Centre No.						Paper Reference	Surname	Initial(s)
Candidate No.						6 7 3 1 / 0 1	Signature	

Paper Reference(s)

6731/01

Edexcel GCE

Physics

Advanced Subsidiary

Unit Test PHY1

Thursday 15 January 2009 – Afternoon

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your signature, your surname and initial(s).
Answer **ALL** questions in the spaces provided in this question paper.
In calculations you should show all the steps in your working, giving your answer at each stage.
Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets.
There are seven questions in this paper. The total mark for this paper is 60.
The list of data, formulae and relationships is printed at the end of this booklet.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking account of your use of grammar, punctuation and spelling.

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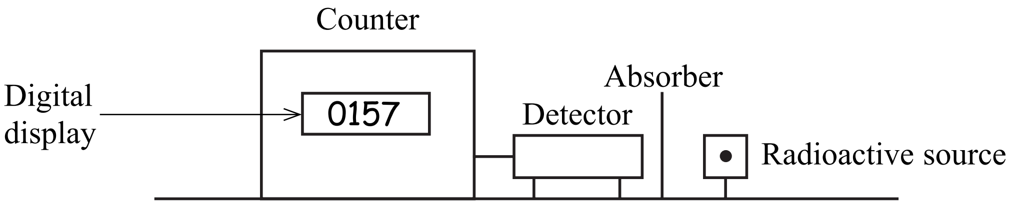
1. The diagram shows an arrangement for determining the type(s) of nuclear radiation emitted by a radioactive source.



Each of four sources is investigated by inserting absorbers, one at a time, between the detector and the source. The absorbers are paper, a 5 mm thick aluminium sheet and a 1 cm thick lead block. The detector and source are kept close to one another throughout.

Complete the table below to show the results and conclusions for these sources.

Source	**Absorber**	**Effect on count rate**	**Nuclear radiations emitted**
A	Paper	No change	
	Aluminium	Reduced to background	
	Lead	Reduced to background	
B	Paper		Alpha and beta
	Aluminium		
	Lead		
C	Paper	Reduced	
	Aluminium	Significantly reduced	
	Lead	Further reduced	
D	Paper		Alpha
	Aluminium		
	Lead		

Q1

(Total 4 marks)

2. An aeroplane is transporting goods to a remote area. It is flying horizontally at a constant speed. It releases a parcel as it passes over a point A on the ground. Figure 1 and Figure 2 show graphs of the horizontal and vertical velocities of the parcel during the time it takes for the parcel to fall to the ground. It is assumed that air resistance is negligible.

