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 21 May 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	
8	
Total	

Materials required for examination	Items included with question papers
Nil	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 eight 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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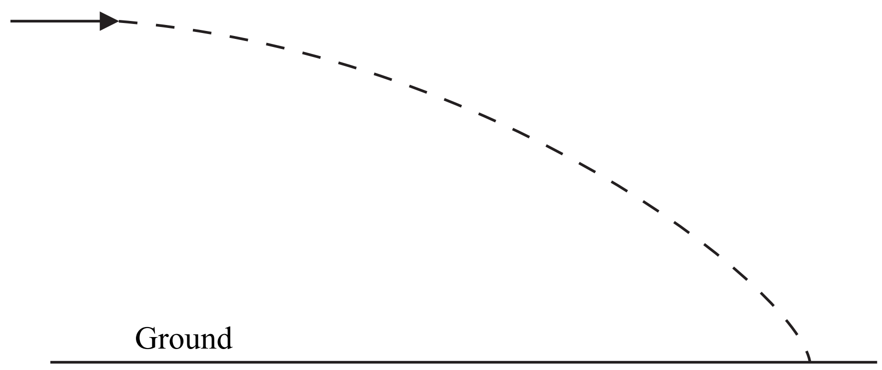
1. A particle is projected with a horizontal velocity from just above the ground, under conditions where the air resistance is negligible. The diagram shows its parabolic path.



For each of the physical quantities in the table below tick the appropriate box to show whether its magnitude increases, decreases or stays the same as the particle moves towards the ground.

Physical quantity	**Increases**	**Decreases**	**Stays the same**
Momentum			
Velocity			
Horizontal velocity			
Vertical acceleration			
Kinetic energy			
Gravitational potential energy			

Q1

(Total 4 marks)

N 3 1 1 2 8 A 0 2 1 6

Leave blank

2. (a) State the principle of conservation of linear momentum.

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(2)

(b) Two ice skaters, A and B, stand together at rest on the ice. Skater A has a mass of 48 kg and skater B a mass of 72 kg. They push each other apart. Skater A moves away with a velocity of 3.0 m s^{-1}.

(i) Calculate skater A's momentum.

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Momentum = ...
(2)

(ii) State skater B's momentum.

Momentum = ...

Explain your answer with reference to the principle of conservation of linear momentum.

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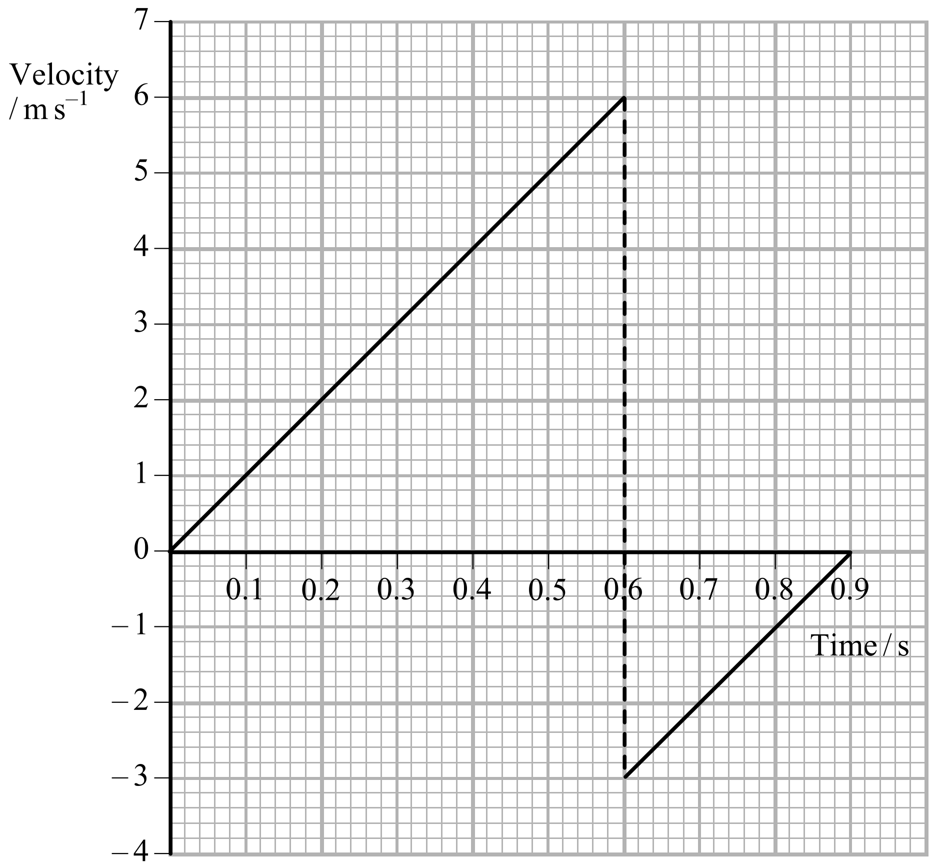
(4)

Q2

(Total 8 marks)

Leave blank

3. A ball is dropped onto a hard surface and rebounds. The idealised graph below shows how the velocity would change with time if air resistance were negligible.



(a) Use the graph to determine:

(i) the height to which the ball rebounds,

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Height = ...

(2)

N 3 1 1 2 8 A 0 4 1 6

Leave blank

(ii) the average speed of the ball during the interval from zero to 0.9 s.

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Average speed = ...

(2)

(b) (i) Describe the change in velocity of the ball at 0.6 s.

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(1)

(ii) Explain why this change in velocity could not happen as shown by the graph.

