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

Friday 8 June 2007 – Morning

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
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. (a) State the difference between distance and displacement.

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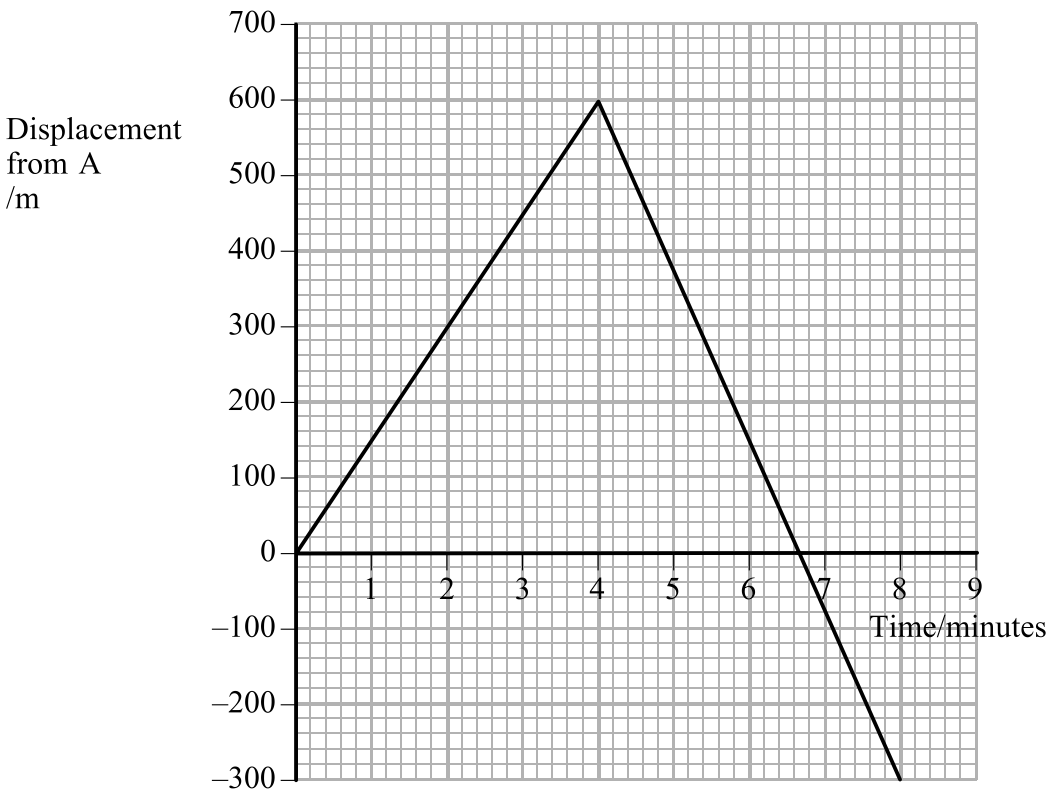
(1)

(b) Figure 1 shows an idealised displacement-time graph for the journey of a train along a straight horizontal track, from the moment when it passes a point A on the track. Initially the train moves in an easterly direction away from A.

Figure 1



(i) Describe the position of the train relative to A at the end of the 8 minutes covered by the graph.

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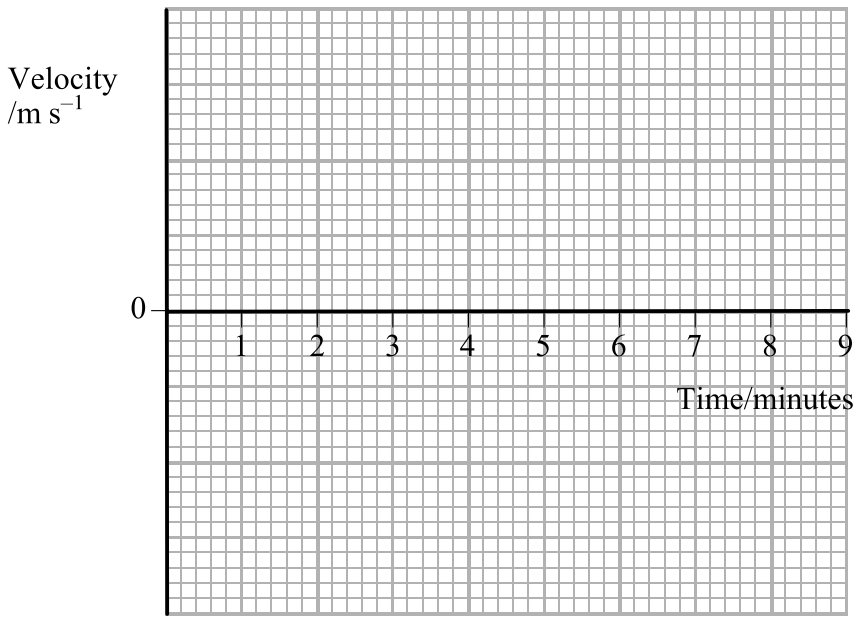
(2)

Leave blank

(ii) Use the grid, Figure 2, to plot a velocity against time graph of the journey shown in Figure 1. Do the calculations that are required on the lines below the grid.

