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

Wednesday 17 January 2007 – 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.

Printer's Log. No.
N26139A
W850/R6731/57570 6/6/6/6/6/11,500

N 2 6 1 3 9 A 0 1 1 6

Turn over

edexcel
advancing learning, changing lives

Leave blank

1. Figure 1 shows a box resting on the floor of a stationary lift. Figure 2 is a free-body force diagram showing the forces *A* and *B* that act on the box.

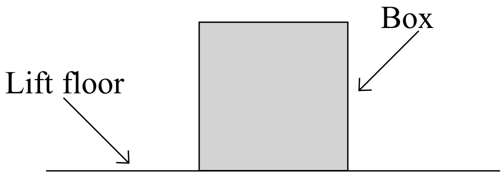


Figure 1

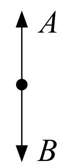


Figure 2

For each of the following situations, **tick** the appropriate boxes to show how the magnitude of the forces *A* and *B* change, if at all, compared with when the lift is stationary.

Situation	Force *A*			Force *B*		
	increases	no change	decreases	increases	no change	decreases
Lift accelerating upwards						
Lift moving with constant speed upwards						
Lift accelerating downwards						
Lift moving with constant speed downwards						

Q1

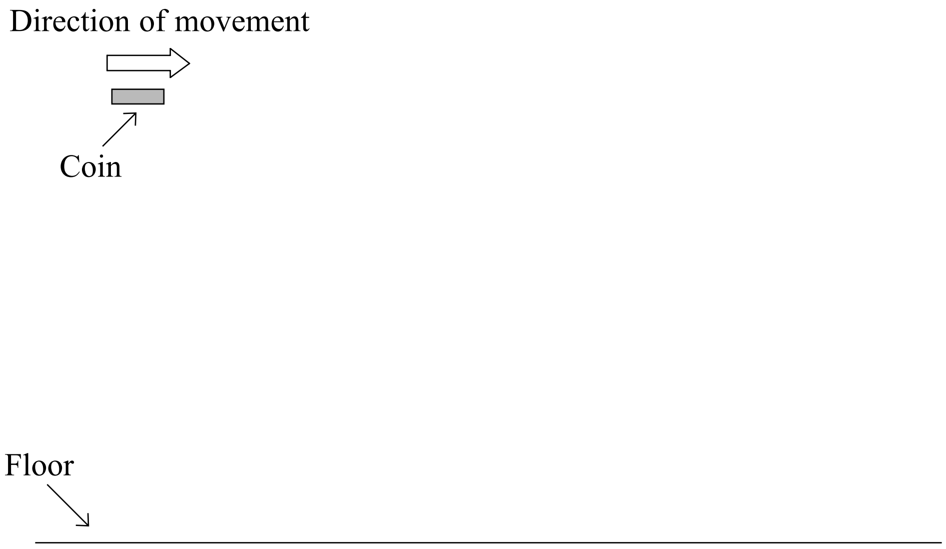
(Total 4 marks)

N 2 6 1 3 9 A 0 2 1 6

BLANK PAGE

Leave blank

2. A coin is flicked off a table so that it initially leaves the table travelling in a horizontal direction with a speed of 1.5 m s^{-1}. The diagram shows the coin at the instant it leaves the table. Air resistance can be assumed to have a negligible effect throughout this question.



(a) Add to the diagram the path followed by the coin to the floor.

(1)

(b) (i) The table is 0.70 m high. Show that the coin takes approximately 0.4 s to reach the floor.

....

....

....

....

....

(3)

(ii) Hence calculate the **horizontal** distance the coin travels in the time it takes to fall to the floor.

....

....

....

Horizontal distance = ...

(2)

Leave blank

(c) A coin of greater mass is flicked with the same horizontal speed of 1.5 m s^{-1}. Compare the path of this coin with that of the coin in the first part of the question. Explain your answer. You may be awarded a mark for the clarity of your answer.

....

....

....

....

....

....

....

....

....

