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 22 May 2008 – Afternoon

Time: 1 hour 15 minutes

HA001456587

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
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 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. For each of the physical quantities in the table below add the missing information. The first one has been done for you.

Physical quantity	Base units	Vector or scalar
force	kg m s^{-2}	vector
displacement		
gravitational potential energy		
power		
impulse		

Q1

(Total 4 marks)

Turn over

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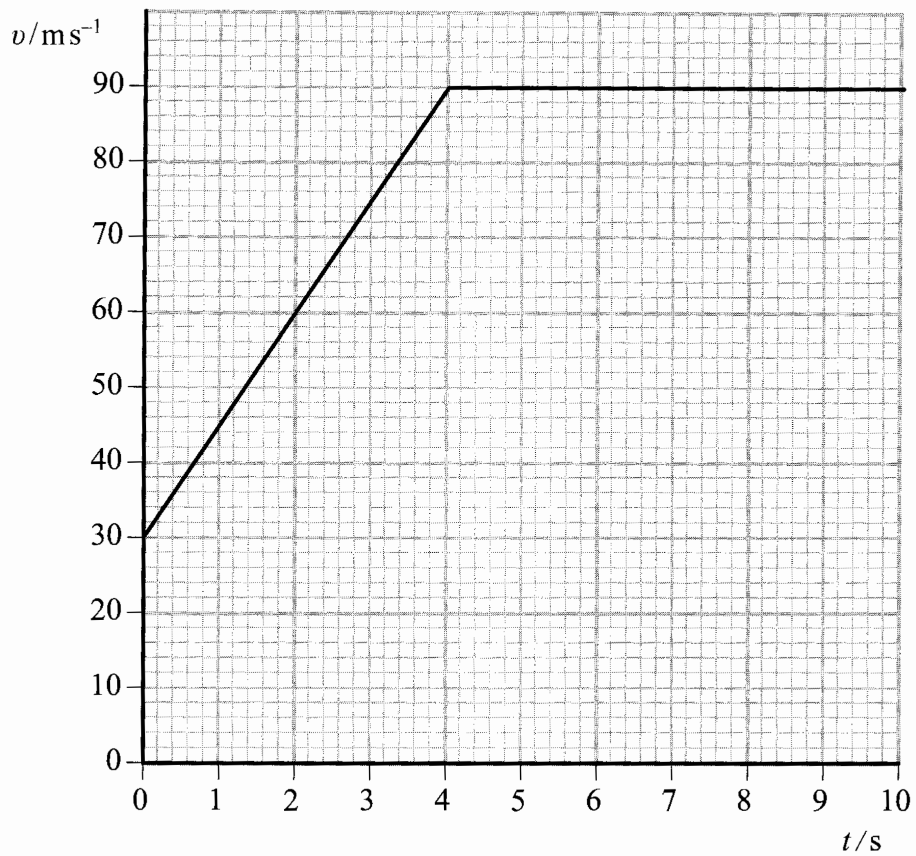
2. The graph below shows how the velocity of a motorbike varies with time during the final 10 s of a race.



(a) (i) Describe the motion shown by the graph.

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(2)

(ii) Show that during the final 10 s the motorbike travels a distance of approximately 800 m.