Figure 2



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(4) **Q1**

(Total 7 marks)

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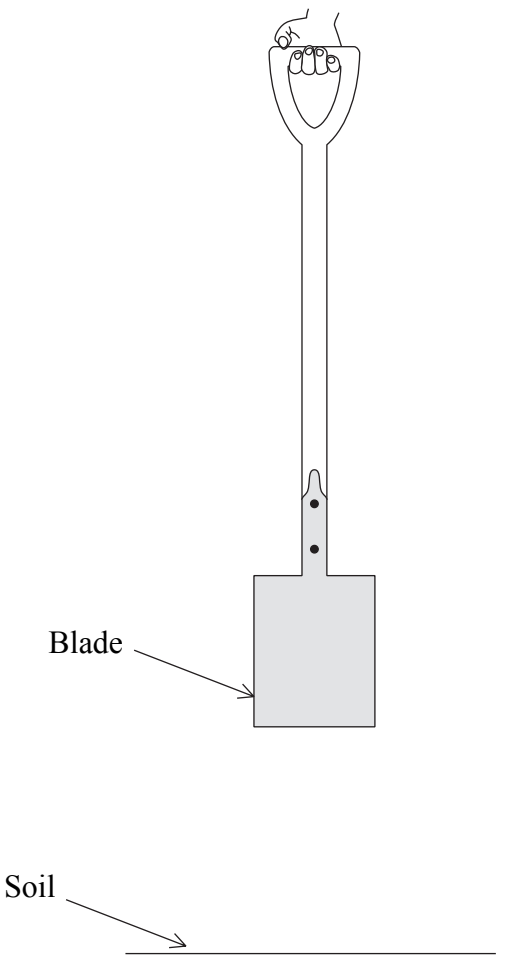
2. The diagram shows a spade being held above a flat area of soil.



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(a) The spade is released and falls vertically. It takes 0.29 s for the blade to reach the soil.

(i) Show that the speed of the spade at this instant is approximately 3 m s^{-1}.

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(3)

(ii) The spade penetrates 50 mm into the soil. Calculate the average acceleration of the spade in the soil.

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Average acceleration = ...

(3)

(b) A **heavier** spade of identical shape is now dropped from the same height into the same patch of soil. Underline the correct phrase in the brackets to describe what difference, if any, there would be in the speed at impact and the acceleration in the soil compared to the lighter spade. Assume the resistive forces on both spades are the same.

The heavier spade would have {a higher/a lower/the same} speed at impact as the lighter spade.

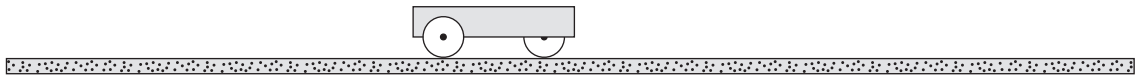
The heavier spade would have {a higher/a lower/the same} acceleration in the soil as the lighter spade.

(2) **Q2**

(Total 8 marks)

Leave blank

3. A student is provided with a trolley and a track as shown in the diagram below. He is required to apply different forces to the trolley, measure the corresponding accelerations and hence demonstrate the relationship between the two. Any additional normal school laboratory equipment is available for him to use.



(a) Describe how he could

(i) apply a constant measurable force;

.....

.....

.....

.....

(1)

(ii) measure the velocity of the trolley at a point on the track as the trolley moves under the action of this applied force. List any additional apparatus that would be required. You may add to the diagram above to help your description.

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(3)

Leave blank

(b) Assuming the velocity has been measured at one point, what additional measurements are required to determine the acceleration?

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(2)

(c) How could the student demonstrate the expected relationship between the force and the acceleration?

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(2)

(d) In such an experiment, the track is given a slight tilt to compensate for friction. Why is this necessary if the relationship suggested by Newton's second law is to be successfully demonstrated?

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(2)

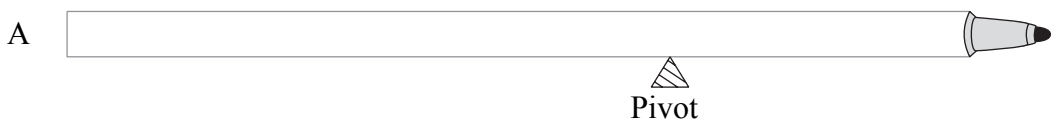
Q3

(Total 10 marks)

Leave blank

4. Figure 1 shows a pen, **drawn full size**, without its cap. The pen has a mass of 11 g and balances on a pivot 80 mm from the end A.

