AS Level Exam Questions

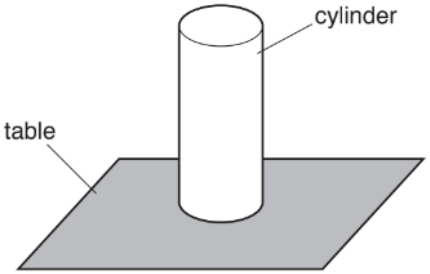
2016 QP - Paper 1 OCR (A) Physics AS-level

23a - 12A.3.11 Density, Pressure and Upthrust

A metal cylinder of diameter of about 5 cm placed on a horizontal table.

Describe how you can use instruments available in a physics laboratory to determine the pressure exerted by the cylinder on the table. State how you would make your results as precise as possible.

[4]



25b - 12B.2.2 EMF and Internal Resistance

A student is given a chemical cell, an ammeter, a voltmeter, a variable resistor and a number of connecting wires.

Design a laboratory experiment to determine the internal resistance r of the chemical cell using a graph. Start with a circuit diagram.

In your description pay particular attention to

- the circuit used
- the measurements taken
- how the data is analysed using a graph

[4]

27a - 12B.3.3 IV characteristics of non ohmic

Fig. 27.1 shows the I-V characteristic of an LED designed to emit blue light.

Describe and justify the variation of resistance R of the LED as the potential difference V across the LED is increased from

- –1.0V to 2.6V
- 2.6V to 3.0V
- 3.0V to 3.4V.

[4]

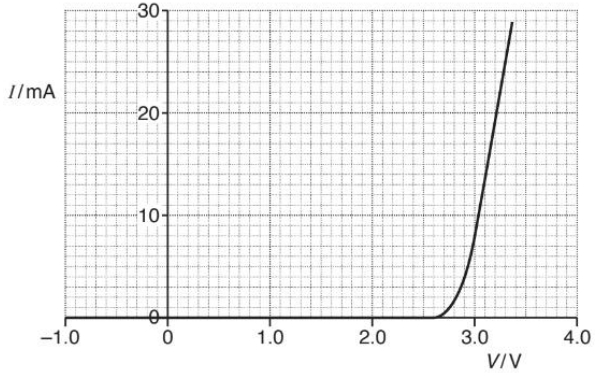


Fig. 27.1

2016 QP - Paper 2 OCR (A) Physics AS-level

6a - 12A.5.4 Stress and Strain

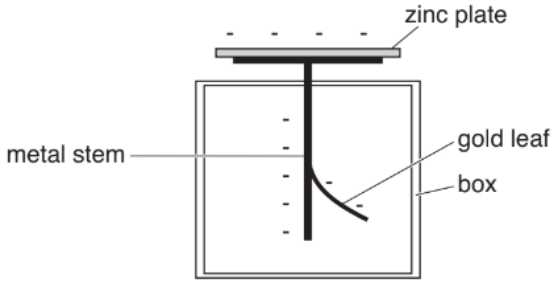
A student wishes to determine experimentally the breaking stress of a metal in the form of a thin wire.

Describe with the aid of a diagram how this experiment can be safely conducted, and how the data can be analysed to determine the breaking stress of the metal.

[6]

7a - 12A.7.2 The Photoelectric Effect

A gold leaf electroscope is used to demonstrate the photoelectric effect. A zinc plate is placed on top of the electroscope. The zinc plate is negatively charged as shown in diagram below.



White light from a table lamp is allowed to fall on to the electroscope from a distance of 10.0 cm. The experiment is then repeated with light from a distance of 4.0 cm. Both experiments are then repeated with ultraviolet radiation. The electroscope is fully charged before each experiment.

The observations are recorded in the table below.

Incident radiation	Observations
Light at a distance of 10.0 cm	Gold leaf takes a very long time to fall
Light at a distance of 4.0 cm	Gold leaf takes a very long time to fall
Ultraviolet radiation at a distance of 10.0 cm	Gold leaf falls quickly
Ultraviolet radiation at a distance of 4.0 cm	Gold leaf falls very quickly

Explain how these observations demonstrate the photoelectric effect and provide evidence for the particulate nature of electromagnetic radiation.

[6]

2017 QP - Paper 1 OCR (A) Physics AS-level

21b - 12A.1.3 Velocity-Time graphs and acceleration

A student uses a motion sensor to investigate the motion of a trolley crashing into a soft barrier.

