Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2025

Physics

Unit 1

Higher Tier

GPY12

[GPY12]
THURSDAY 22 MAY, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink and use a dark HB pencil for drawings and graphs.
Do not write with a gel pen.
Answer **all** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You may use a scientific calculator.
Quality of written communication will be assessed in Question **1(c)**.

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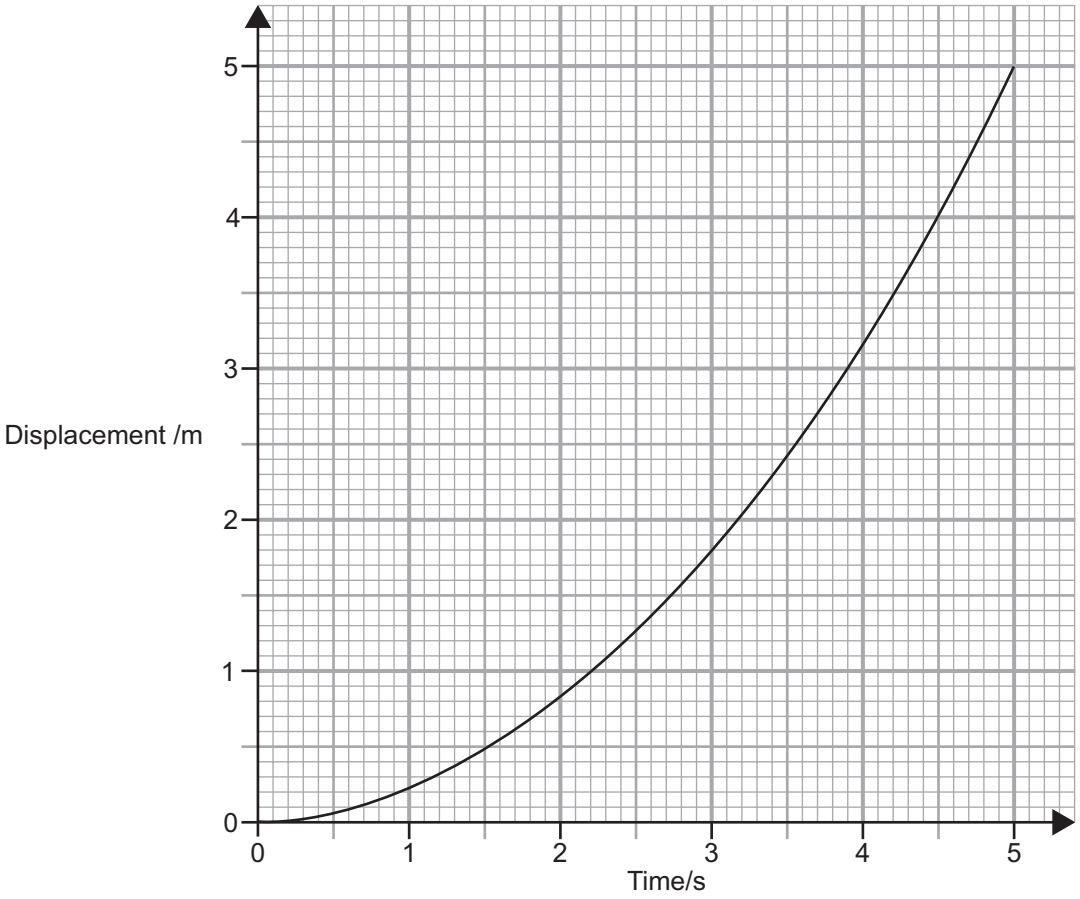
1 **(a)** The graph below shows how the displacement of a cyclist varies with time.



(i) Calculate the average velocity of the cyclist for the five seconds of their motion.
Show your working out.

Average velocity = _____ m/s [2]