Figure 1

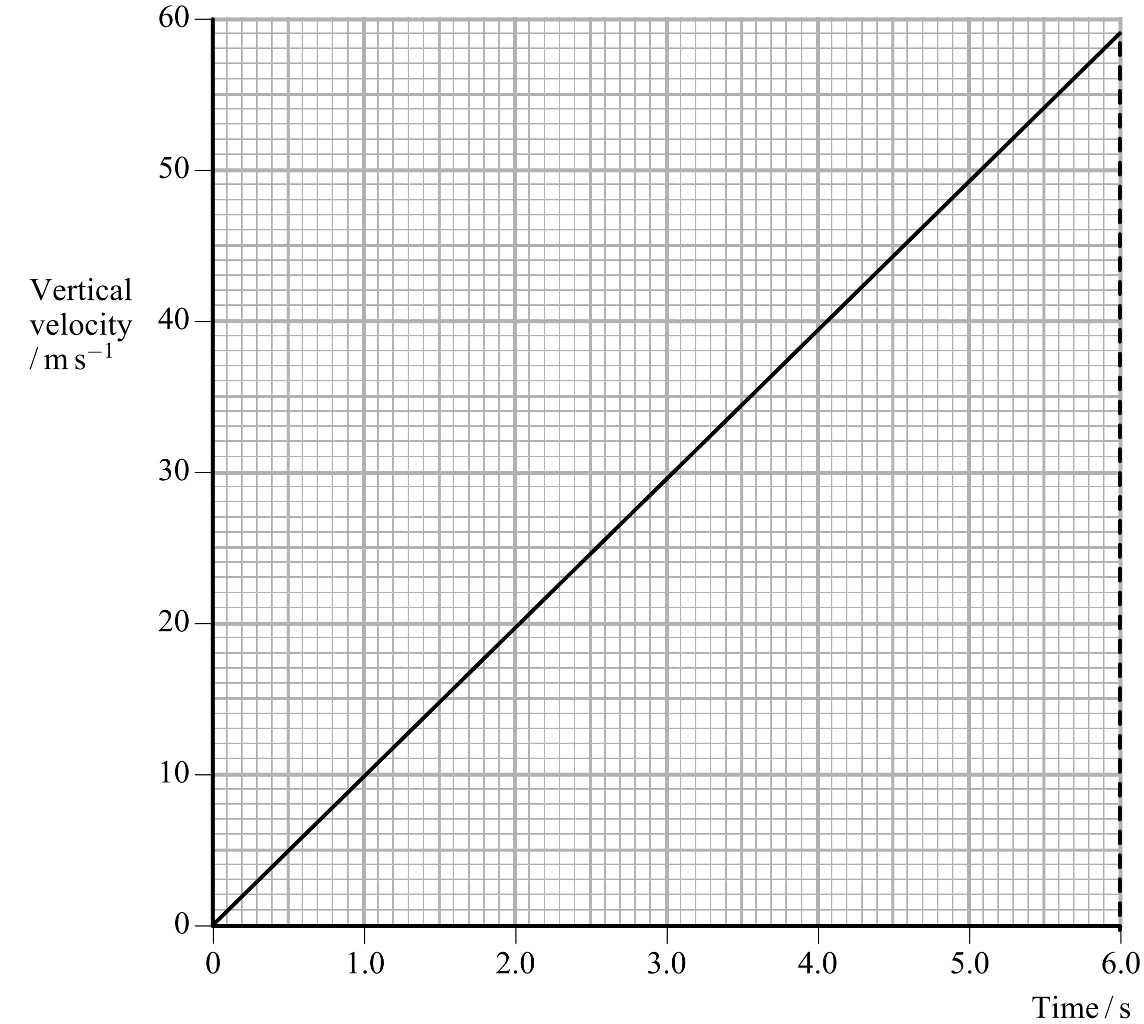
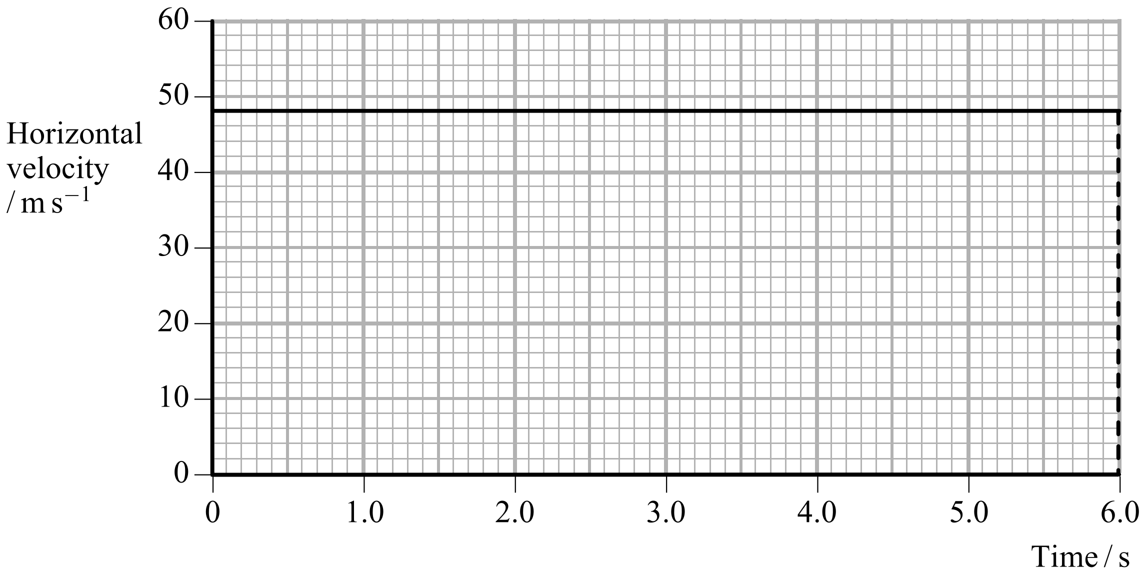


Figure 2



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Use the appropriate graph to determine:

(a) the acceleration of free fall,

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Acceleration = ...
(2)

(b) the height above point A from which the parcel was released,

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Height = ...
(2)

(c) the horizontal distance from A at which the parcel has the same horizontal and vertical speeds.

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....