Fig. 21 shows the displacement s against time t graph for the trolley in one experiment.

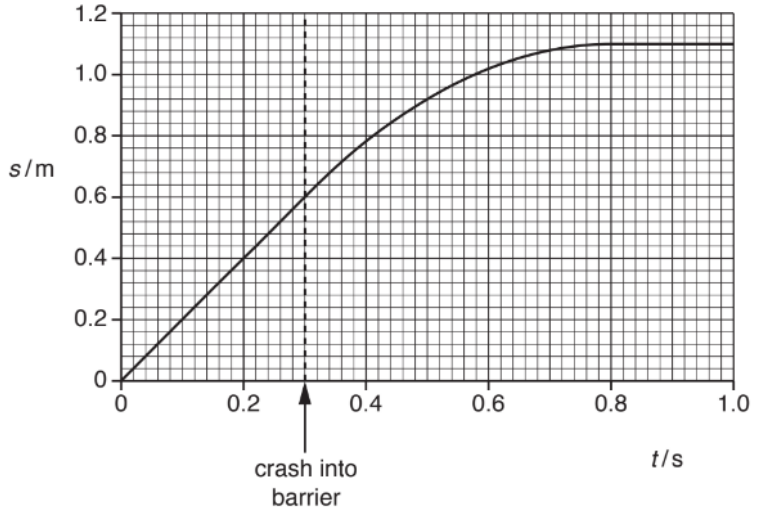


Fig. 21

Use Fig. 21 to describe and explain the variation of the velocity of the trolley from t = 0 to t = 1.0s.

[4]

2017 QP - Paper 2 OCR (A) Physics AS-level

3b - 12A.3.6 Terminal Velocity

A student wishes to investigate how the terminal velocity v of a metal sphere varies with the radius r of the sphere as it travels through a liquid.

It is suggested that

$$v = Kr^2$$

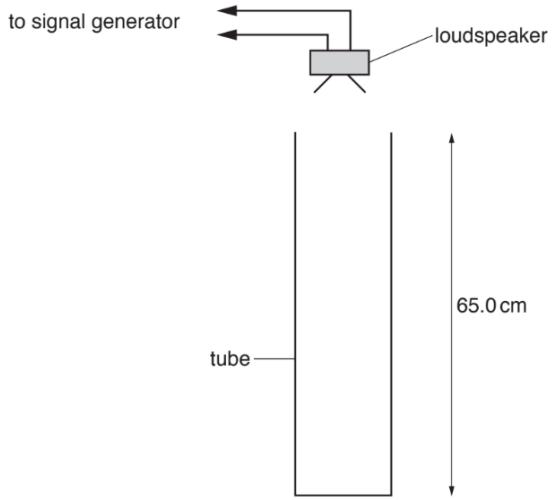
where K is a constant.

Describe with the aid of a suitable diagram how an experiment can be safely conducted, and how the data can be analysed to determine K.

[6]

6b - 12B.7.3 Standing Waves in an Air Column

A student is investigating stationary waves in a hollow tube. The tube is open at one end and closed at the other end. The student connects a signal generator to a loudspeaker which is placed just above the tube as shown in diagram below.



The length of the tube is 65.0cm.

As the frequency of the signal generator is slowly increased from 0 Hz the student observes sound that varies in loudness. The loudest sound occurs at frequencies 130 Hz, 390 Hz and 650 Hz.

The experiment is then repeated with a hollow tube of the **same** length but open at both ends. The loudest sound now occurs at frequencies 260 Hz, 520 Hz and 780 Hz.

Using your knowledge and understanding of stationary waves explain these observations. Include in your answer how you could determine an experimental value for the speed of sound in air.

[6]

2018 QP - Paper 1 OCR (A) Physics AS-level

23a - 12A.3.11 Density, Pressure and Upthrust

This question is about upthrust and other forces acting on a sealed hollow tube in water.

One end of a string is attached to the bottom of the tube and the other end of the string is attached to the bottom of the container. The string exerts a downward force F on the tube.

At time t = 0, the tube is half submerged in the water, as shown in Fig. 23.1.

