4.8 \times 1.6 = 7.7$ N.

3.3 mass is the amount of matter, which does not change with location; weight is the force of gravity, which is smaller on the Moon because its gravitational field strength is weaker.

3 A space probe that has a mass of 600 kg is on the planet Mars.

The acceleration of free fall on Mars is 4.0 m/s^2.

What is the weight of the space probe on Mars?

A 60 N **B** 150 N **C** 2400 N **D** 6000 N

IGCSE Physics: **w25 23**

4 Which measuring instrument is used to compare masses?

A balance

B protractor

C stop-watch

D voltmeter

2 Table 2.1 contains information about the planet Mars.

Table 2.1

mass	6.4×10^{23} kg
gravitational field strength at surface	3.7 N/kg
average density	3900 kg/m^3

(a) Define gravitational field strength.

....

.... [1]

(b) **(i)** An object has a weight of 42 N at the surface of the Earth.

Calculate the weight of the object at the surface of Mars.

weight = ... [2]

(ii) Calculate the volume of Mars.

volume = ... [2]

(c) Fig. 2.1 shows a space buggy that is tested on Earth. The buggy is travelling at a constant speed in a straight line. The driving force on the buggy is 30 N.

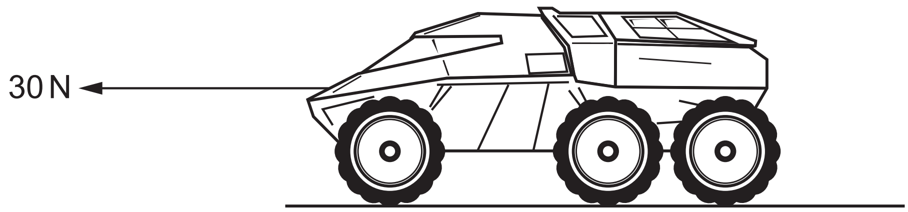


Fig. 2.1

(i) Draw and label **one** arrow on Fig. 2.1 to show the size and direction of the resistive forces on the buggy. [2]

(ii) Air resistance on Mars is less than air resistance on Earth.
The same driving force, 30 N, is exerted on the buggy on Mars.

1. State the effect this has on the resultant force on the buggy on Mars.

....

2. State the relationship between resistive forces, driving force and resultant force.

....
[1]

[Total: 8]

2 Which name is given to the quantity of matter in an object?

A density

B mass

C volume

D weight

3 A body is moved from place X to place Y where the gravitational field strength is different.

What happens to its mass and to its weight due to the move?

	mass	weight
A	changes	changes
B	changes	stays the same
C	stays the same	changes
D	stays the same	stays the same

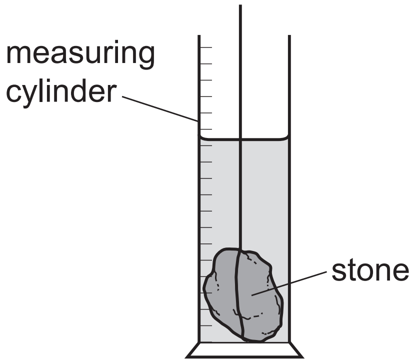
4 On the Earth, a spring stretches by 5.0 cm when a mass of 3.0 kg is suspended from one end.

The gravitational field strength on the Moon is $\frac{1}{6}$ of that on the Earth.

Which mass, on the Moon, would stretch the spring by the same extension?

A 0.50 kg **B** 3.0 kg **C** 5.0 kg **D** 18 kg

6 A student determines the density of an irregularly shaped stone. The stone is slowly lowered into a measuring cylinder partly filled with water.



Which other apparatus does the student need to calculate the density of the irregularly shaped stone?

A a balance

B a thermometer

C a metre rule

D a stop-watch

IGCSE PHYSICS • EXERCISE SHEET

1.4 Density

Name: ____________ Class: ________ Date: __________ **Total: 9 marks**

KEY WORDS density 密度 • floats 漂浮 • displacement method 排水法 • mass 质量 • measuring cylinder 量筒

Objective

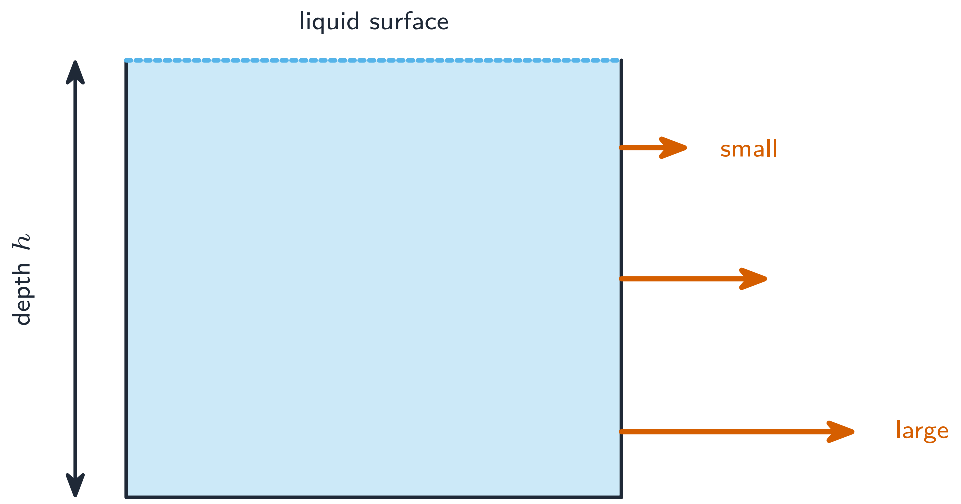
Build the skills to answer exam questions on **density 密度** — using $\rho = \frac{m}{V}$, finding volume (incl. the **displacement method 排水法**), and floating/sinking.

You must be able to:

- use $\rho = \frac{m}{V}$ with consistent units
- find the volume of a regular and an irregular solid
- predict floating or sinking from densities

1 Worked examples

■ Density and the displacement method



Density ρ is mass per unit volume; a denser liquid also gives a greater pressure with depth

Stone, mass 54 g, water rises 20 → 40 cm^3: volume = 20 cm^3; $\rho = \frac{54}{20} = 2.7\ \text{g/cm}^3$.

Float/sink: floats if its density $<$ the liquid's density.

2 Practice

2.1 A block has mass 240 g and volume 30 cm^3. Find its density. [2]

2.2 State how to find the volume of a small irregular stone. [1]

3 Exam-style questions

3.1 An object floats on water (density 1.0 g/cm^3) if its density is: [1]

- **A** greater than 1.0 g/cm^3
- **B** less than 1.0 g/cm^3
- **C** exactly 1.0 g/cm^3 only
- **D** any value

3.2 A rectangular metal block measures 2.0 cm $\times$ 3.0 cm $\times$ 5.0 cm and has mass 216 g.

(a) Find its volume. [1]

(b) Find its density. [2]

3.3 A liquid of density 0.80 g/cm^3 is poured onto water. State, with a reason, which liquid floats on top. [2]

Solutions

2.1 $\rho = \frac{m}{V} = \frac{240}{30} = 8.0\ \text{g/cm}^3$.

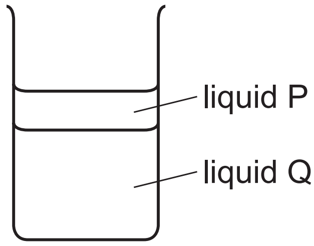
2.2 lower it into water in a measuring cylinder; the rise in water level is its volume.

3.1 **B**. It floats if its density is less than that of water.

3.2 (a) $V = 2.0 \times 3.0 \times 5.0 = 30\ \text{cm}^3$.
(b) $\rho = \frac{216}{30} = 7.2\ \text{g/cm}^3$.

3.3 the liquid of density $0.80\ \text{g/cm}^3$ floats; because its density is less than that of water ($1.0\ \text{g/cm}^3$).