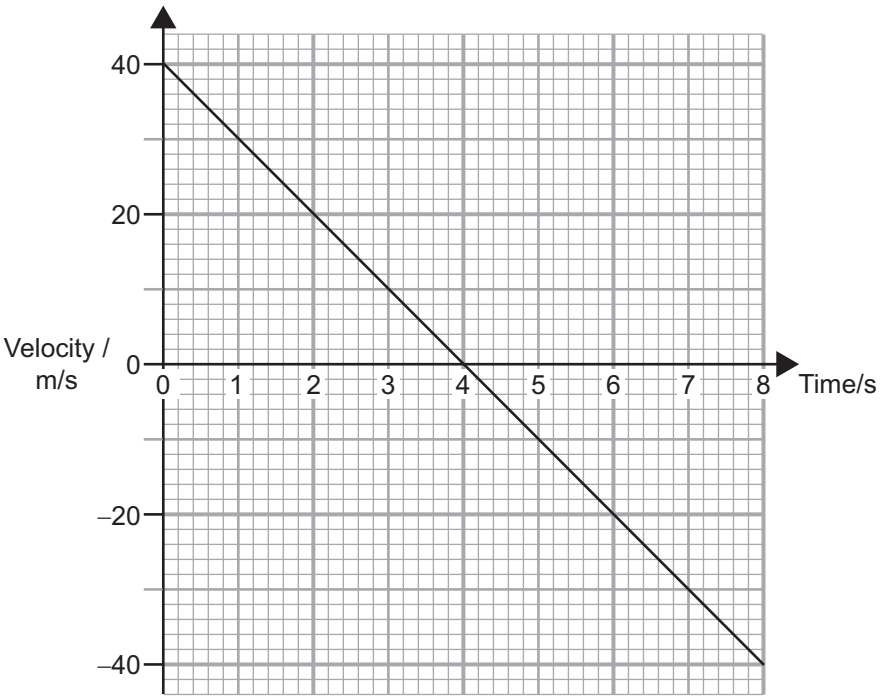
(ii) Explain how the graph shows that the cyclist was accelerating.

_____

_____ [1]

[Turn over

(b) An object is fired vertically upwards. Its velocity–time graph is shown below.



(i) Calculate the acceleration of the object.
Show your working out.

Acceleration = _____ m/s^2 [3]

(ii) Calculate the average velocity of the object as it moved upwards.
Show your working out.

Average velocity = _____ m/s [3]

(iii) Calculate the maximum height reached by the object.
Show your working out.

Maximum height = _____ m [3]

(iv) Why is the velocity of the object negative after 4.0 s?

_____ [1]

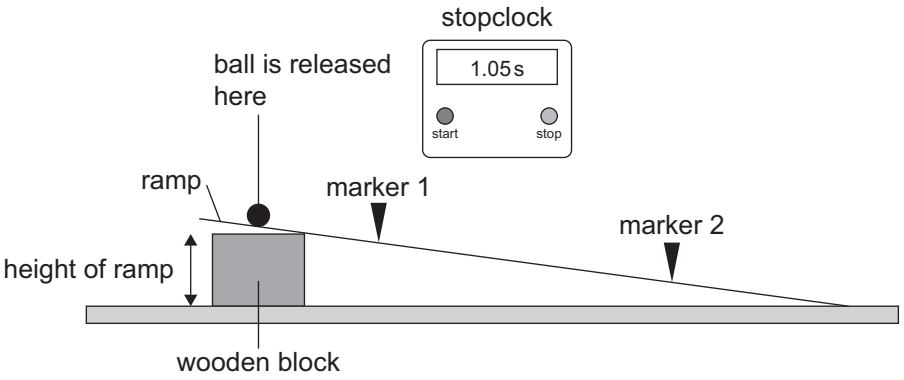
(v) Calculate the height above the ground of the object at 6.0 s.
Show your working out.

Height = _____ m [3]

(vi) On the graph opposite, draw the velocity–time graph for an object fired upwards with an initial velocity of 20 m/s. [2]

[Turn over

(c) The diagram below shows the equipment used to investigate the time it takes a ball to travel down a ramp from marker 1 to marker 2, for different heights of the ramp. The time is measured using a stopclock and the height of the ramp is changed using wooden blocks of different sizes.



Describe how this investigation is carried out.
In your answer you should;

- name the independent, the dependent and the controlled variables;
- explain how the time measurements can be made more reliable;
- predict what happens to the time as the height of the ramp increases;
- explain what an anomalous reading is and how it should be treated if one is recorded during the experiment.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

Write your answer in the appropriate space on the next page.

[6]

[Turn over

2 **(a)** **(i)** What is meant by the mass of an object?

_____

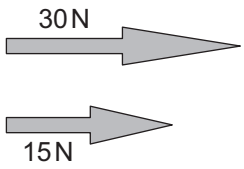
_____ [1]

(ii) What is meant by the weight of an object?

_____

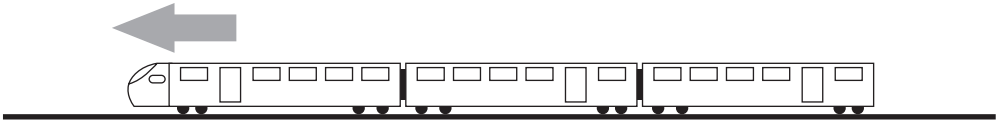
_____ [1]

(iii) What size is the resultant force of the two forces shown below?