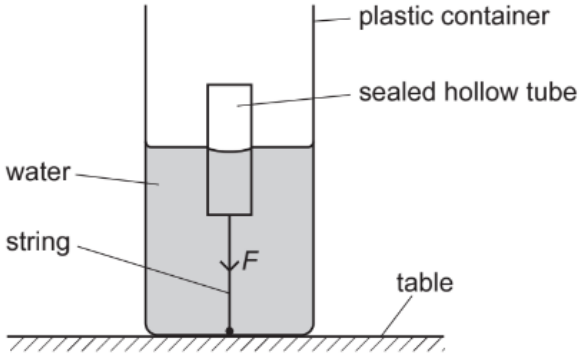


Fig. 23.1

The container is slowly filled with water at a constant rate until the container is full.

Fig. 23.2 shows the graph of F against time t.

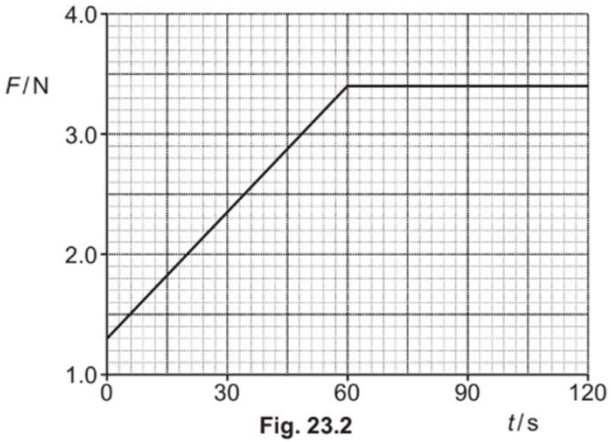


Fig. 23.2

By considering the forces acting on the tube, explain the general shape of the graph shown in Fig. 23.2.

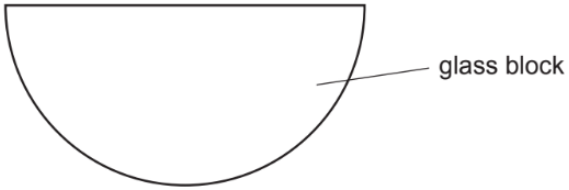
[3]

26c - 12B.5.2 Reflection and Refraction

A student is given a semi-circular glass block.

Describe with the aid of a ray diagram how an experiment can be conducted to accurately determine the critical angle for light within the glass block and hence the refractive index of the glass.

[3]



2018 QP - Paper 2 OCR (A) Physics AS-level

2 - 12A.4.3 Power Efficiency

A student wishes to determine experimentally the efficiency of a small low-voltage DC motor. The motor is used to lift light loads.

Describe with the aid of a suitable diagram how an experiment to determine the efficiency of the electric motor can be safely conducted, and how the data can be analysed.

[6]

7a - 12B.7.2 Fundamental Frequency & Harmonics

In an experiment to investigate microwaves, a microwave detector D is placed between a microwave transmitter T and a flat metal sheet.

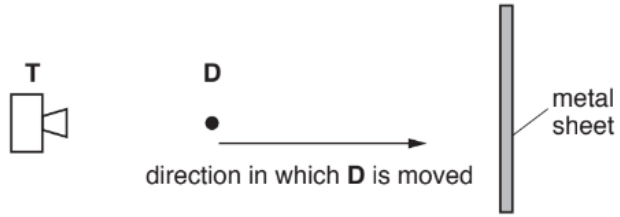


Fig. 7.1

The detected signal at D shows regions of maximum and minimum intensity as D is moved towards the metal sheet as shown in Fig. 7.1. The distance between adjacent regions of maximum and minimum intensities is 72 mm.

Explain the presence of the regions of maximum and minimum intensity and determine the frequency of the microwaves.

The speed of microwaves in air is 3.0×10^8 ms^{-1}.

[6]

2019 QP - Paper 1 OCR (A) Physics AS-level

24a - 12B.5.2 Reflection and Refraction

You are provided with a rectangular block of plastic.

Describe how you can use a ray-box (or a laser beam), together with other equipment available in the laboratory, to accurately determine the refractive index of the plastic block.

[3]

25c - 12A.7.2 The Photoelectric Effect

Electromagnetic waves interact with matter as photons.

Explain the photoelectric effect using ideas of photons, conservation of energy and work function.

[4]

2019 QP - Paper 2 OCR (A) Physics AS-level

2a - 12A.5.5 Brittle, Ductile and Polymeric Materials

A student is investigating the stretching of materials.