4 The diagram shows one liquid floating on top of another liquid.



Which statement explains why liquid P floats on top of liquid Q?

A The mass of liquid Q is greater than the mass of liquid P.

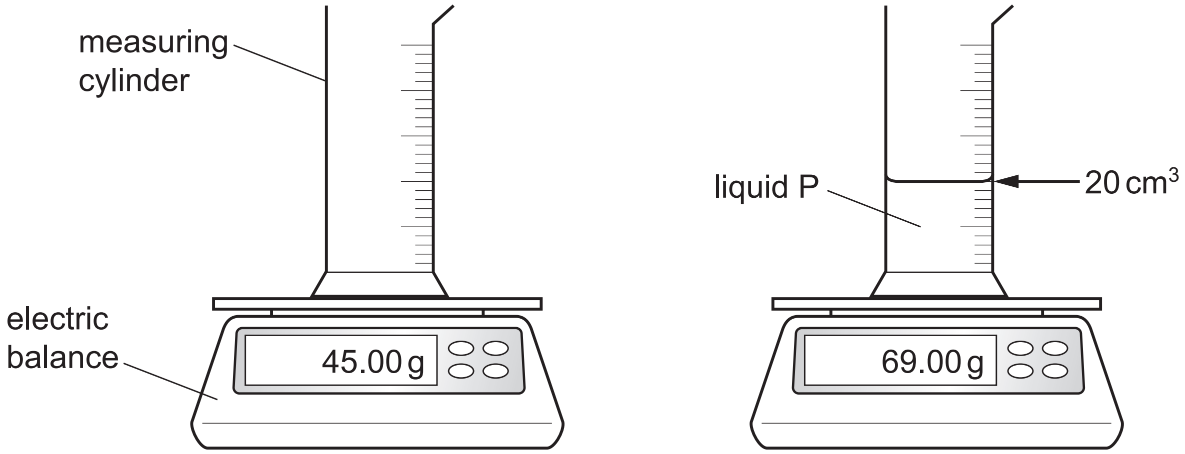
B The mass of $1\,cm^3$ of liquid Q is greater than the mass of $1\,cm^3$ of liquid P.

C The volume of liquid Q is greater than the volume of liquid P.

D The volume of $1\,g$ of liquid Q is greater than the volume of $1\,g$ of liquid P.

4 Students are asked to predict the order in which three liquids, P, Q and R, will float on each other. They are told that the liquids will **not** mix.

The diagrams show how the density of liquid P is determined.



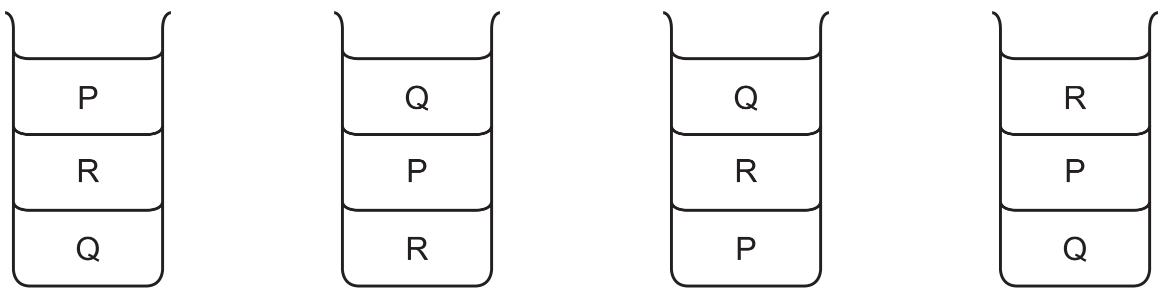
The table shows the densities of Q and R.

liquid	density / g/cm^3
Q	0.75
R	1.1

The liquids are poured gently into a tall beaker and allowed to settle.

Which diagram shows the liquids settled in the correct order?

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



5 Three different liquids are poured into a tall beaker. The liquids do **not** mix.

The liquid densities are shown in the table.

liquid	density / g/cm^3
P	1.8
Q	2.4
R	1.2

What is the correct order of the liquids from the top of the beaker to the bottom?

A P → Q → R **B** Q → P → R **C** Q → R → P **D** R → P → Q

4 **(a)** **(i)** A rectangular glass tank contains $3.0\,m^3$ of liquid. The mass of the liquid is 2800 kg. Calculate the density of the liquid.

density = ... [1]

(ii) A metal block is placed in the tank and it sinks to the bottom. The top surface of the block is 1.1 m below the surface of the liquid.

Fig. 4.1 shows the block on the bottom of the tank.

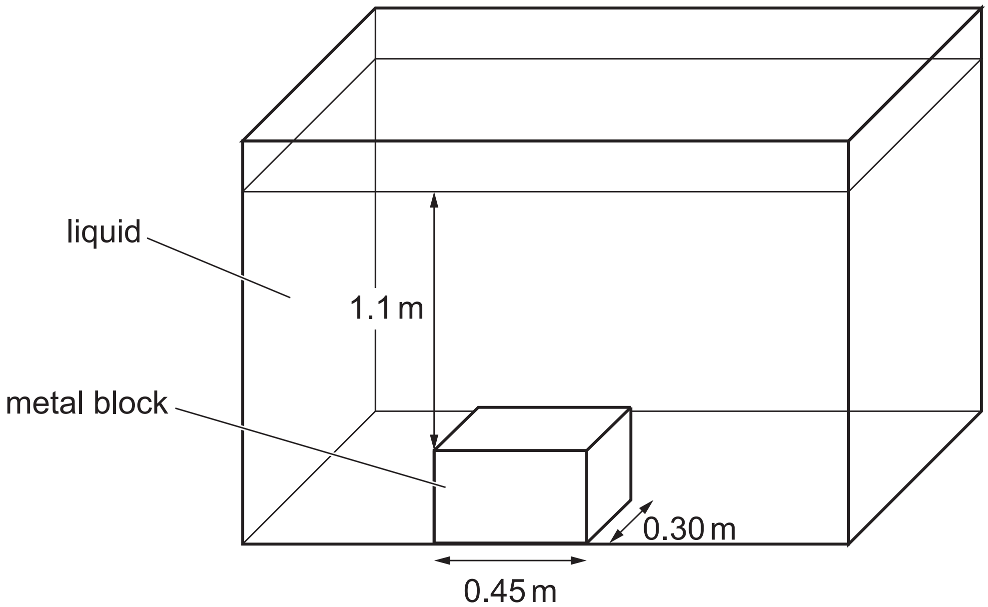


Fig. 4.1

Calculate the force exerted by the liquid on the top of the block.

force on top of the block = ... [4]

(b) Fig. 4.2 shows part of a steel railway track. There are small gaps between sections of the rail.

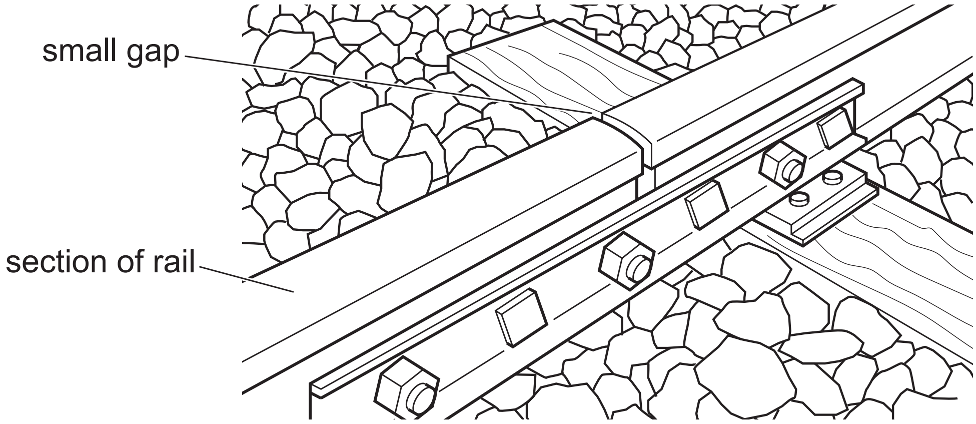


Fig. 4.2

State why gaps are needed between the sections of rail. Explain your answer in terms of particles.

statement ....

explanation ....