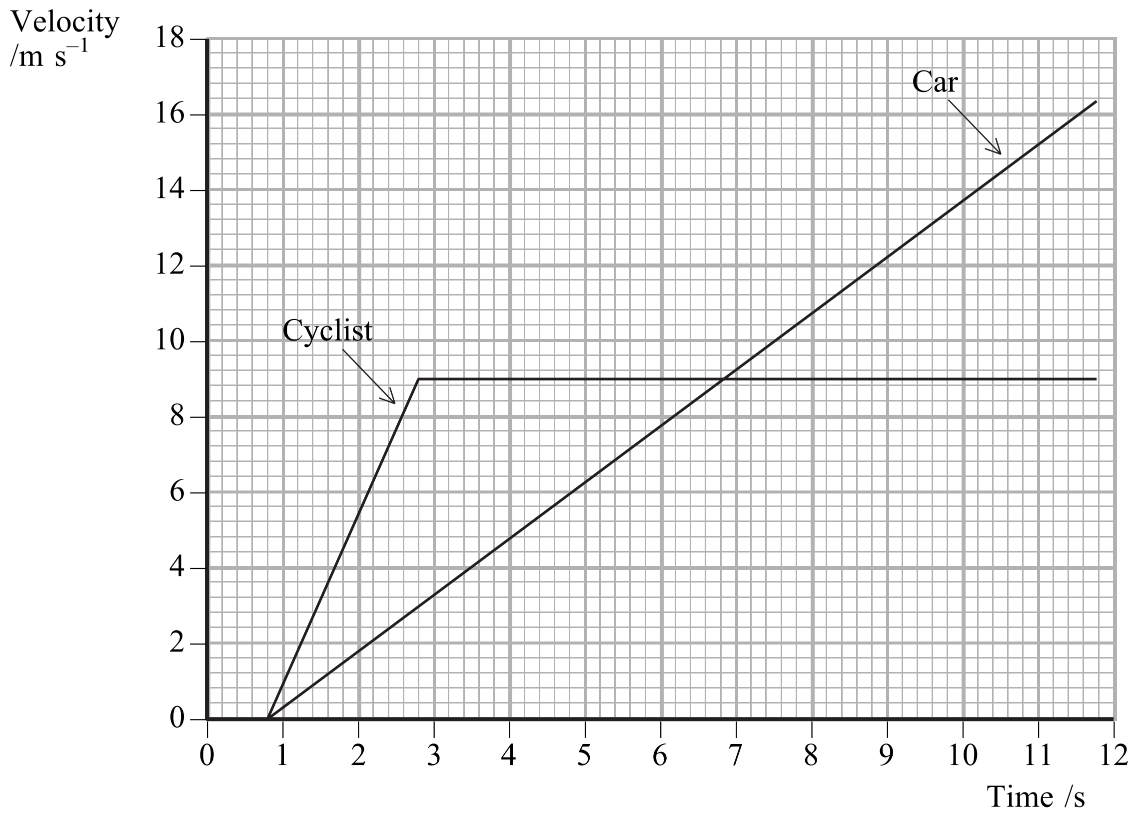
(4)

Q2

(Total 10 marks)

Leave blank

3. A cyclist and a car are both stationary at traffic lights. They are alongside each other with their front wheels in line. The lights change and they both move forward in the same direction along a straight flat road. The idealised graph shows the variation of velocity against time for both the cyclist and the car from the instant the lights change to green to the instant they are again level.



(a) What does the time interval of 0.8 s at the beginning of the graph represent?

....

....
(1)

(b) (i) How long does it take, from the instant the lights change to green, for the car to reach the same velocity as the cyclist?

....
(1)

N 2 6 1 3 9 A 0 6 1 6

Leave blank

(ii) Determine the distance between the cyclist and the car at this time.

....

....

....

....

....

....

Distance = ...

(3)

(c) What is the relationship between the average velocity of the cyclist and the average velocity of the car for the time interval covered by the graph?

....

(1)

Q3

(Total 6 marks)

N 2 6 1 3 9 A 0 7 1 6

Turn over

Leave blank

4. A gardener is laying a path. She is using concrete paving slabs of dimensions 600 mm × 600 mm × 40 mm. They are made of concrete of density 3300 kg m^{-3}.

(a) Show that the weight of a slab is about 470 N.

....

....

....

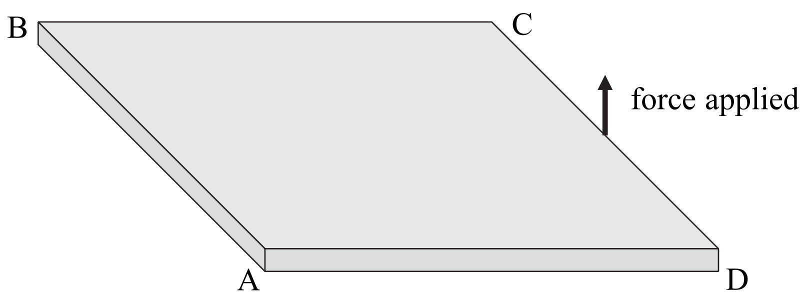
....

....

....

(3)

(b) To move a slab from lying flat on the ground to standing vertically, she initially applies an upward force centrally to the side CD as shown in the diagram. The slab then turns about the edge AB.



(i) Add to the diagram the position of the centre of gravity of the slab. Show how you located this position.

(1)

(ii) Hence calculate the force she will be applying at the moment that the bottom edge of side CD just leaves contact with the ground.

....

....

....