The student applies varying loads to material J and determines the stress and the strain until the material breaks.

The experiment is then repeated for a second material K.

Fig. 2.1 shows how the stress for each material varies with strain.

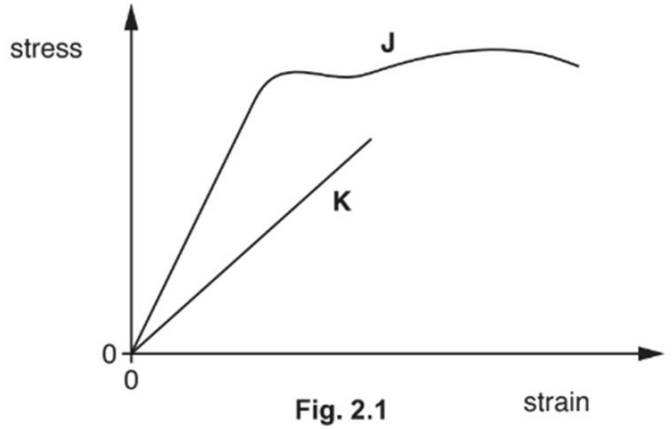


Fig. 2.1

Compare materials J and K using Fig. 2.1 and the six terms listed below.

Brittle ductile elastic plastic

ultimate tensile strength Young modulus

Include in your answer an explanation of each term.

[6]

5b - 12B.7.3 Standing Waves in an Air Column

A student wishes to investigate how the fringe spacing x of an interference pattern produced by sound waves varies with the frequency f of the sound waves.

It is suggested that

$$\frac{v}{f} = \frac{aX}{D}$$

where

a is the separation of the sources of sound

D is the distance from the sources of sound to the interference maxima and minima

v is the speed of sound in air.

Describe with the aid of a suitable diagram how an experiment can be safely conducted in the laboratory, and how the data can be analysed to determine v.

[6]

2020 QP - Paper 1 OCR (A) Physics AS-level

21b - 12A.6.2 Collisions

The diagram below shows a person on a horizontal skateboard holding a heavy ball.

The person is initially stationary.

The person throws the ball horizontally to the right.

Describe and explain the motion of the person on the skateboard **immediately** after the ball is thrown.

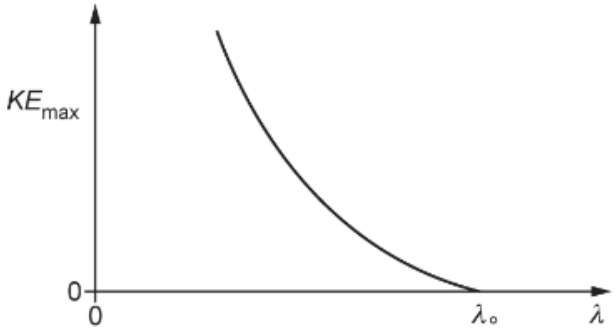
[3]

28A - 12A.7.3 Einstein's Photoelectric Equation

Electromagnetic radiation, with a range of wavelengths, is incident on a metal.

Electrons are removed from the metal due to the photoelectric effect.

The maximum kinetic energy KE_{max} of the emitted electrons against wavelength λ graph is shown below.



Explain the shape of the graph in terms of quantum physics.

[3]

2020 QP - Paper 2 OCR (A) Physics AS-level

4 - 12A.2.4 Projectiles

A metal ball leaves a horizontal surface with velocity v.

A student investigates the horizontal distance R that the ball travels before it hits the ground.

It is suggested that the relationship between R and v is given by

$$R = v\sqrt{\frac{Q}{g}}$$

where g is the acceleration of free fall and Q is a constant.

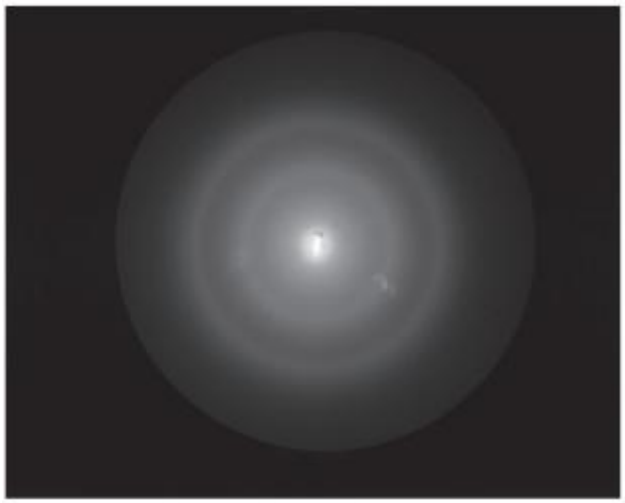
Describe with the aid of a suitable diagram how an experiment can be safely conducted, and how the data can be analysed, to determine Q.