.... [2]

(c) Fig. 4.3 shows a saucepan of boiling water on the heating ring of an electric cooker.

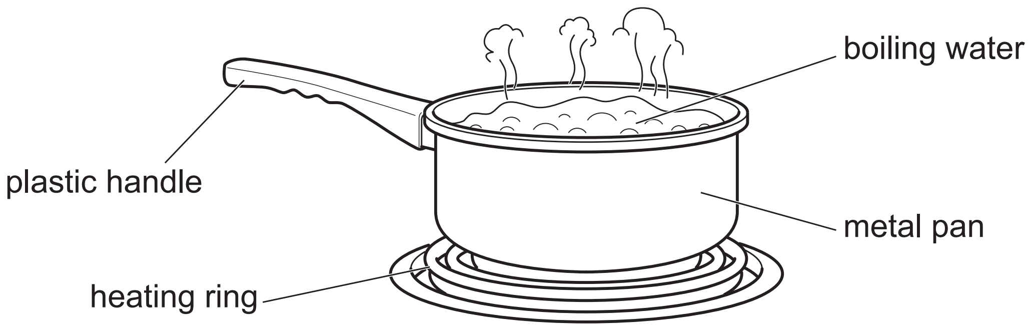


Fig. 4.3

The handle is made from plastic.
Explain why this material is suitable.

....

....

.... [2]

[Total: 9]

1 A student determines the volume of a block of modelling clay by two methods.

Method 1

He measures the block of modelling clay shown full size in Fig. 1.1.

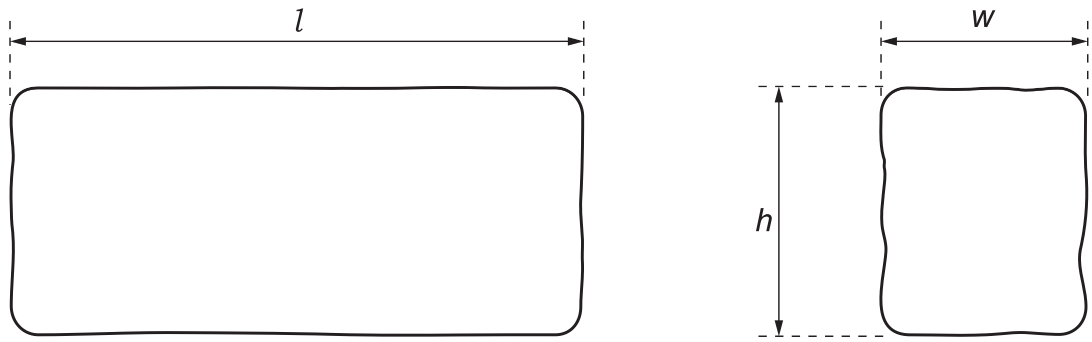


Fig. 1.1

(a) **(i)** Measure the length l, width w and height h of the block of modelling clay on Fig. 1.1. Record your values in centimetres to the nearest millimetre.

length l = ... cm

width w = ... cm

height h = ... cm
[2]

(ii) Calculate a value V_A for the volume of the block. Use your measurements from **(a)(i)** and the equation:

$$V_A = l \times w \times h.$$

V_A = ... cm^3 [1]

(b) Suggest why V_A is only an approximate value for the volume of the block.

Describe how the accuracy of V_A can be improved.

suggestion ....

....

improvement ....

....
[2]

(c) Another student measures the dimensions of a block of clay which is much smaller than the block in **(a)**. Suggest why these measurements may not be as accurate as yours, even if they are done carefully.

....

....

.... [1]

Method 2

(d) (i) The student pours water into a measuring cylinder.

Record the volume V_1 of the water in the measuring cylinder shown in Fig. 1.2.

V_1 = ... cm^3 [1]

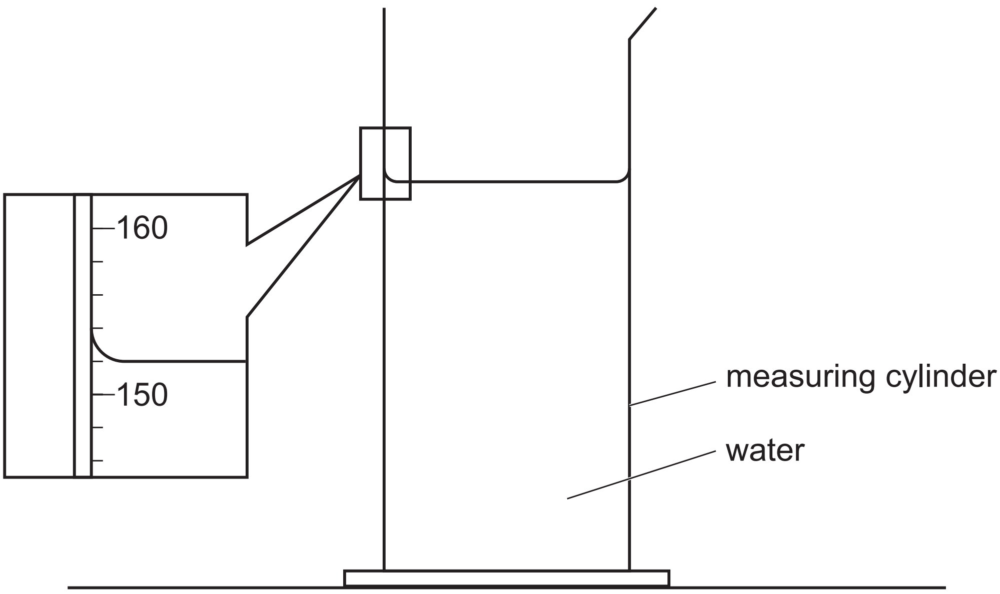


Fig. 1.2

(ii) Describe briefly how a measuring cylinder is read to obtain an accurate value for the volume of water.

....

.... [1]

(e) The student lowers the modelling clay into the water using a loop of thread, as shown in Fig. 1.3.

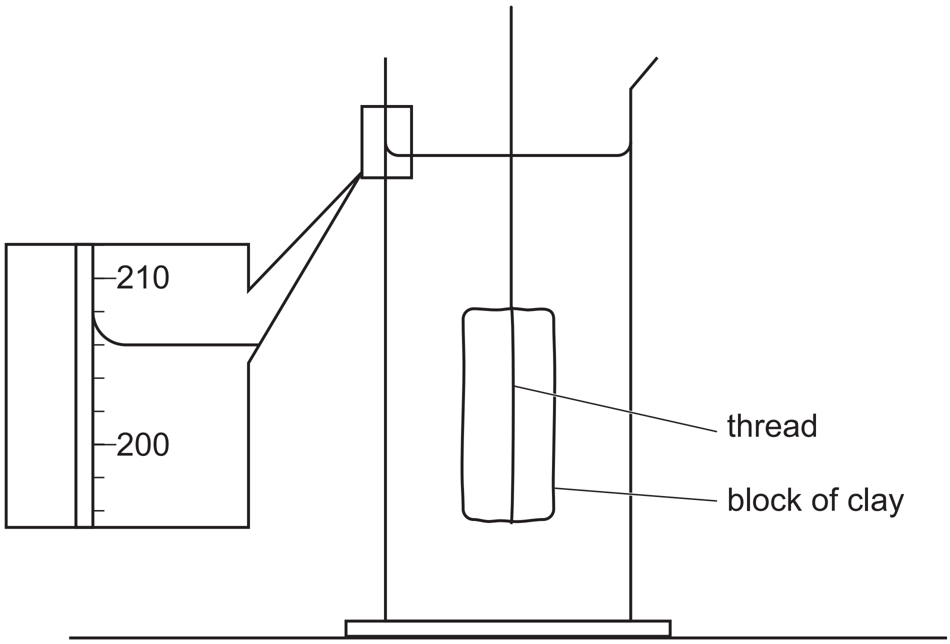


Fig. 1.3

Record the new reading V_2 shown on the measuring cylinder scale in Fig.1.3.