Resultant force = _____ N [1]

(b) A train of mass 2.25×10^5 kg is travelling along a straight track at a constant velocity of 20 m/s.



Source: Principal Examiner

The total frictional force acting on the train is **0.3 N for every kilogram of mass**.

(i) Calculate the total frictional force acting on the train.

Frictional force = _____ N [2]

(ii) State the size of the force provided by the engine of the train and give an explanation for your answer.

Engine force = _____ N

Explanation _____

_____ [2]

(c) A different train is approaching a station at a constant velocity when the driver applies the brakes.
The train then decelerates at $0.4\,m/s^2$ and eventually comes to rest.

(i) The mass of this train is 2×10^5 kg.
Calculate the total decelerating force.
Show your working out.

Total decelerating force = _____ N [4]

There are two forces causing the train to decelerate. One is the force of friction between the wheels and the track. The other is the force produced by the brakes on the wheels.

(ii) The force of friction between the wheels and the track is 2.5×10^4 N.
Calculate the size of the force produced by the brakes on the wheels.
Give your answer in kilonewtons (kN).
Show your working out.

Force produced by the brakes = _____ kN [3]

[Turn over

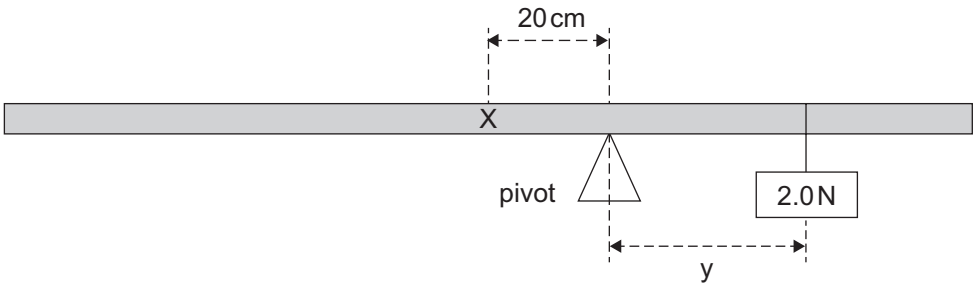
(d) (i) State the Principle of Moments.

_____

_____

_____ [3]

(ii) A uniform beam has a weight of 3.0 N.
Its centre of gravity is labelled X.
A pivot is positioned 20 cm from X.



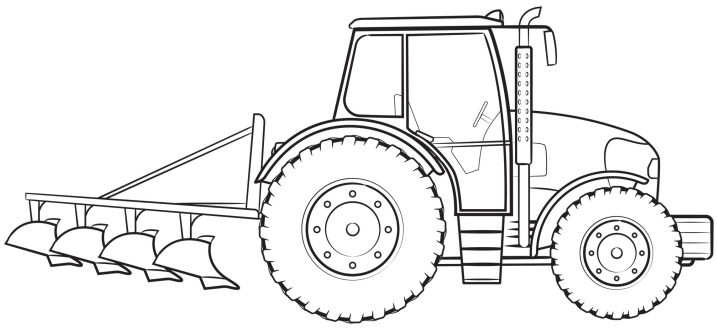
Source: Principal Examiner

A 2.0 N weight is moved until the beam is balanced as shown above.

Use the Principle of Moments to calculate the distance y.

Distance y = _____ cm [3]

(e) A tractor exerts a pressure of 30 N/cm^2 on the ground.



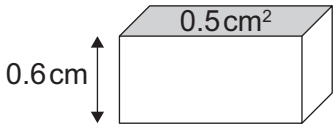
Source: © Getty Images

The **total area** of the tyres in contact with the ground is 1200 cm^2.
Calculate the weight of the tractor.
Show your working out.

Weight of tractor = _____ N [3]