[6]

8 - 12A.7.5 Particles as Waves

A student is investigating electron diffraction. A beam of electrons is directed towards a thin slice of graphite in an evacuated tube.

The electrons are accelerated by a potential difference of 2000 V. The diagram below shows the pattern formed on the fluorescent screen of the evacuated tube.



Describe and explain how the pattern changes as the potential difference is increased. Include how the de Broglie wavelength of the electron is related to the potential difference V.

[6]

2021 QP - Paper 1 OCR (A) Physics AS-level

23a - 12A.7.4 Planck's constant (PAG 6)

A light-emitting diode (LED) emits visible light when the potential difference across it exceeds a threshold voltage.

Describe, with the help of a circuit diagram, how you could carry out an experiment to accurately determine the threshold voltage of an LED in a brightly-lit laboratory.

[3]

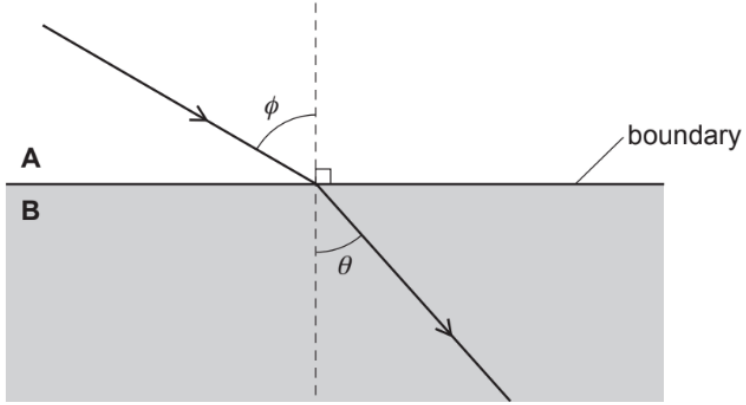
25aii - 12B.5.3 Diffraction and Oscilloscopes

Describe and explain how you could demonstrate the diffraction of sound waves in the laboratory.

[3]

25bii1 - 12B.5.2 Reflection and Refraction

The diagram below shows the path of light in two transparent materials **A** and **B**.



Not to scale

The refractive index of **B** is 1.3 times greater than the refractive index of **A**.

The wavelength of the light in **A** is λ_A and the wavelength of the light in **B** is λ_B.

Explain how λ_B compares with λ_A.

[3]

2021 QP - Paper 2 OCR (A) Physics AS-level

3a - 12A.6.2 Collisions

A linear air track is used to investigate the collision of two gliders **A** and **B**, as shown in Fig. 3.1.

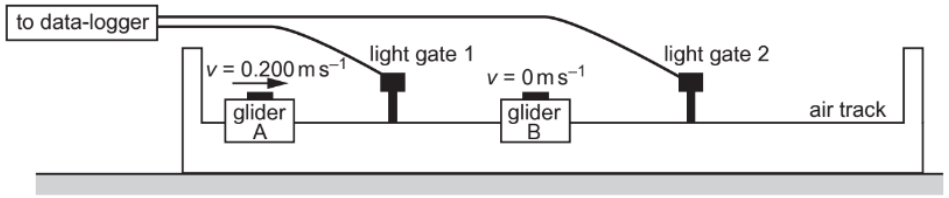


Fig. 3.1

Light gates 1 and 2 are connected to a data-logger to determine the speed of the gliders. Glider **A** has a mass of 0.75 kg and glider **B** has a mass of 1.25 kg.

Two experiments are carried out.

Experiment 1

- Glider **B** is initially at rest between light gates 1 and 2.
- Glider **A** passes light gate 1 at a speed of 0.200 ms^{-1}.
- Glider **A** collides with glider **B**.
- Glider **A** rebounds and passes light gate 1 at a speed of 0.050 ms^{-1} and glider **B** passes light gate 2 at a speed of 0.150 ms^{-1}.