V_2 = ... cm^3

Calculate another value V_B for the volume of the block.

Use your measurements from **(d)(i)** and **(e)** and the equation: $V_B = (V_2 - V_1)$.

V_B = ... cm^3
[1]

(f) Suggest **one** possible source of inaccuracy in Method 2 and suggest **one** improvement to reduce its effect.

source of inaccuracy ....

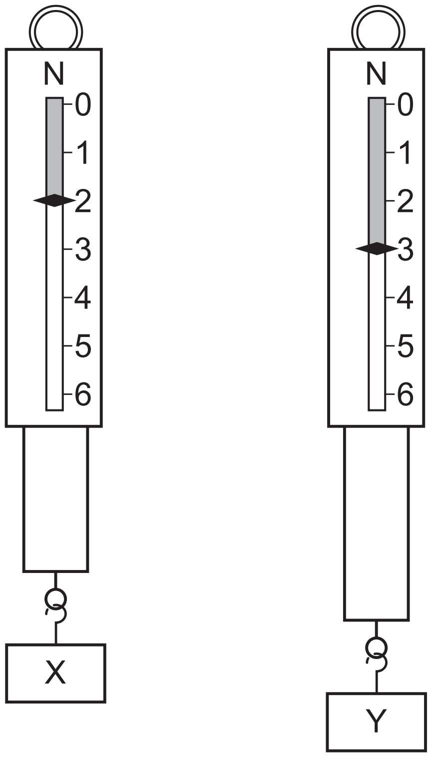
....

improvement ....

....
[2]

[Total: 11]

3 The diagrams show two metal blocks, X and Y, suspended from identical force meters. X and Y have identical dimensions.



Which statement about X and Y is correct?

A They have different volumes and different weights.

B They have different volumes and equal weights.

C They have equal volumes and equal weights.

D They have equal volumes and different weights.

1 A student determines the density of a ball.

(a) He places the ball between two wooden blocks, as seen from above in Fig. 1.1.

He takes two measurements, d_1 and d_2.

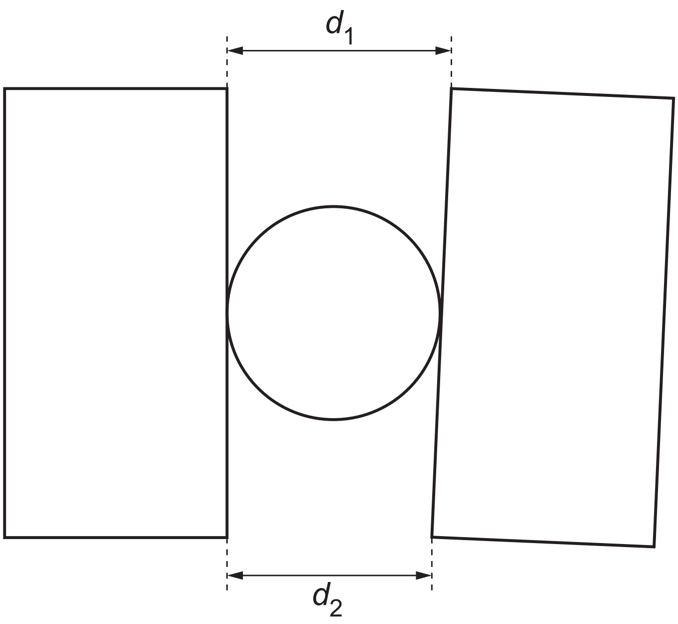


Fig. 1.1

(i) On Fig. 1.1, measure the lengths d_1 and d_2.

d_1 = ... cm

d_2 = ... cm [1]

(ii) Using your measurements, calculate the diameter d of the ball. Show your working.

d = ... cm [1]

(iii) Explain why this method is used to measure the diameter of the ball.

....

.... [2]

(b) Calculate the volume V of the ball using the equation $V = 0.52d^3$.

Include the unit.

V = ... [2]

(c) The student measures the mass m_D of a dish.

m_D = 102.5 g

He places the ball in the dish and measures the combined mass m_C of the dish and the ball.

Fig. 1.2 shows the dish and the ball on a balance.

Record the reading shown on the balance.

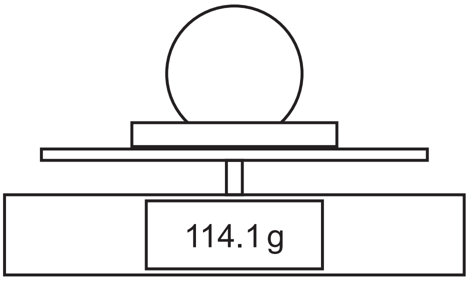


Fig. 1.2

m_C = ... g

Calculate the mass m_B of the ball. Show your working.

m_B = ... g
[2]

(d) Calculate the density ρ of the ball using the equation:

$$\rho = \frac{m_B}{V}.$$

Give your answer to a suitable number of significant figures for this experiment. Include the unit.

ρ = ... [3]

[Total: 11]

4 The mass of an object is 2.5 kg. The volume of the object is 480 cm^3.

What is the density of the object?

A $5.2 \times 10^{-3}\,g/cm^3$

B $5.2\,g/cm^3$

C $190\,g/cm^3$

D $1.2 \times 10^{3}\,g/cm^3$

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4 The table shows the mass and volume of three different liquids, X, Y and Z.

liquid	mass / g	volume / cm^3
X	120	200
Y	80	67
Z	100	120

The liquids are placed in the same container. The liquids do not mix.

Which liquid is at the top of the container and which liquid is at the bottom?

	liquid at top	liquid at bottom
A	X	Y
B	X	Z
C	Y	X
D	Y	Z

1.5 Forces

Name: ____________ Class: ________ Date: __________ **Total: 10 marks**

KEY WORDS resultant force 合力 • moments 力矩 • friction 摩擦力 • limit of proportionality 比例极限 • principle of moments 力矩原理

Objective

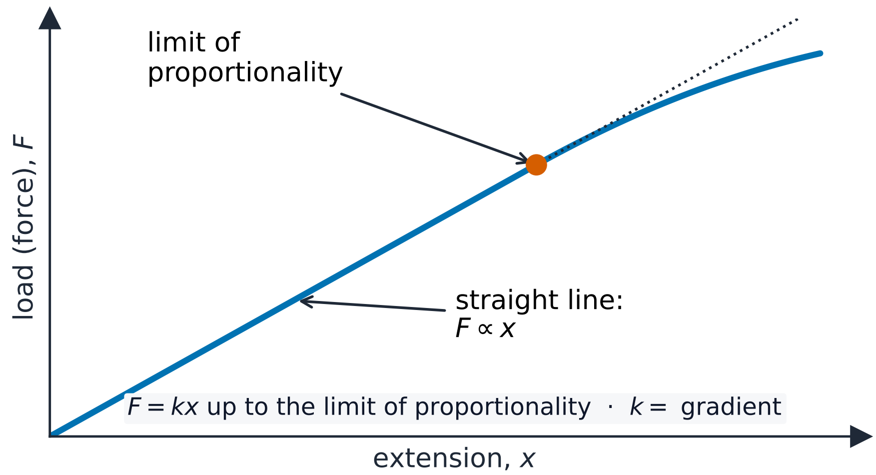
Build the skills to answer exam questions on **forces 力** — **Hooke's law 胡克定律**, **resultant force 合力** and $F = ma$, friction, and **moments 力矩**.