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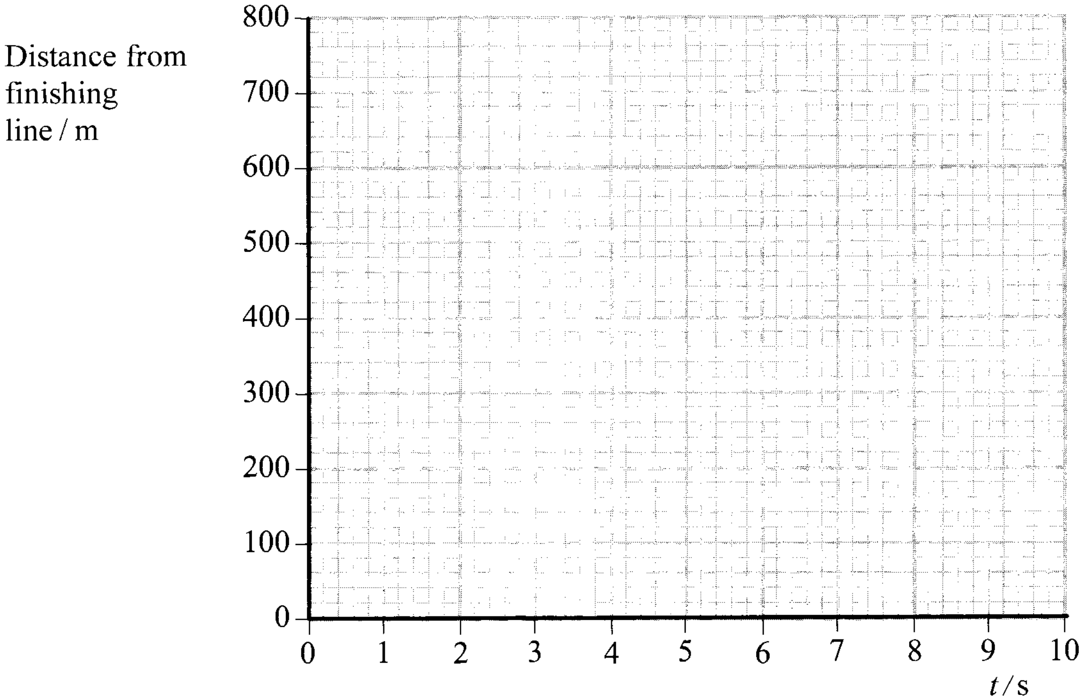
(3)

(b) Using the axes below, sketch a graph showing how the distance of the motorbike from the finishing line varies with time during the final 10 s of the race.



(3)

(Total 8 marks)

Leave blank

Q2

Leave blank

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

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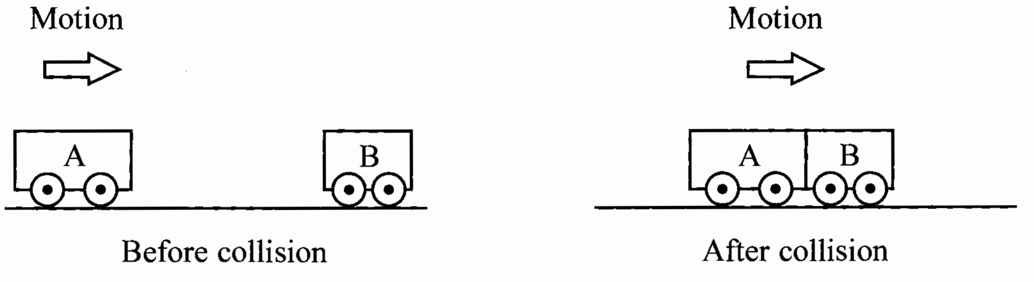
(2)

(b) A student considers how she could use two trolleys to demonstrate the principle of conservation of momentum. She decides on a collision between a moving trolley A and a stationary trolley B in which both stick together after the collision. This is shown in the diagram below.



(i) Describe a method for measuring the velocity of A. You may add to the diagram to help your description if you wish.

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(3)

Leave blank

(ii) What further measurements, in addition to the two velocities, will she have to make to demonstrate the principle?

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(1)

(iii) The student realises that if the velocity measurements are to lead to a demonstration of the principle, then both the velocity of A before the collision and the velocity of A and B after the collision need to be constant.
Explain why the velocities need to be constant.

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(2) **Q3**

(Total 8 marks)

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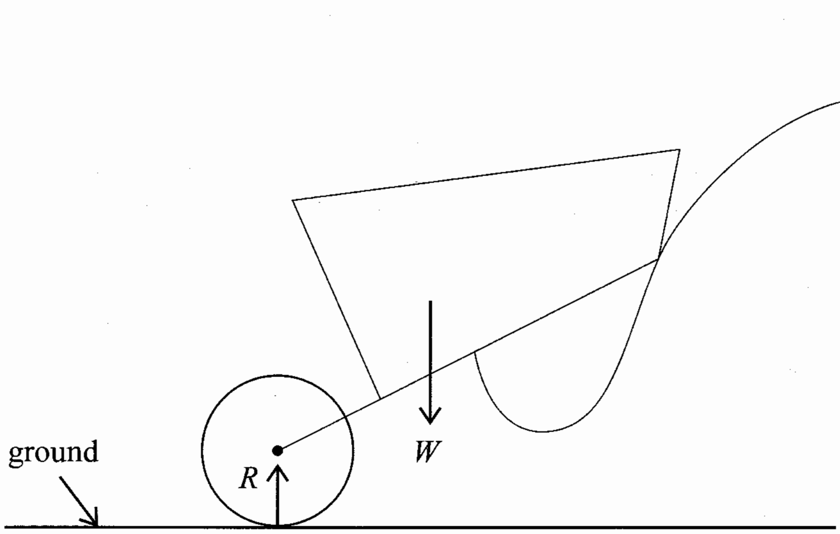
4. A gardener tilts a wheelbarrow of weight W by applying a total upward force F to its handles. The diagram shows the forces acting on the wheelbarrow. R is the normal reaction (contact) force acting on the wheel.