Horizontal distance = ...
(3) **Q2**

(Total 7 marks)

Leave blank

3. A boy throws a ball vertically upwards. It rises a maximum distance of 28.0 m in 2.4 s.

(a) (i) Calculate the distance of the ball above the point of release 3.8 s after it was thrown.

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Distance = ...

(4)

(ii) State an assumption you have made.

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(1)

Leave blank

(b) The ball is caught by the boy.

Explain why moving his hands downwards as he catches the ball will reduce the force that the ball applies to his hand. You may be awarded a mark for the clarity of your answer.

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(5)

Q3

(Total 10 marks)

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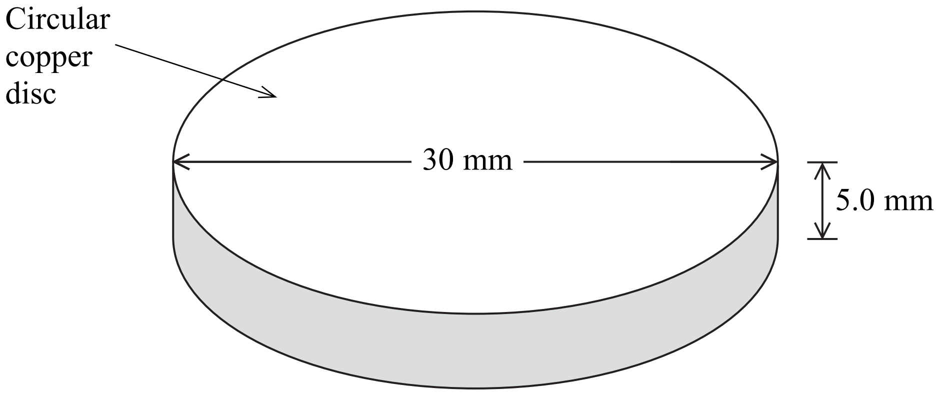
4. (a) The enlarged diagram shows a circular copper disc. It has a diameter of 30 mm and a thickness of 5.0 mm.



Show that the weight of the disc is about 0.3 N.

Density of copper = 8900 kg m^{-3}

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(3)

N 3 0 6 1 5 A 0 8 1 6

(b) (i) State Newton's first law of motion.

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(2)

(ii) Two copper discs as described in part (a) of the question are placed on top of one another as shown in the diagram below.

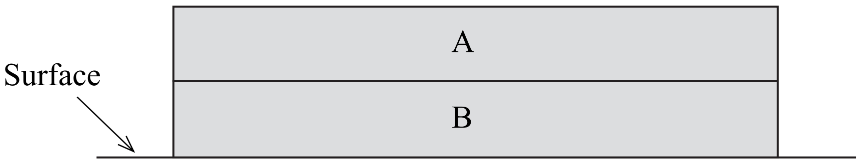
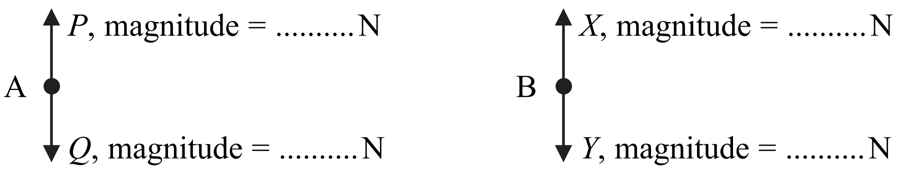


Figure 1 and Figure 2 are free-body force diagrams which show the resultant upward and the resultant downward forces acting on the discs A and B respectively. Label the magnitude of the forces *P*, *Q*, *X* and *Y*.

Figure 1 (Disc A) **Figure 2 (Disc B)**



(2)

(iii) A force *F* forms a Newton's third law pair with the force *Q*.

State the following:

magnitude of *F* = ...

direction of *F* = ...

type of force = ...

object upon which *F* acts = ...
(4)

(Total 11 marks)

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Q4

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5. (a) State the principle of moments.