You must be able to:

- use $k = \dfrac{F}{x}$ and the limit of proportionality
- find a resultant force and use $F = ma$
- use the principle of moments for a balanced beam

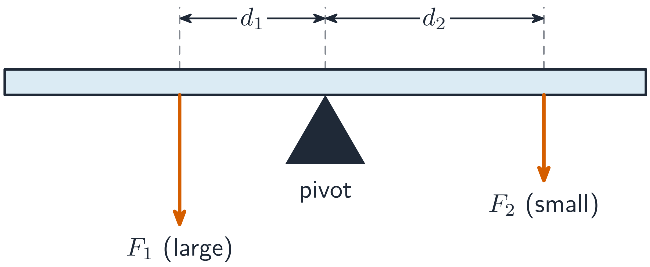
1 Worked examples

F = ma and moments



Load ∝ extension up to the limit of proportionality; $k = \dfrac{F}{x}$

balanced: $F_1 d_1 = F_2 d_2$



Balanced: clockwise moment = anticlockwise moment

Car 1200 **kg, drive** 3000 **N, friction** 600 **N:** resultant = 2400 N; $a = \frac{2400}{1200} = 2.0\ \text{m/s}^2$.

2 Practice

2.1 A spring stretches 4.0 cm under a 20 N load. Find the spring constant in N/cm. [2]

2.2 State the principle of moments. [1]

3 Exam-style questions

3.1 A resultant force of zero on a moving object means it: [1]

- **A** speeds up
- **B** slows down
- **C** moves at constant velocity
- **D** stops at once

3.2 A box of mass 5.0 kg is pushed with a force of 30 N against a friction force of 10 N.

(a) Find the resultant force. [1]

(b) Find the acceleration. [2]

3.3 A uniform beam balances on a pivot. A 40 N weight is 0.30 m to the left of the pivot. A weight W is 0.50 m to the right. Find W. [3]

Solutions

2.1 $k = \dfrac{F}{x} = \dfrac{20}{4.0} = 5.0$ N/cm.

2.2 for a balanced object, the total clockwise moment equals the total anticlockwise moment (about the pivot).

3.1 **C**. Zero resultant force means no acceleration — constant velocity.

3.2 (a) resultant $= 30 - 10 = 20$ N.
(b) $a = \dfrac{F}{m} = \dfrac{20}{5.0} = 4.0$ m/s^2.

3.3 moments balance: $40 \times 0.30 = W \times 0.50$; $12 = 0.50W$; $W = 24$ N.

IGCSE PHYSICS • EXERCISE SHEET

1.6 Momentum

Name: ____________ Class: ________ Date: __________ **Total: 11 marks**

KEY WORDS momentum 动量 • impulse 冲量 • conservation of momentum 动量守恒 • force 力 • mass 质量

Objective

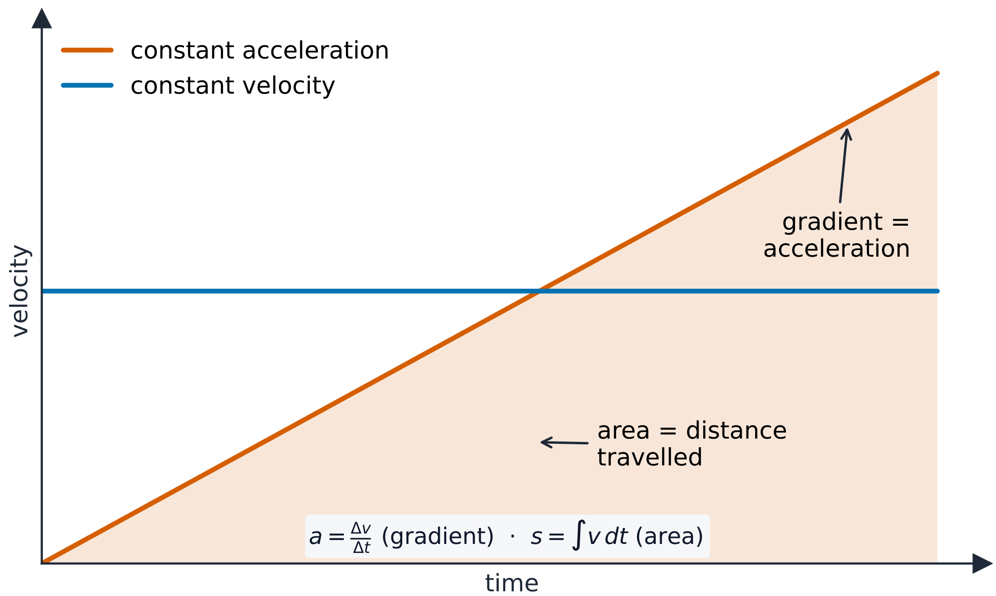
Build the skills to answer exam questions on **momentum 动量** — $p = mv$, $F = \dfrac{\Delta p}{\Delta t}$, and the **conservation of momentum 动量守恒**.

You must be able to:

- calculate momentum $p = mv$ (a vector — mind the direction)
- use $F = \dfrac{\Delta p}{\Delta t}$ (impulse)
- apply conservation of momentum to a collision

1 Worked examples

■ Conservation of momentum



Momentum $p = mv$ combines mass and velocity; in a collision the total is conserved

2.0 **kg at** 3.0 **m/s hits stationary** 1.0 **kg, they stick:** $(2.0 \times 3.0) + (1.0 \times 0) = (3.0)v \Rightarrow v = 2.0$ m/s.

2 Practice

2.1 Find the momentum of a 0.40 kg ball moving at 5.0 m/s. [2]

2.2 State the principle of conservation of momentum. [1]

3 Exam-style questions

3.1 The momentum of an object is its mass multiplied by its: [1]

- **A** acceleration
- **B** velocity
- **C** weight
- **D** density

3.2 A 3.0 kg trolley moving at 4.0 m/s collides with a stationary 1.0 kg trolley and they move off together.

(a) Find the total momentum before the collision. [2]

(b) Find their common velocity after the collision. [2]

3.3 A force acts on a 2.0 kg ball for 0.10 s and changes its velocity from 0 to 6.0 m/s. Find the force. [3]

Solutions

2.1 $p = mv = 0.40 \times 5.0 = 2.0$ kg m/s.

2.2 when no external force acts, the total momentum before a collision equals the total momentum after.

3.1 **B**. Momentum = mass × velocity.

3.2 (a) before $= 3.0 \times 4.0 + 1.0 \times 0 = 12$ kg m/s.
(b) $12 = (3.0 + 1.0)v \Rightarrow v = 3.0$ m/s.

3.3 $F = \dfrac{\Delta p}{\Delta t} = \dfrac{2.0 \times 6.0}{0.10} = \dfrac{12}{0.10}; = 120$ N.

7 The momentum of a car changes from 10 000 kg m/s to 15 000 kg m/s in a time of 8.0 s.

What is the resultant force acting on the car?

A 630 N **B** 3100 N **C** 40 000 N **D** 200 000 N

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6 Diagram 1 shows a ball X of mass 0.15 kg travelling horizontally with a velocity of 2.1 m/s towards ball Y travelling at 0.4 m/s in the opposite direction.

Diagram 2 shows the velocities of the balls immediately after they collide.

diagram 1

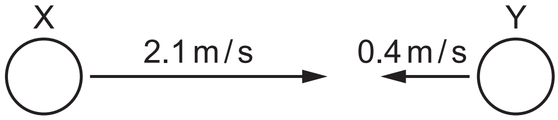
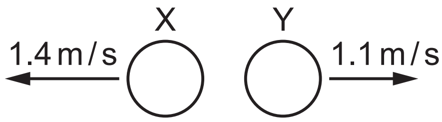


diagram 2



What is the mass of ball Y?

A 0.15 kg **B** 0.19 kg **C** 0.35 kg **D** 0.79 kg

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8 A ball is at rest on the ground. A boy kicks the ball. The boy's boot is in contact with the ball for a time of 0.040 s.

The average force on the ball is 200 N. The ball leaves the boy's boot with a speed of 20 m/s.