(a) (i) The wheelbarrow is stationary. State an expression that relates R, W and F.

....

(1)

(ii) Each of these three forces is one of a Newton's third law pair of forces.

Complete the following statements.

The force that pairs with R acts on ....

The force that pairs with W acts on ....

The force that pairs with F acts on ....

(3)

(b) The gardener now pushes the wheelbarrow forward. To do this he must change the magnitude and direction of the force F.

(i) Add an arrow to the diagram, at X, to show the approximate direction in which this force must act. Label this arrow P.

(1)

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(ii) Explain why the magnitude and direction of force F must change when the gardener pushes the wheelbarrow forward.

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(3) **Q4**

(Total 8 marks)

H 3 0 4 2 8 A 0 9 2 0

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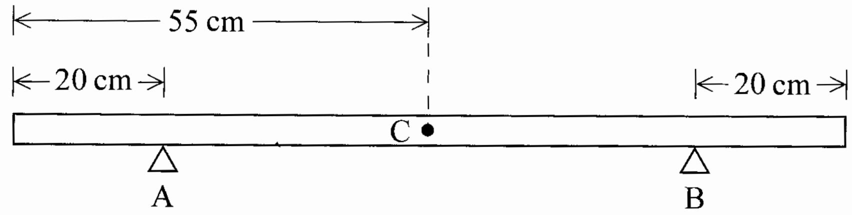
5. (a) A shelf is made of a 110 cm length of wood of weight 22 N. It rests on two brackets A and B. The centre of gravity of the shelf is at C.



(i) State the magnitude of the normal contact force that acts at each bracket.

Normal contact force = ...

(1)

(ii) By taking moments about bracket A, show that your answer is consistent with the principle of moments.

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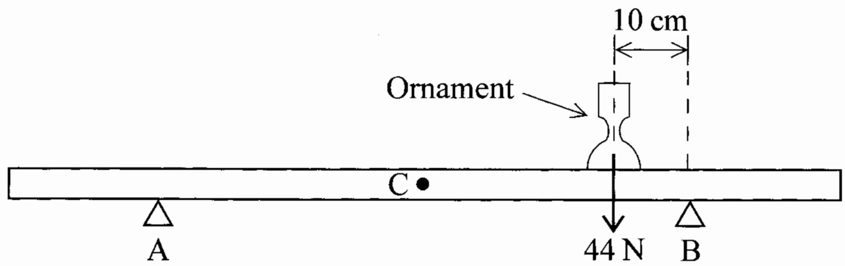
(2)

(b) An ornament of weight 44 N is now placed on the shelf 10 cm from bracket B as shown in the diagram.



(i) Calculate the normal contact force that now acts at bracket B.

....

....

....

....

Normal contact force = ...

(2)

(ii) The ornament is now positioned to the right of B. Explain why there is a limit to the distance from B that the ornament can be placed. You may be awarded a mark for the clarity of your answer.

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(4)

(iii) The ornament is placed at the limiting position. State the magnitude of the normal contact force at A.

Normal contact force = ...

(1)

Q5

(Total 10 marks)

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Turn over

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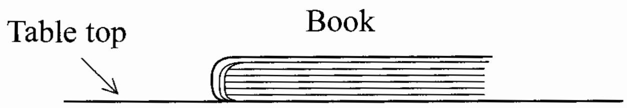
6. A book rests on a table as shown in the diagram.