Figure 1



(a) Calculate the weight of the pen.

.....

.....

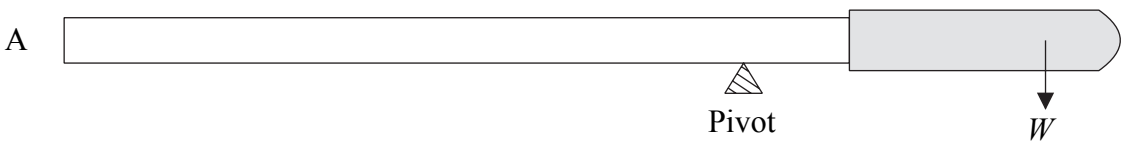
.....

Weight of pen =.....

(2)

(b) The cap is now put on the pen. The cap has a weight *W* which acts at the point shown. The pen together with its cap is then balanced as shown in Figure 2, which is also **drawn full size**.

Figure 2



(i) Add to Figure 2 a labelled arrow to represent the weight of the pen without its cap.

(1)

(ii) Calculate the weight *W* of the cap.

.....

.....

.....

Weight of cap = ...

(3)

Leave blank

(c) In addition to the two weights, a third force acts on the pen when balanced as in Figure 2.

(i) State where this force acts and give its direction.

.....

(ii) Calculate its magnitude.

.....

Magnitude = ...

(iii) Explain why it produces no moment about the point of balance.

.....

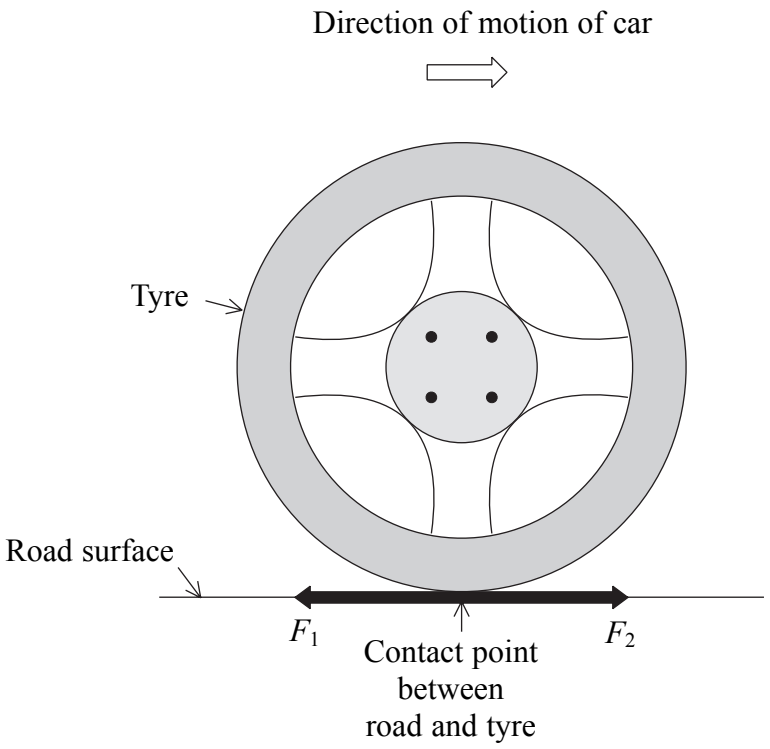
.....

(3) **Q4**

(Total 9 marks)

Leave blank

5. The force produced by the engine of a car which drives it is ultimately transmitted to the area of contact between the car's tyres and the road surface. The diagram shows a wheel at an instant during the motion of the car when it is being driven forward in the direction indicated.



Two horizontal forces act at the point of contact between the tyre and road due to the transmitted force from the engine. These are shown as F_1 and F_2. Assume that the area of contact between the tyre and road is very small.

(a) Complete the statements

(i) F_1 is the force of the ..... on the ..... .

(ii) F_2 is the force of the ..... on the ..... .

(2)

Leave blank

(b) (i) The total forward force on the car is 400 N when the car is travelling at a constant speed of 10 m s^{-1} along a level road. Calculate the effective power driving the car forward.

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.....

Power = ...

(2)

(ii) Hence calculate the total work done by the 400 N force in 5 minutes in maintaining the speed of 10 m s^{-1}.

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Work done = ...

(1)

(c) Although work is done on the car, it continues to move at a constant speed.

Explain why the car is not gaining kinetic energy.

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(2) **Q5**

(Total 7 marks)

Leave blank

6. (a) State the name given to atoms of the same element which have different numbers of neutrons in their nuclei.

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(1)

(b) An iodine nucleus has 78 neutrons and has a nucleon number of 131. Another iodine nucleus has 70 neutrons.

Complete the symbols for both these nuclei.

..... I .... I .....