Which row gives the impulse of the boot on the ball and the average acceleration of the ball during the time of 0.040 s?

	impulse on ball / N s	average acceleration of ball / m/s^2
A	8	0.8
B	8	500
C	5000	0.8
D	5000	500

2 A cricket ball is travelling at a speed of 25 m / s horizontally through the air. The mass of the ball is 0.14 kg.

A player catches the ball and the ball comes to rest.

(a) Calculate the change in momentum of the ball during the catch.

change in momentum = ... [2]

(b) The player's hands are in contact with the moving ball for 9.7 ms.

Calculate the horizontal force exerted by her hands to bring the ball to rest.

force = ... [3]

[Total: 5]

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6 A ball of mass m falls vertically and hits a hard surface.

Its speed on hitting the surface is v_1.

It rebounds vertically upwards with speed v_2.

What is the change in momentum of the ball?

A mv_1 **B** mv_2 **C** $m(v_1 + v_2)$ **D** $m(v_2 - v_1)$

2 Fig. 2.1 shows two identical trolleys, P and Q, held at rest on a frictionless horizontal surface. A load is fixed to trolley P.

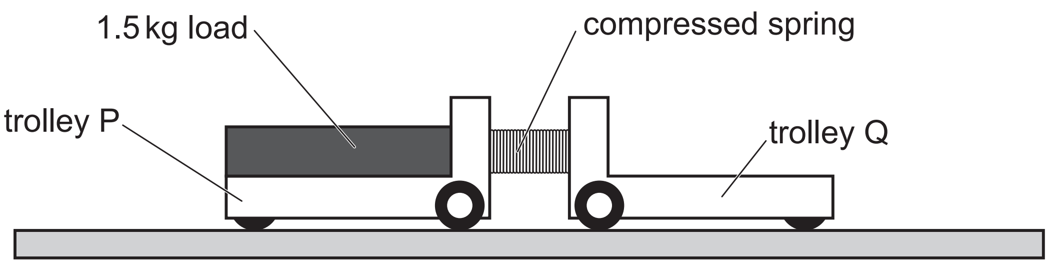


Fig. 2.1

There is a compressed spring between trolley P and trolley Q.

The trolleys are released. As the spring expands, it pushes the trolleys apart.

Trolley Q moves to the right at a constant speed of 0.36 m/s.

The mass of each trolley is 1.2 kg. The mass of the load on trolley P is 1.5 kg.

The spring has negligible mass.

(a) Calculate:

(i) the speed at which trolley P moves to the left

speed of P = ... [3]

(ii) the kinetic energy of trolley Q when it moves at 0.36 m/s.

kinetic energy of Q = ... [3]

(b) State the energy transfer that takes place as the spring expands.

....

....

.... [2]

[Total: 8]

7 A sphere X collides head on with a second identical sphere Y which is stationary.

The mass of each sphere is 0.15 kg.

Sphere X is travelling at a velocity of 2.0 m / s before the collision and produces an impulse of 0.21 N s on sphere Y.

What is the velocity of sphere X after collision?

A 0.60 m / s in the opposite direction to Y

B 0.60 m / s in the same direction as Y

C 1.4 m / s in the opposite direction to Y

D 1.4 m / s in the same direction as Y

1 A girl holds a rubber ball out of a window of a tall building. The mass of the ball is 0.20 kg. The ball is at rest 10 m above a concrete path.

(a) Calculate the gravitational potential energy of the ball relative to the concrete path.

gravitational potential energy = ... [2]

(b) The girl releases the ball and it falls towards the path. The ball strikes the path and bounces vertically upwards.

Fig. 1.1 shows the ball falling towards the path.

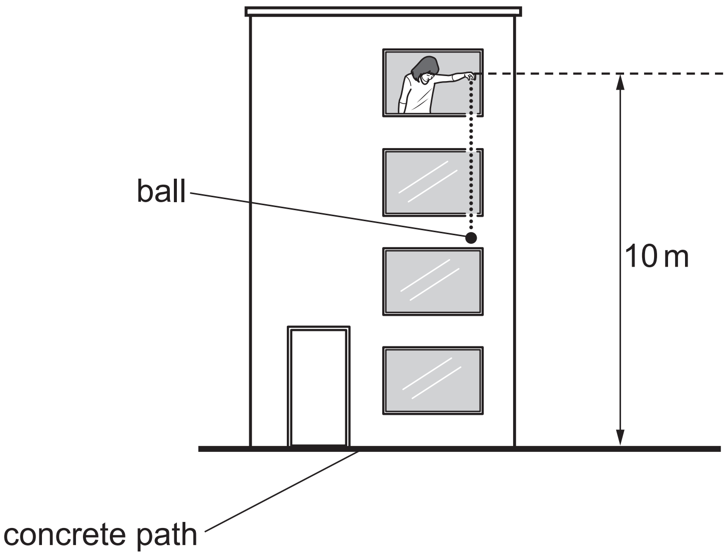


Fig. 1.1

The speed of the ball immediately **before** it strikes the path is 14 m/s.

The speed of the ball immediately **after** it strikes the path is 12 m/s.

(i) Calculate the kinetic energy of the ball immediately **after** it strikes the concrete path.

kinetic energy = ... [2]

(ii) Show that the change in momentum of the ball when it bounces off the path is 5.2 kg m/s.

[3]

(iii) The ball is in contact with the path for 0.25 s.

Calculate the average resultant force on the ball when it is in contact with the path.

force = ... [2]

[Total: 9]

IGCSE PHYSICS • EXERCISE SHEET

1.7 Energy, work and power

Name: ____________ Class: ________ Date: __________ **Total: 12 marks**

KEY WORDS efficiency 效率 • power 功率 • kinetic 动能 • energy 能量 • work done 做功

Objective

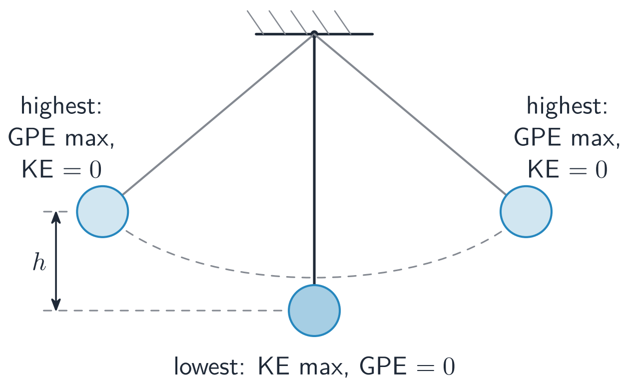
Build the skills to answer exam questions on **energy, work and power** 能量、功与功率 — energy stores, E_k and ΔE_p, conservation of energy, $W = Fd$, $P = \frac{W}{t}$, and **efficiency** 效率.

You must be able to:

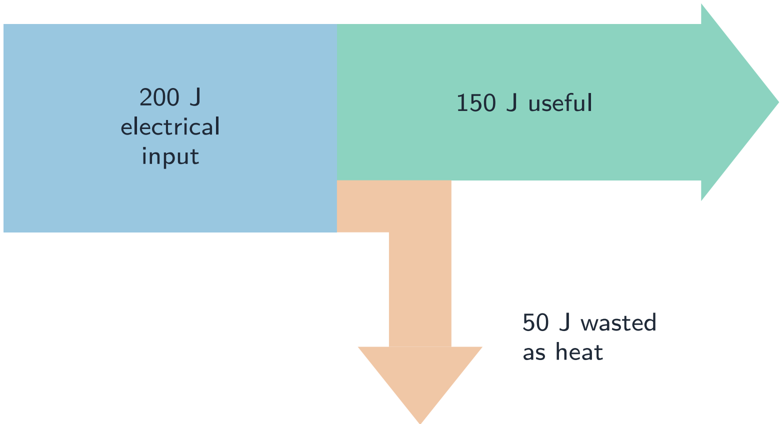
- use $E_k = \frac{1}{2}mv^2$ and $\Delta E_p = mg\Delta h$
- use conservation of energy ($E_p \to E_k$ for a falling object)
- use $W = Fd$, $P = \dfrac{W}{t}$ and the efficiency formula

1 Worked examples

Energy and efficiency



Energy moves between gravitational PE (top) and KE (bottom)



$$Efficiency = \frac{useful\ output}{total\ input} \times 100\%$$

Ball dropped 1.8 **m** ($g = 10$)**:** $v = \sqrt{2g\Delta h} = \sqrt{36} = 6.0$ m/s.