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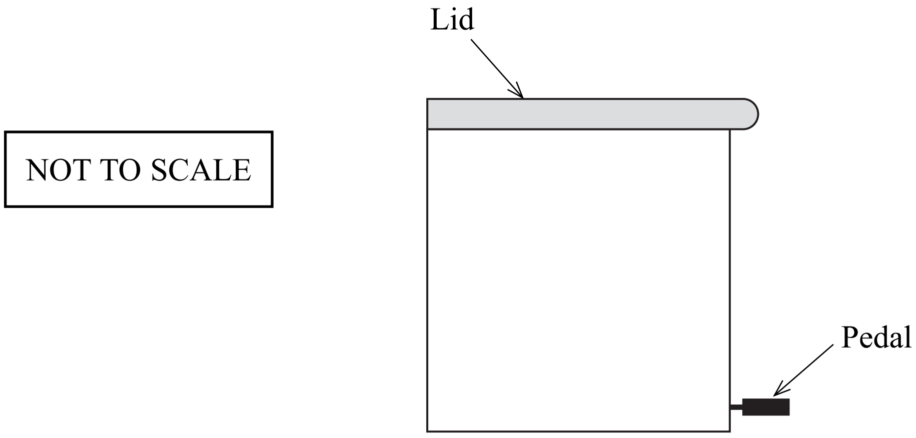
(2)

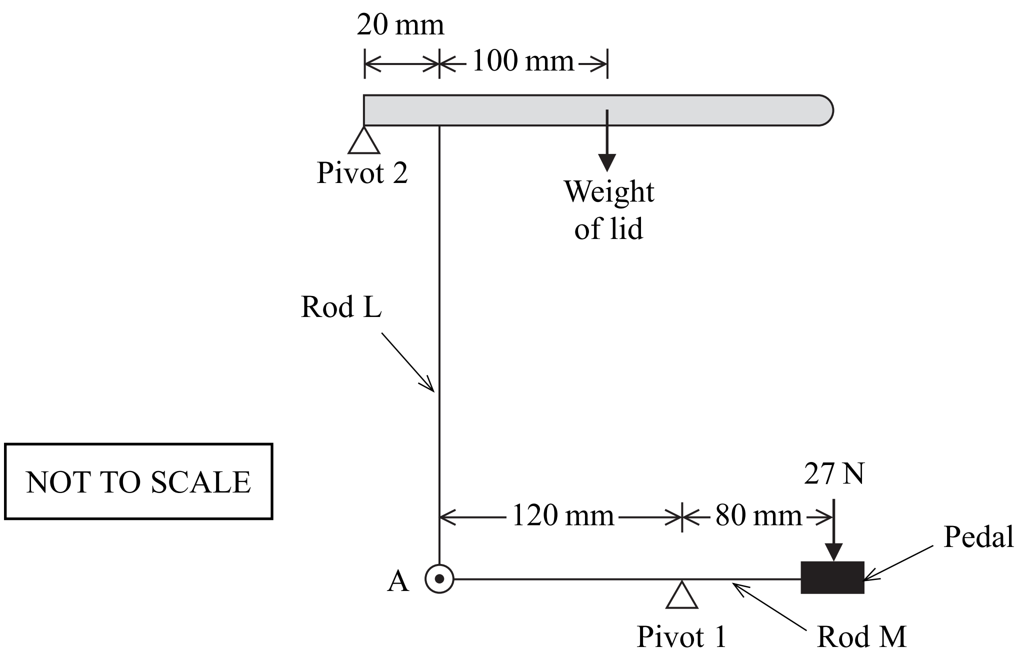
(b) Figure 1 shows a pedal bin which is used to collect waste.

Figure 1



The lid is raised by placing a foot on the pedal. Figure 2 shows the mechanism that makes this happen.

Figure 2



N 3 0 6 1 5 A 0 1 0 1 6

Leave blank

Rod L and rod M are separately connected to a common axis at A. A is free to move up or down causing the rod L and therefore the lid to do the same.
For each of the following questions you will need to refer to Figure 2.

(i) A force of 27 N is applied to the pedal as shown. Calculate the upward force the rod L will apply to the lid. Assume the rods L and M and the pedal have negligible weight.

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Force = ...

(2)

(ii) 27 N is the minimum force that must be applied to the pedal to raise the lid.

Calculate the weight of the lid.

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Weight of lid = ...

(2)

(iii) Determine the size and direction of the resultant normal contact force that acts on pivot 2 when 27 N is applied to the pedal.

....

Size of contact force = ...

Direction of contact force = ...

(2)

Q5

(Total 8 marks)

6. (a) State the principle of conservation of energy.