Experiment 2

- Glider **B** is initially at rest between light gates 1 and 2.
- Glider **A** passes light gate 1 at a speed of 0.200 ms^{-1}.
- Glider **A** collides with glider **B**.
- Glider **A** sticks to glider **B**.
- Both gliders pass light gate 2 at a speed of 0.075 ms^{-1}.

With the help of calculations and the terms below, explain the results of the two experiments.

elastic **inelastic** **momentum**

[6]

6 - 12B.3.6 LDRs and Thermistors

The table shows some of the properties of a light dependent resistor (LDR).

	Resistance of LDR/Ω
Very bright	2.0×10^2
Daylight	2.0×10^3
Very dark	2.0×10^5

Design a circuit, using a potential divider with the LDR, so that the output potential difference from the circuit is

- greater than 5.0V when the LDR is in very bright light
- less than 1.0V when the LDR does not receive any light.

In your answer, include

- a circuit diagram with suggested component values
- an explanation of the operation of the circuit
- how the circuit could be adjusted to change the output potential difference for a different light intensity.

[6]

2022 QP - Paper 1 OCR (A) Physics AS-level

22a - 12A.5.3 Springs in Series and Parallel (PAG 2)

A pogo stick is a spring-based toy used by a circus clown for jumping vertically up and down.

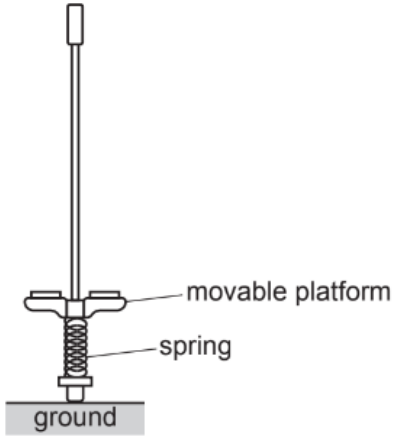
A compression spring is fixed to the bottom of the pogo stick. The upper end of the spring is attached to a movable platform.

The force constant of the spring is 1.7×10^4 Nm^{-1}.

The mass of the clown is 68 kg.

The mass of the pogo stick is negligible compared with the mass of the clown.

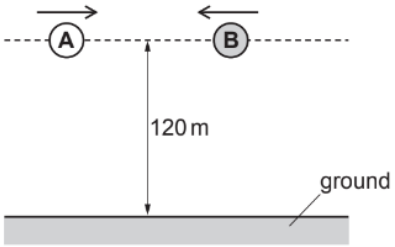
Describe how the force constant of the compression spring in the pogo stick can be verified in the laboratory.



[2]

23a - 12A.6.2 Collisions

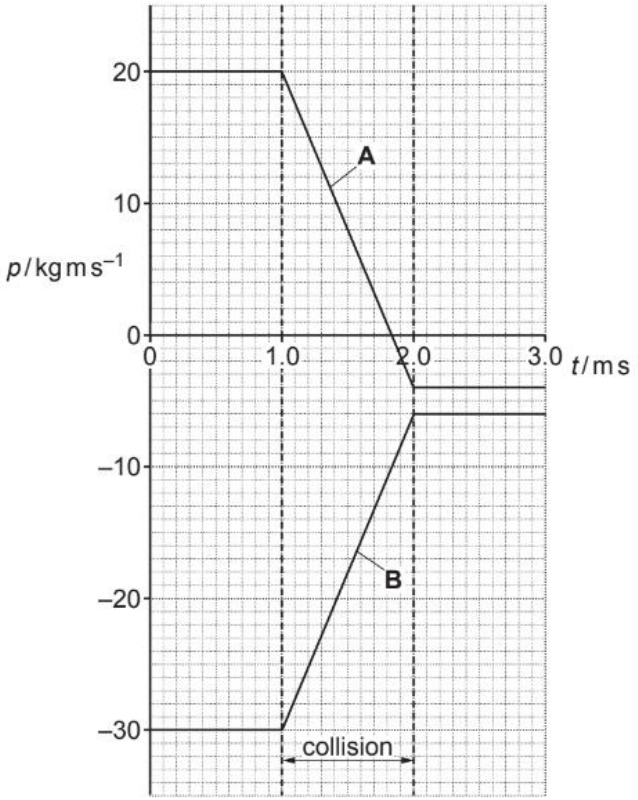
Two objects **A** and **B** are travelling horizontally and in opposite directions. The objects collide in mid-air at a height of 120 m above the horizontal ground, as shown below.