2 Practice

2.1 A 2.0 kg object moves at 3.0 m/s. Find its kinetic energy. [2]

2.2 A force of 25 N moves a box 4.0 m. Find the work done. [2]

3 Exam-style questions

3.1 A machine has an efficiency of 60%. For every 100 J of input energy, the useful output is: [1]

- **A** 40 J
- **B** 60 J
- **C** 100 J
- **D** 160 J

3.2 A crane lifts a 500 N load through a height of 12 m in 8.0 s.

(a) Find the work done. [2]

(b) Find the power. [2]

3.3 A motor is supplied with 400 J of electrical energy and does 260 J of useful work.

(a) Find the efficiency. [2]

(b) State what happens to the wasted energy. [1]

Solutions

2.1 $E_k = \frac{1}{2}mv^2 = \frac{1}{2}(2.0)(3.0^2) = 9.0$ J.

2.2 $W = Fd = 25 \times 4.0 = 100$ J.

3.1 **B**. 60% of 100 J is 60 J.

3.2 (a) $W = Fd = 500 \times 12 = 6000$ J.
(b) $P = \dfrac{W}{t} = \dfrac{6000}{8.0} = 750$ W.

3.3 (a) efficiency $= \dfrac{260}{400} \times 100\% = 65\%$.
(b) it is transferred to the surroundings as heat (thermal energy).

IGCSE PHYSICS • EXERCISE SHEET

1.8 Pressure

Name: ______________ Class: __________ Date: ____________ **Total: 9 marks**

KEY WORDS pressure 压强 • depth 深度 • density 密度 • force 力

Objective

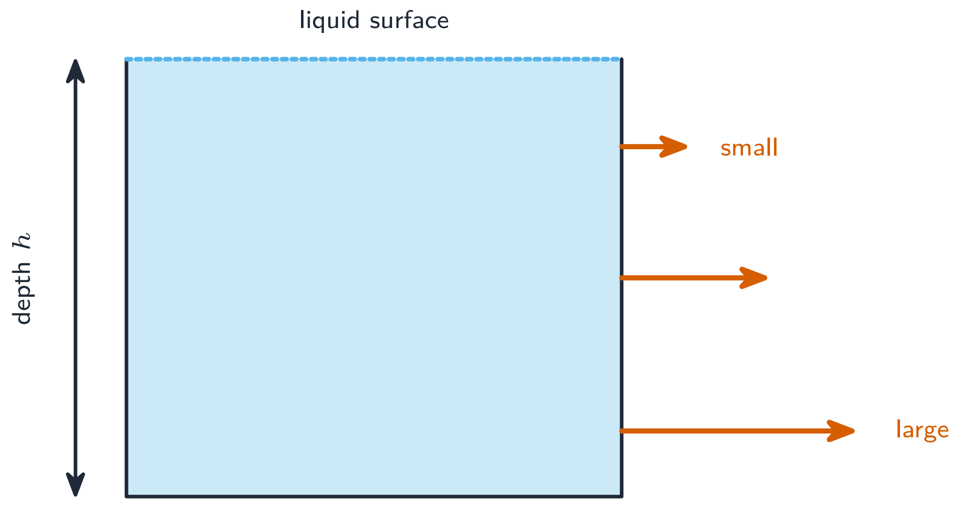
Build the skills to answer exam questions on **pressure 压强** — $p = \frac{F}{A}$, and **pressure in a liquid** $\Delta p = \rho g \Delta h$.

You must be able to:

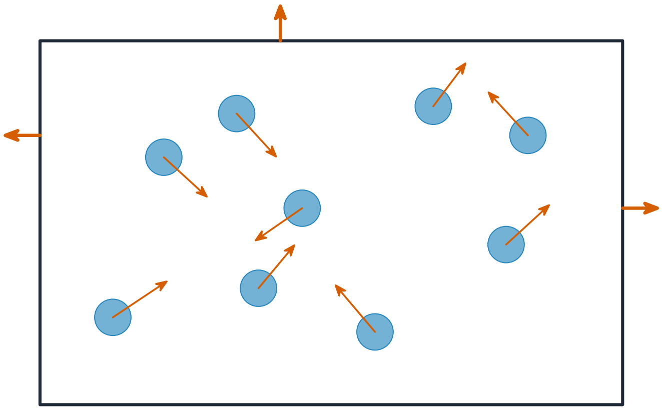
- use $p = \frac{F}{A}$ and explain area effects (sharp knife, snowshoes)
- use $\Delta p = \rho g \Delta h$ for pressure with depth
- state that liquid pressure acts in all directions and grows with depth

1 Worked examples

Pressure in a liquid



Pressure increases with depth and with density: $\Delta p = \rho g \Delta h$



Gas pressure comes from particles colliding with the walls

Depth 2.0 **m in water** ($\rho = 1000$, $g = 10$)**:** $\Delta p = 1000 \times 10 \times 2.0 = 20\,000$ Pa.

Area effect: a small area under a force gives a large pressure.

2 Practice

2.1 A force of 200 N acts on an area of 0.50 m^2. Find the pressure. [2]

2.2 State why a sharp knife cuts more easily than a blunt one. [1]

3 Exam-style questions

3.1 The pressure in a liquid increases with: [1]

- **A** depth only
- **B** density only
- **C** both depth and density
- **D** neither

3.2 A diver is 15 m below the surface of sea water of density 1030 kg/m^3 (g = 10 N/kg).

(a) Find the extra pressure due to the water. [2]

(b) State the direction(s) in which this pressure acts on the diver. [1]

3.3 A box weighing 240 N stands on the ground on a base of area 0.30 m^2. Find the pressure it exerts on the ground. [2]

Solutions

2.1 $p = \dfrac{F}{A} = \dfrac{200}{0.50} = 400$ Pa.

2.2 its edge has a very small area, so the same force gives a very large pressure.

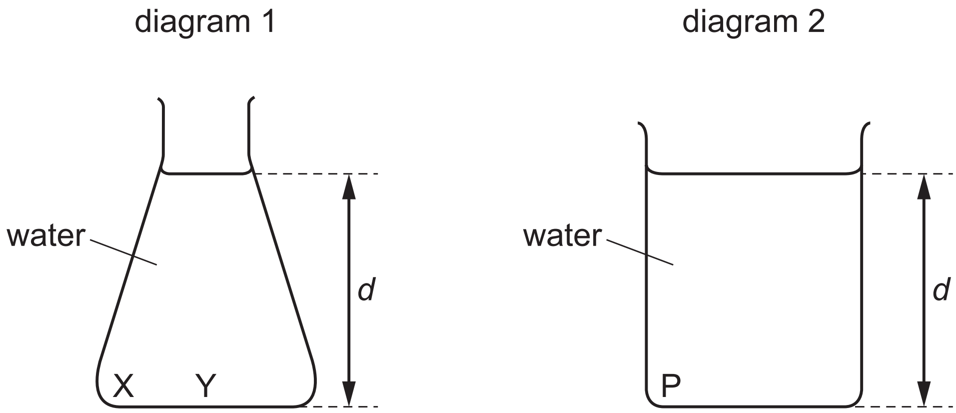
3.1 **C**. Liquid pressure increases with both depth and density.

3.2 (a) $\Delta p = \rho g \Delta h = 1030 \times 10 \times 15 = 154\,500$ Pa.
(b) in all directions.

3.3 $p = \dfrac{F}{A} = \dfrac{240}{0.30} = 800$ Pa.