The mass of the book is 1.80 kg. A student applies a momentary horizontal force to the book after which it slides across the table for a distance of 1.25 m before coming to rest. The frictional force between the book and the table is 2.75 N.

(a) Show that the speed of the book as it loses contact with the student is about 2.0 m s^{-1}.

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(3)

(b) Calculate the momentum of the book at this instant.

....

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Momentum = ...

(2)

(c) The momentary force applied to the book by the student lasts for 0.70 s.
Calculate the average value of this force.

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Average force = ...

(3)

Q6

(Total 8 marks)

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7. A satellite uses a radium-226 source as a back-up power supply. Radium-226 is an alpha particle emitter.

(a) The satellite requires a back-up power of 55 W. Each alpha particle is emitted with an energy of 7.65×10^{-13} J. Show that the activity of the source must be about 7×10^{13} Bq.

....

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(2)

(b) Radium-226 has a half-life of 1620 years. Show that its decay constant is about $1.4 \times 10^{-11}\ s^{-1}$.
1 year = 3.15×10^{7} s

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(2)

(c) Hence determine the number of radium-226 nuclei that would produce the required activity.

....

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....

Number of nuclei = ...

(2)

(d) Calculate the mass of radium-226 that would produce a power of 55 W.
226 g of radium-226 contains 6.02×10^{23} nuclei.

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Mass = ...

(2)

Leave blank

(e) In practice this mass of radium-226 produces more than 55 W of power. Suggest a reason why.

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(1)

Q7

(Total 9 marks)

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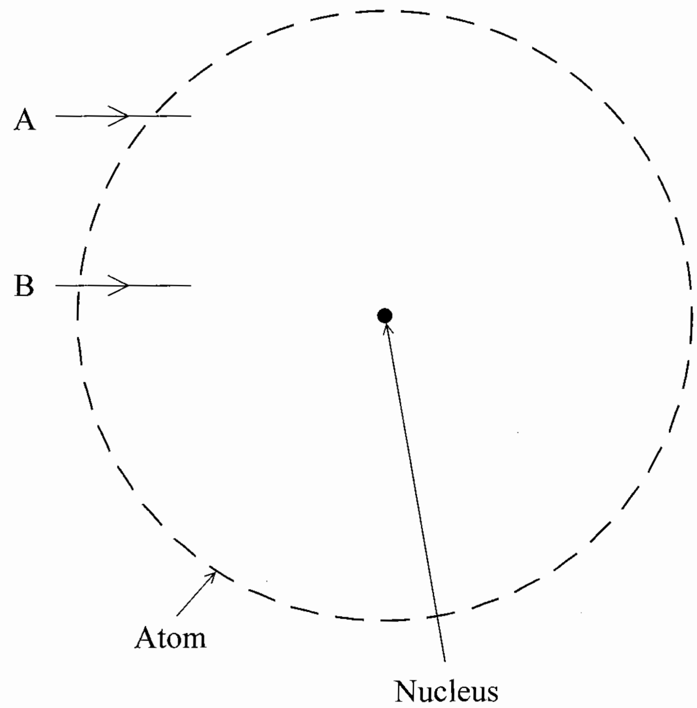
8. (a) The lines A and B show part of the paths of two alpha particles as they travel through an atom.



Add to the diagram the subsequent paths of each alpha particle as they travel through and out of the atom.

(2)

H 3 0 4 2 8 A 0 1 6 2 0

(b) Rutherford investigated the scattering of alpha particles by gold foil in an evacuated container. The evidence from his investigations led to the nuclear model of the atom.

Why was it important for this investigation that

(i) the alpha source was inside the container,

....

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....

(1)

(ii) the alpha particles had the same initial kinetic energy,

....

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(1)

(iii) the container was evacuated?

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(1)

Q8

(Total 5 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 $\quad F = m\dfrac{\Delta v}{\Delta t} = \dfrac{\Delta p}{\Delta t}$

Impulse $\quad F\Delta t = \Delta p$

Mechanical energy

Power $\quad P = Fv$

Radioactive decay and the nuclear atom

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

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

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 $\quad y = mx + c$

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

sphere $= 4\pi r^2$

Volume $\quad$ cylinder $= \pi r^2 h$

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

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

$\cos\theta \approx 1$