The mass of **A** is 2.0 kg and the mass of **B** is 3.0 kg.

After the collision the objects are joined together.

The momentum p against time t graphs for each object before, during and after the collision are shown below.



Explain how the graphs demonstrate Newton's third law during the collision.

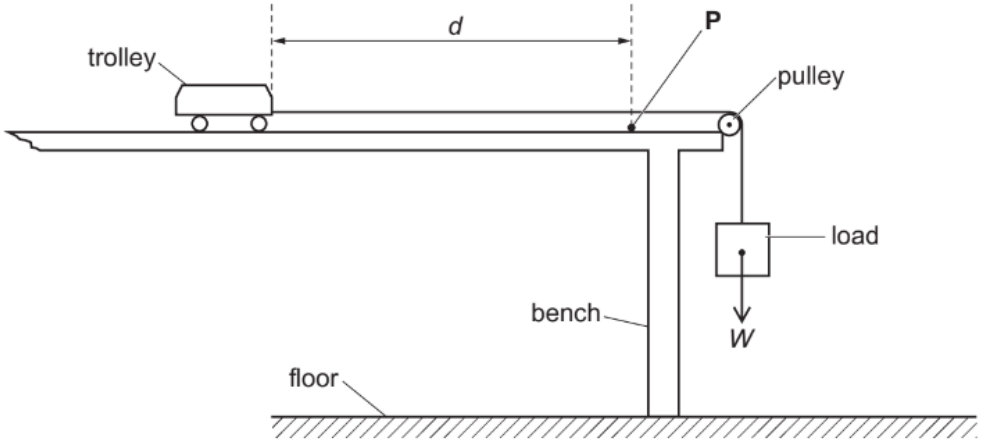
[2]

2022 QP - Paper 2 OCR (A) Physics AS-level

2 - 12A.1.6 Investigating the Velocity of a Car on a slope

A student is investigating the motion of a trolley as it accelerates from rest along a horizontal surface.

The diagram shows the trolley on a horizontal surface. A load of weight **W** accelerates the trolley.



Point P is a distance d from the initial position of the trolley.

A light gate connected to a timer is used to determine the velocity v of the trolley at point P.

It is suggested that the relationship between v and the mass M of the trolley is

$$\frac{1}{v^2} = \frac{M}{2dW - Q} + R$$

where Q and R are constants.

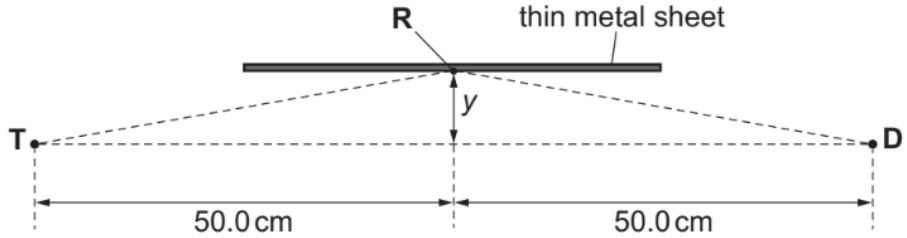
Describe, with the aid of a suitable diagram,

- how an experiment can be safely conducted to test this relationship between v and M, and,
- how the data can be analysed to determine Q and R.

[6]

8 - 12B.7.2 Fundamental Frequency & Harmonics

In an experiment to investigate microwaves, a microwave detector D is placed 100.0 cm from a microwave transmitter T.



A thin metal sheet is placed parallel to the line joining **T** and **D**. Point **R** is at the bottom of the metal sheet. The perpendicular distance between this line and point **R** is y.

The diagram shows the path of microwaves travelling directly from **T** to **D** and the path of microwaves from **T** reflected from **R** to **D**. There is a 180° phase change when microwaves are reflected at **R**.

The metal sheet is moved away from the line joining **T** and **D** so that y increases. The metal sheet remains parallel to the line from **T** and **D**. A series of maximum and minimum intensities are observed.

The table shows the values of y for successive maximum and minimum intensities.

Intensity	y/ cm
maximum	8.4
minimum	11.9
maximum	14.6
minimum	17.0

Explain the presence of the regions of maximum and minimum intensities and determine the wavelength of the microwaves.

[6]