9 Diagram 1 shows a conical flask containing water.

Diagram 2 shows a beaker with the same base area as the flask and containing water of the same depth *d*.



Which statement is correct?

A The pressure at P is equal to the pressure at X.

B The pressure at P is greater than the pressure at Y.

C The pressure at P is greater than the pressure at X.

D The pressure at Y is greater than the pressure at X.

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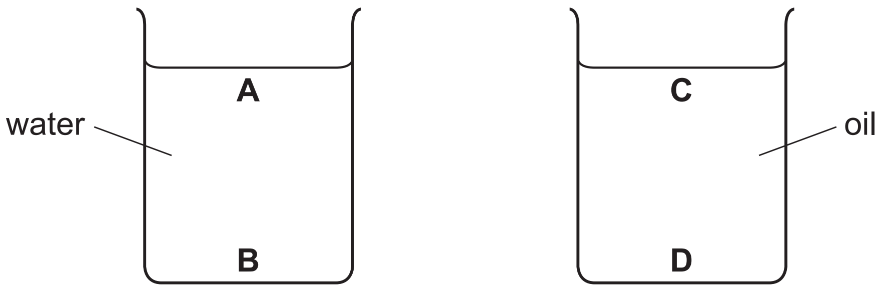
9 Two beakers are filled to the same depth, one with water and one with oil.

The density of water is $1000\,kg/m^3$. The density of oil is $920\,kg/m^3$.

In which position is the pressure the greatest?



4 Fig. 4.1 shows gas trapped in a cylinder by a piston.

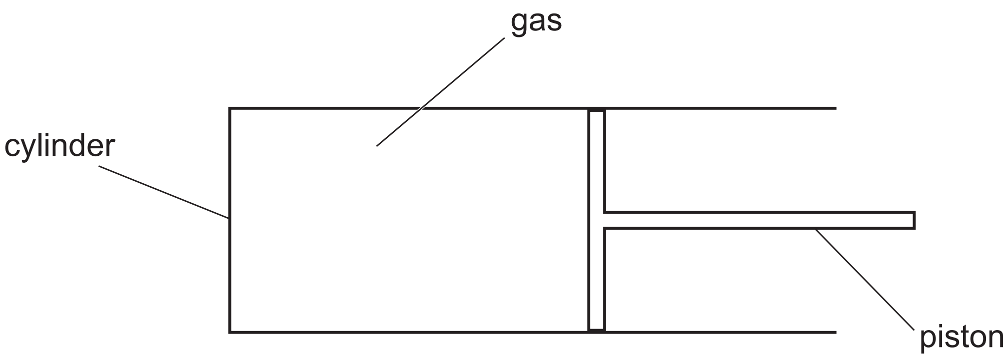


Fig. 4.1

(a) The volume of gas is 240 cm^3.
The piston is pushed to the left and is held in its new position.

(i) The pressure of the gas increases from 1.0×10^5 Pa to 1.4×10^5 Pa.

The temperature of the gas remains constant.

Calculate the volume of the gas when the piston is in its new position.

volume = ... cm^3 [3]

(ii) The area of the piston in contact with the gas is $1.9 \times 10^{-3}\,m^2$.

Calculate the force exerted on the piston by the gas when the piston is held in its new position.

force = ... [2]

(iii) The distance moved by the piston is 0.036 m. The average force exerted by the piston as it moves is 220 N.

Calculate the mechanical work done by the piston. State the equation you use.

work done = ... [2]

(b) Explain, in terms of particles, why gases can be compressed but liquids cannot.

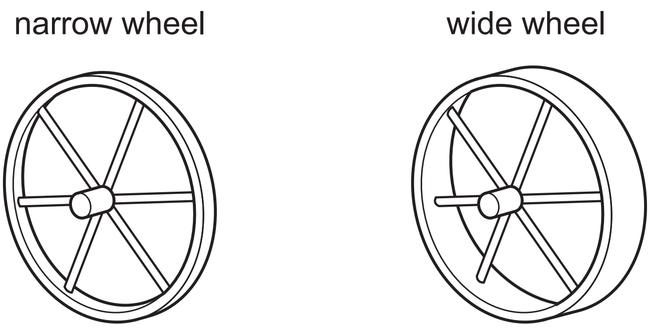
....

....

.... [1]

[Total: 8]

9 A farmer has two carts. The carts have the same weight, but one has four narrow wheels and the other has four wide wheels.



Which cart wheels sink less into soft ground and what is the reason?

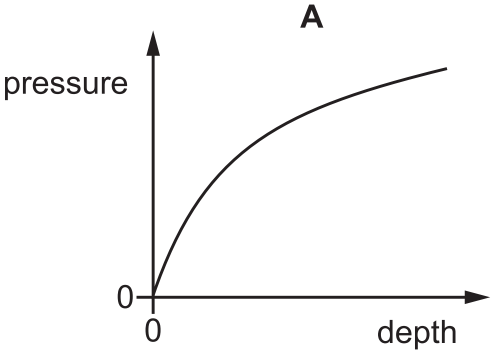
	cart wheels	reason
A	narrow	greater pressure on the ground
B	narrow	less pressure on the ground
C	wide	greater pressure on the ground
D	wide	less pressure on the ground

11 The water in a swimming pool exerts a pressure at the bottom of the pool.

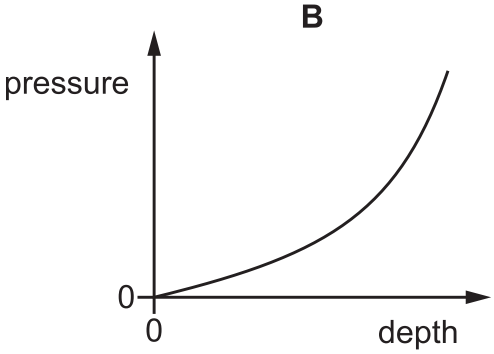
Which graph shows the relationship between the pressure exerted by the water and the depth of water in the pool?

(Assume the density of water is constant.)

A



B



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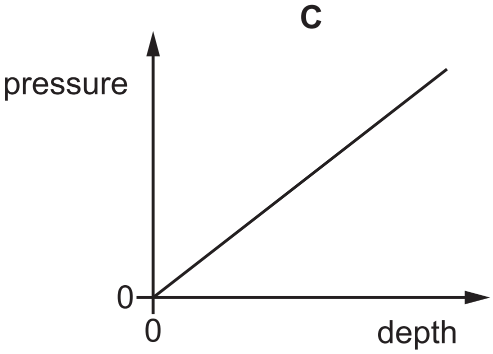
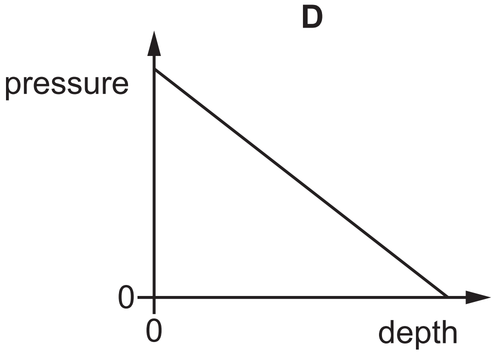


D



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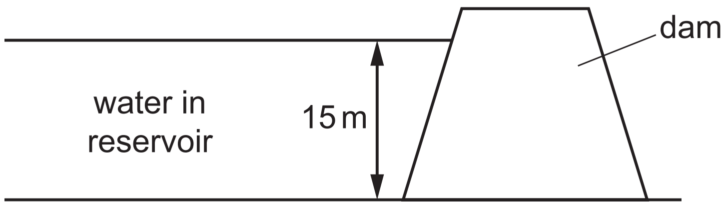
13 A dam holds water in a reservoir. The height of the water in the reservoir is 15 m.



The density of water is $1000\,kg/m^3$.

What is the pressure due to the water at the bottom of the dam?

A 6.8 Pa **B** 1500 Pa **C** 15 000 Pa **D** 150 000 Pa