[Turn over

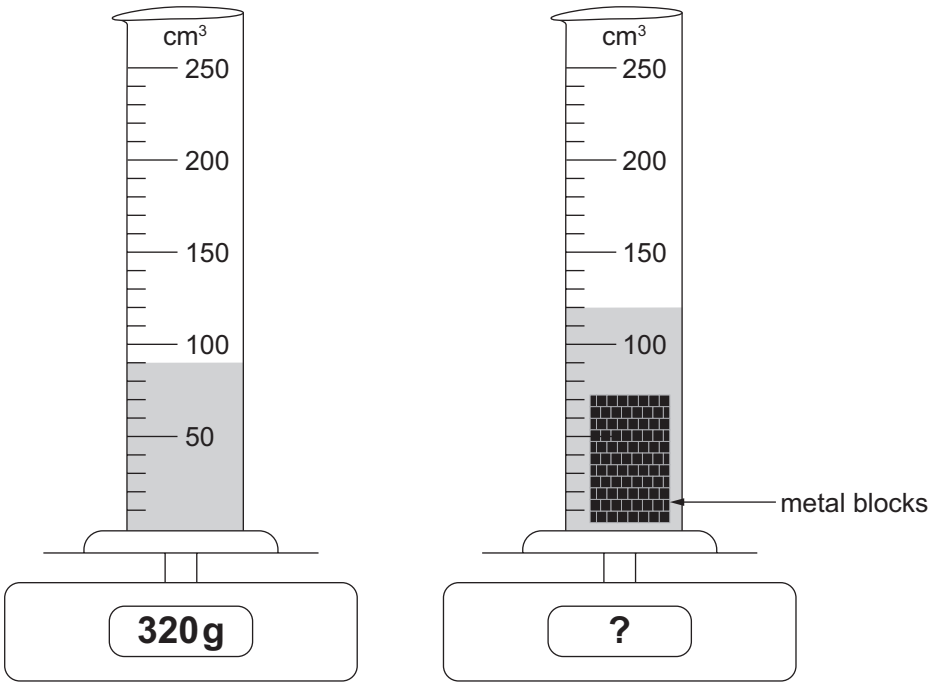
3 **(a)** A small block of metal is shown below. The height of the block is 0.6 cm and the surface area of the shaded face is 0.5 cm^2.



(i) Calculate the volume of the block of metal.
Show your working out.

Volume of block = _____ cm^3 [2]

An unknown number of these metal blocks were added to a measuring cylinder initially containing 90 cm^3 of water.
The level of water rose as shown in the diagram below.



(ii) Using your answer to **(a)(i)**, calculate the number of metal blocks in the measuring cylinder.

Number of blocks = _____ [3]

(iii) The density of the metal is 8g/cm^3.
Calculate the reading on the digital balance when all the metal blocks have been added.
Show your working out.

Reading on digital balance = _____ g [4]

(b) The density of the metal is much greater than the density of air.
Use the kinetic theory of matter to explain why this is the case.

_____

_____

_____ [2]

[Turn over

4 **(a)** **(i)** Explain the difference between a renewable energy resource and a non-renewable energy resource.

_____

_____

_____

_____ [2]

(ii) Name two renewable energy resources.

1. _____

2. _____ [2]

(iii) Name two non-renewable energy resources.

1. _____

2. _____ [2]

(iv) Many countries use fossil fuels to generate electricity.
State two effects this can have on the environment.

1. _____

_____

2. _____

_____ [2]

(b) The picture below shows a ship of mass 1.0×10^5 tonnes (1 tonne = 1000 kg).

Source: Principal Examiner

(i) The ship is moving at a constant speed of 2 m/s as it approaches a dock. Calculate the kinetic energy of the ship.
Show your working out.

Kinetic energy = _____ J [5]

(ii) How much work would need to be done in bringing the ship to a stop at the dock?

Work done = _____ J [1]

[Turn over

(iii) At a distance of 400 m from the dock the ship starts to slow down.
Calculate the **braking force** acting on the ship over the 400 m stopping distance.
Show your working out.

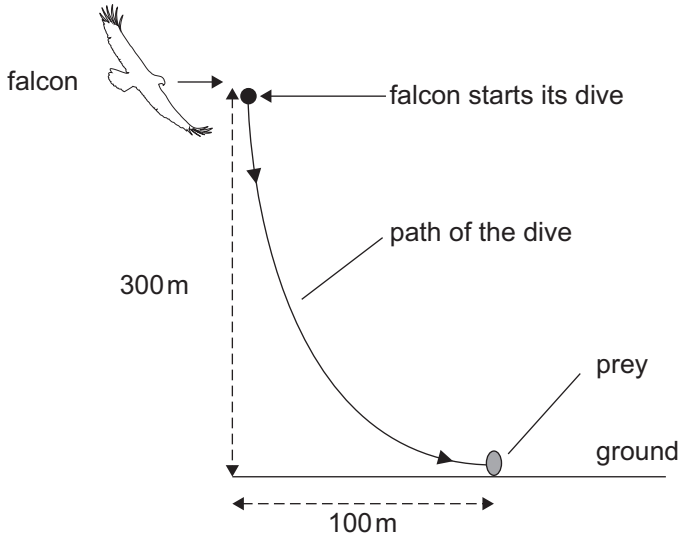
Braking force = _____ N [3]

(iv) It takes 80 s before the ship comes to a stop.
Calculate the power produced by the resistive forces.
Include the unit for power with your answer.
Show your working out.