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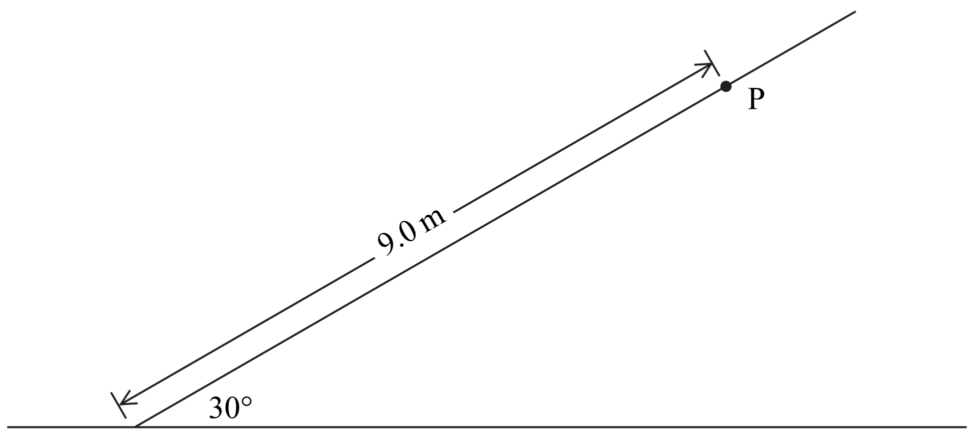
(2)

(b) The diagram shows an incline.



A box of mass 6.5 kg is released from rest at point P. It slides 9.0 m to the bottom of the incline.

(i) Calculate the loss in gravitational potential energy of the box.

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Loss in gravitational potential energy = ...
(3)

Leave blank

Leave blank

(ii) The speed of the box at the bottom of the incline is 8.2 m s^{-1}. Calculate its gain in kinetic energy.

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Gain in kinetic energy = ...

(2)

(iii) The gain in kinetic energy of the box does not equal its loss in gravitational potential energy. Explain how the principle of conservation of energy still applies in this example.

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(2)

Q6

(Total 9 marks)

Leave blank

7. (a) The radioisotope iodine-131 is used in medicine to diagnose problems in the thyroid gland. It undergoes beta-minus decay to form xenon (Xe). Complete the nuclear equation for this decay.

$$^{131}_{53}\text{I} = \qquad\qquad + $$

(2)

(b) Define the meaning of the decay constant of a radioisotope.

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(1)

(c) The decay constant of iodine-131 is $9.9 \times 10^{-7}\,\text{s}^{-1}$. Show that its half-life is about 8 days.

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(2)

(d) A patient requires a dose of iodine-131 with an activity of 2.2×10^6 Bq.

(i) Calculate the number of atoms of iodine-131 that would produce this activity.

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Number of atoms = ...

(2)

(ii) 131 g of iodine-131 contains 6.0×10^{23} atoms. Calculate the total mass of iodine that must be given to this patient.

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Mass of iodine = ...

(2)

(e) Gamma radiation is also emitted in the decay of iodine-131. Explain why this emission does not affect the nuclear composition of the atom.

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(2)

Leave blank

Q7

(Total 11 marks)

TOTAL FOR PAPER: 60 MARKS

END

List of data, formulae and relationships

Data

Speed of light in vacuum	$c = 3.00 \times 10^8 \text{ m s}^{-1}$	
Acceleration of free fall	$g = 9.81 \text{ m s}^{-2}$	(close to the Earth)
Gravitational field strength	$g = 9.81 \text{ N kg}^{-1}$	(close to the Earth)

Rectilinear motion

For uniformly accelerated motion:

$$v = u + at$$

$$x = ut + \tfrac{1}{2}at^2$$

$$v^2 = u^2 + 2ax$$

Forces and moments

Moment of F about O = $F \times$ (Perpendicular distance from F to O)

Sum of clockwise moments about any point in a plane = Sum of anticlockwise moments about that point

Dynamics

Force $F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

Impulse $F\Delta t = \Delta p$

Mechanical energy

Power $P = Fv$

Radioactive decay and the nuclear atom

Activity $A = \lambda N$ (Decay constant λ)

Half-life $\lambda t_{\frac{1}{2}} = 0.69$

Experimental physics

$$\text{Percentage uncertainty} = \frac{\text{Estimated uncertainty} \times 100\%}{\text{Average value}}$$

Mathematics

$$\sin(90° - \theta) = \cos\theta$$

Equation of a straight line $y = mx + c$

Surface area cylinder $= 2\pi rh + 2\pi r^2$

sphere $= 4\pi r^2$

Volume cylinder $= \pi r^2 h$

sphere $= \tfrac{4}{3}\pi r^3$

For small angles: $\sin\theta \approx \tan\theta \approx \theta$ (in radians)

$\cos\theta \approx 1$