(2)

(c) State how the nucleon number and the proton number of a nucleus change when an alpha particle is emitted from the nucleus.

Nucleon number .....

Proton number .....

(1)

Q6

(Total 4 marks)

Leave blank

7. A specimen of solid material, in the form of a cube, contains 1×10^{21} atoms. It has a volume of $8 \times 10^{-9}\,m^3$.

(a) Use this information to estimate the diameter of one of its atoms.

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.....

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.....

.....

Diameter = ...

(3)

(b) The density of this material is 2300 kg m^{-3}. The nuclei of its atoms occupy a volume which is 10^{-13} times the volume of its atoms.

Explain why this suggests that the nuclear material has a density that is about 10^{13} times greater than 2300 kg m^{-3}.

You may be awarded a mark for the clarity of your answer.

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(4)

Q7

(Total 7 marks)

Leave blank

8. (a) Radioactivity involves the *spontaneous* emission of *radiation* from *unstable* nuclei.

Explain the meaning of the words in italics as they apply to the process of radioactivity.

Spontaneous .....

.....

.....

Radiation .....

.....

.....

Unstable .....

.....

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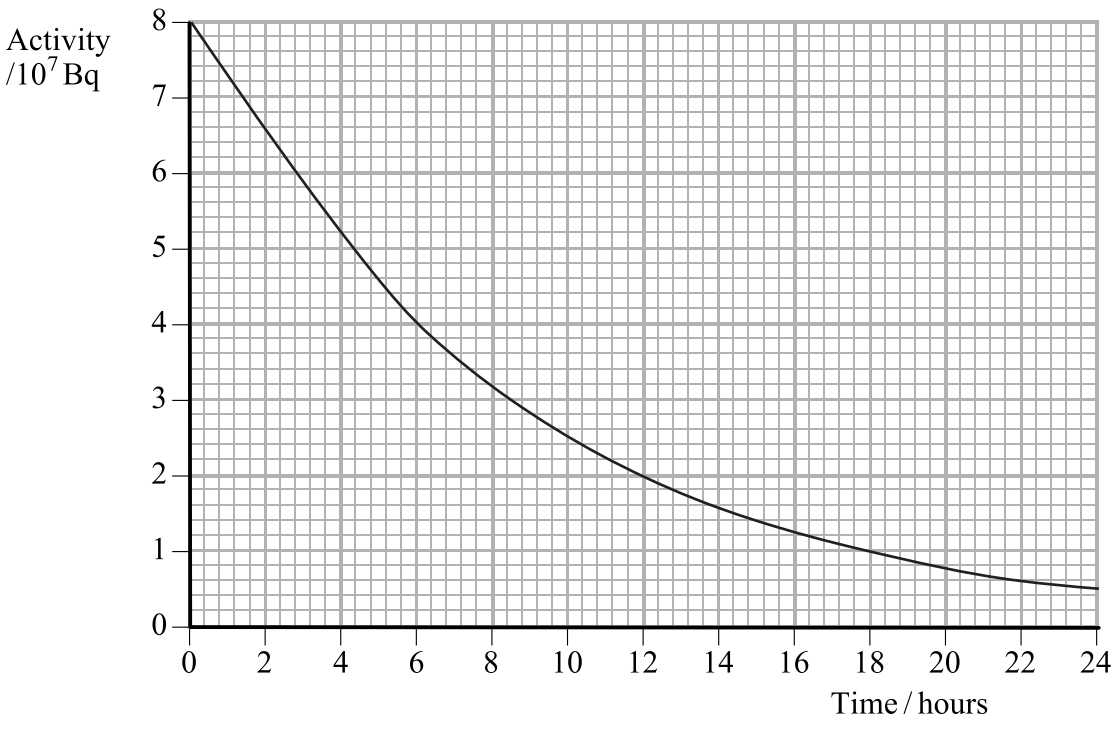
(3)

(b) The graph shows how the activity of a sample of the radioisotope technetium, which is used extensively in medicine, varies with time.



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(i) Use the graph to determine the half-life of technetium.

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Half-life = ...

(2)

(ii) Hence calculate the decay constant for technetium.

.....

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.....

Decay constant = ...

(1)

(iii) Determine the number of technetium atoms remaining in the sample after 24 hours.

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.....

Number of atoms = ...

(2) **Q8**

(Total 8 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

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

$$\begin{array}{l}\text{Sum of clockwise moments} \\ \text{about any point in a plane}\end{array} = \begin{array}{l}\text{Sum of anticlockwise moments} \\ \text{about that point}\end{array}$$

Dynamics

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

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

$$\text{cylinder} = 2\pi rh + 2\pi r^2$$

$$\text{sphere} = 4\pi r^2$$

Volume

$$\text{cylinder} = \pi r^2 h$$

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

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

$\cos\theta \approx 1$