Braking power = _____

Unit = _____ [4]

(c) A falcon dives to strike its prey. The diagram below represents the conditions just prior to its dive.



The falcon has a mass of 0.75 kg and is flying horizontally at a height of 300 m above ground level before it dives.

(i) Calculate the potential energy of the falcon just as it starts to dive.
Show your working out.

Potential energy = _____ J [3]

(ii) The **total energy** of the falcon just as it starts to dive is 2850 J.
Calculate its kinetic energy just as its starts to dive.
Show your working out.

Kinetic energy = _____ J [2]

[Turn over

5 **(a)** **(i)** Three types of radiation can be emitted by radioactive sources.
Name each from the descriptions listed below.
Do not use symbols.

An electromagnetic wave _____

A fast electron _____

A helium nucleus _____ [3]

(ii) What does ionising radiation do to atoms?

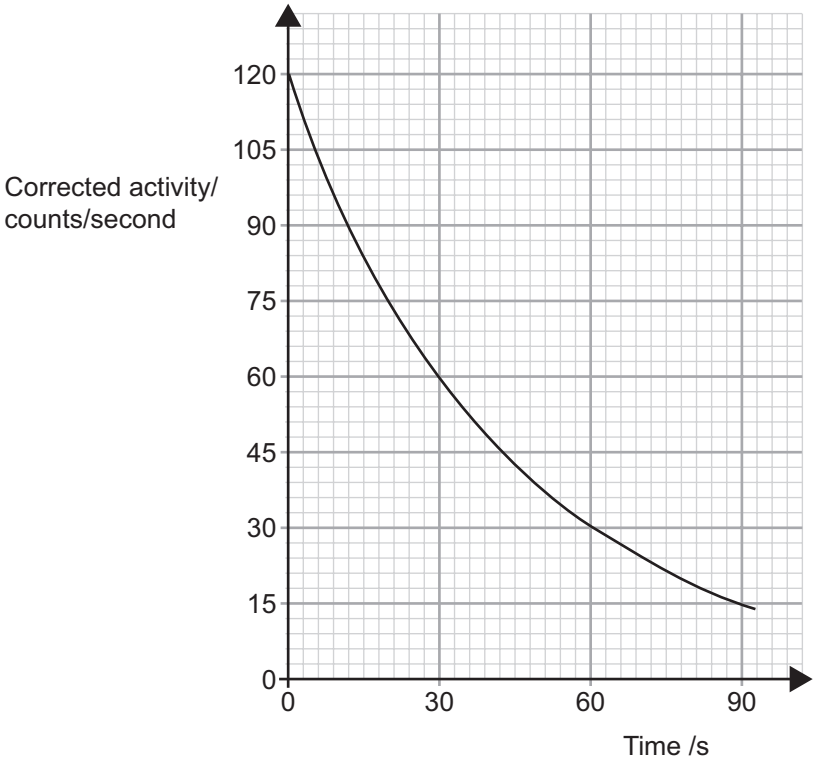
_____ [1]

(iii) Explain why ionising radiation is dangerous to living creatures.

_____

_____ [1]

(b) The graph below shows how the activity of a radioactive source changes with time.
The measurements of activity have been corrected for background activity.



(i) Describe how the measurements of activity are corrected for background activity.

_____ [1]

(ii) Use the graph to determine the half-life of the radioactive source.

Half-life = _____ s [2]

[Turn over

(c) Trees contain carbon atoms.
Some of the carbon atoms are radioactive.
When a tree is cut down, the activity of these carbon atoms slowly decreases.
The activity of an ancient piece of wood is found to be 4 units.
The activity of a modern piece of wood of the same mass as the ancient piece of wood is found to have an activity of 16 units.
The half-life of this carbon is 5730 years.

(i) How old is the ancient piece of wood?
Show your working out.

Age = _____ years [2]

(ii) The notation ${}^{A}_{Z}X$ describes the structure of a nucleus.

What does A tell us about the nucleus?

_____

What does Z tell us about the nucleus?

_____ [2]

(iii) The decay equation for a carbon-14 nucleus is shown below.
Complete the decay equation.
Write the appropriate numbers in the boxes below.

$$\square^{14}_{\square}C \longrightarrow \square^{\square}_{7}N + \square^{\square}_{\square}\beta$$

[4]

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For Examiner's use only	
Question Number	**Marks**
1	
2	
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Total Marks	

Examiner Number