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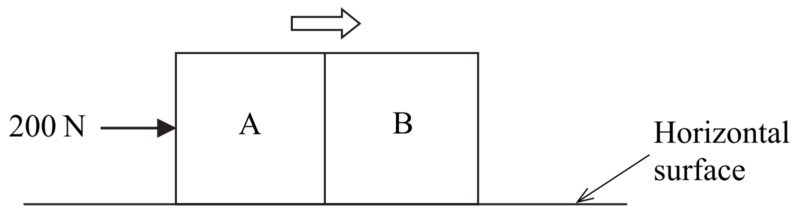
(2)

Q3

(Total 7 marks)

Leave blank

4. Two identical boxes A and B, each of mass 55 kg, rest on a horizontal surface. They are pushed along the surface by a horizontal force of 200 N as shown in the diagram below.



(a) The boxes accelerate at 1.2 m s^{-2}.

(i) Calculate the resultant horizontal force acting on the boxes.

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Resultant horizontal force = ...

(2)

(ii) Hence determine the total resistive force acting on the boxes.

....

Resistive force = ...

(1)

Leave blank

(b) When the force of 200 N is applied to box A what force does box B apply to box A? Assume the resistive force is distributed equally to both boxes.

Force applied by box B to box A = ...

Explain your answer.

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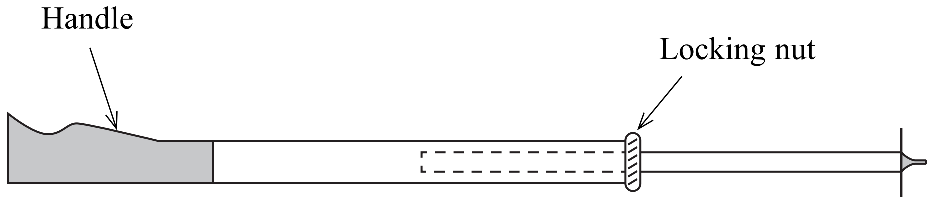
(4)

Q4

(Total 7 marks)

Leave blank

5. The diagram below shows a walking pole. It consists of two tubes, one fitting inside the other. The length of the pole is adjusted by sliding the smaller tube in or out of the larger tube.



(a) The pole has a mass of 300 g. Calculate its weight.

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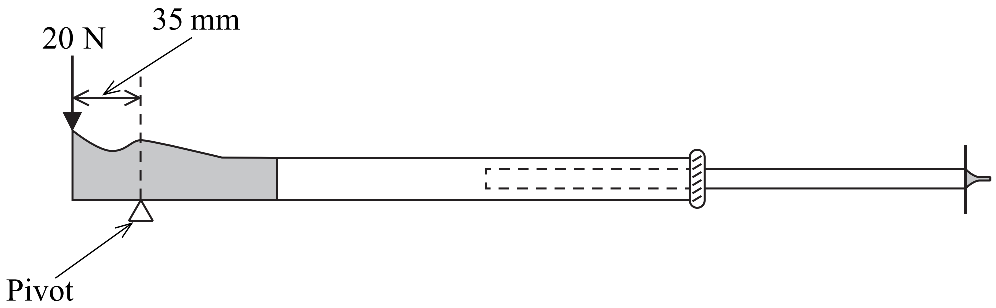
Weight of pole = ...
(2)

(b) The pole is balanced horizontally about a pivot by applying a force of 20 N to the end of the handle as shown in the diagram below.



Determine the distance of the centre of gravity of the pole from the end of the handle.

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Distance from end of handle = ...
(3)

Leave blank

(c) The pole is made longer and is balanced again with the pivot in the same position. Explain how the force applied to the end of the handle will have to be adjusted. You may be awarded a mark for the clarity of your answer.

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(5)

Q5

(Total 10 marks)

Leave blank

6. (a) A stone is dropped from rest down a well. It takes 1.2 s to reach the water surface.

Show that the speed of the stone as it reaches the water is about 12 m s^{-1}.

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(2)

(b) The stone enters the water and continues to move vertically. After falling 1.6 m its speed is reduced to 5.0 m s^{-1}.

(i) The mass of the stone is 600 g. Calculate the change in its kinetic energy during this 1.6 m fall.

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Change in kinetic energy = ...
(3)

(ii) Hence determine the average resultant force acting on the stone during this 1.6 m fall.

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Average resultant force = ...
(2)

Leave blank

(c) The stone then continues to move at a terminal velocity of 5.0 m s^{-1} through the water until it reaches the bottom of the well. Explain this observation.

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(2)

Q6

(Total 9 marks)

Leave blank

7. When alpha particles travel through the air they ionise atoms.

(a) Describe what happens when an atom is ionised by an alpha particle.

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(2)

(b) The average energy required for each ionisation is 4.7×10^{-18} J. This energy is obtained from the kinetic energy of the alpha particle.

An alpha particle is emitted with an energy of 9.0×10^{-13} J. It ionises 5.0×10^{3} atoms per millimetre of its path. Calculate its range in air.

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Range = ...

(3)

(c) Explain the effect that reducing the density of the air would have on the range of this alpha particle.

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(2)

Leave blank

(d) An alpha particle and a beta particle are emitted with similar energies and so produce similar numbers of ions along the total length of their paths. Explain why the beta particle has a much greater range.

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(2) **Q7**

(Total 9 marks)

Leave blank

8. (a) Define radioactive half-life.

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(2)

(b) A sample of thorium-234 has an activity of 2×10^{10} Bq which reduces by 75% in 48 days.

(i) Determine its half-life.

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Half-life = ...
(2)

(ii) Radioactivity is a random process and yet the future activity of a sample of radioactive material, such as this sample of thorium-234, can be predicted with a high degree of accuracy. Explain this apparent contradiction.

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(2)

Q8

(Total 6 marks)

TOTAL FOR PAPER 60 MARKS

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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)

$\cos\theta \approx 1$