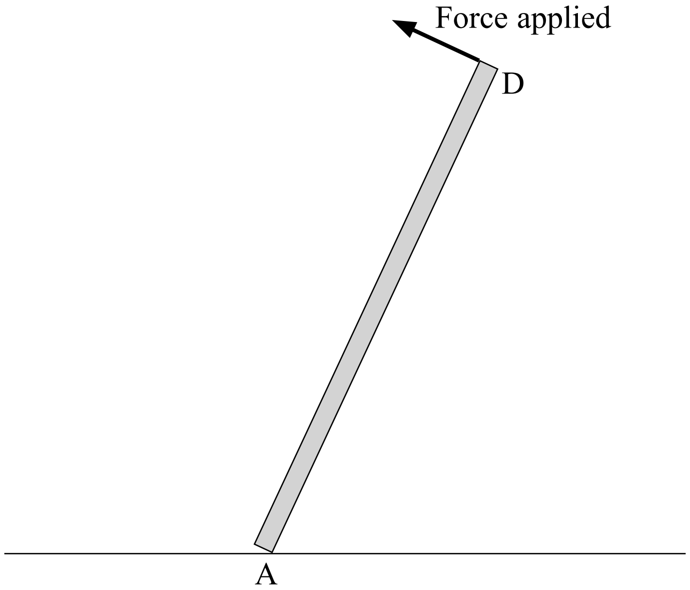
....

Force = ...

(2)

N 2 6 1 3 9 A 0 8 1 6

(c) The gardener continues to apply a force perpendicular to the face of the slab, as shown in the diagram below. Explain why it will gradually become easier to raise the slab towards the vertical. You may add to the diagram if you wish.



....

....

....

....

....

....

....

....

....

....

....

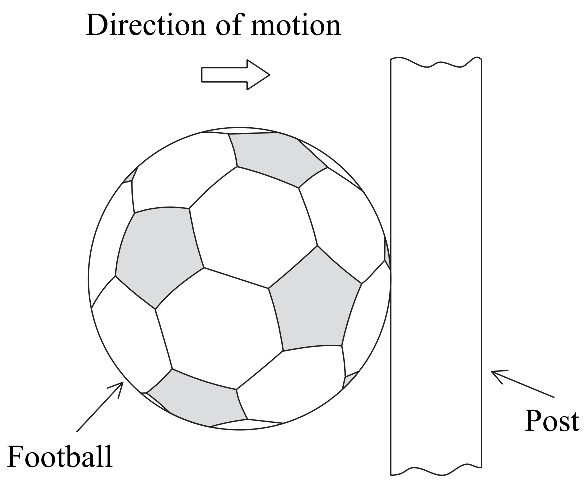
(3) **Q4**

(Total 9 marks)

Leave blank

Leave blank

5. During a game of football the ball, mass 0.42 kg, is kicked towards the goal. It hits one of the posts and rebounds directly back into play. The diagram shows the ball as it is just colliding with the post. At impact its speed is 27 m s^{-1}.



(a) Calculate the ball's momentum at impact.

....

....

Momentum = ...

(2)

(b) The ball's speed at the moment it loses contact with the post is 20 m s^{-1} in the opposite direction. Calculate its momentum at this instant.

....

....

Momentum = ...

(2)

(c) (i) The ball remains in contact with the post for 0.22 s. Determine the average force exerted on the ball due to the collision.

....

....

....

Average force = ...

(3)

(ii) Show the direction of this force on the diagram.

(1)

Leave blank

(d) State one difference and one similarity between this force and the force that acts on the post due to the impact of the ball.

Difference: ....

....

Similarity: ....

....

(2)

Q5

(Total 10 marks)

Leave blank

6. An elastic collision is one in which kinetic energy is conserved.

A proton, mass 1.67×10^{-27} kg, travelling with a speed of $2.40 \times 10^{6}\,\mathrm{m\,s^{-1}}$, has a head-on elastic collision with a stationary helium nucleus. After the collision the helium nucleus, mass 6.65×10^{-27} kg, moves off with a speed of $9.65 \times 10^{5}\,\mathrm{m\,s^{-1}}$.

(a) Show that the kinetic energy of the helium nucleus is approximately 3×10^{-15} J.

....

....

....

....

(2)

(b) (i) How much kinetic energy is lost by the proton?

....

(1)

(ii) Hence determine the speed of the proton after the collision.

....

....

....

....

....

....

Speed of proton = ...

(3)

(c) Name a quantity, other than kinetic energy, that is conserved in this collision.

....

(1)

Q6

(Total 7 marks)

Leave blank

7. The scattering of alpha particles by thin films of metal, such as gold, reveals details about the structure of an atom.

(a) For each of the two observations below give one clear deduction that can be made concerning atomic structure.

(i) Most alpha particles pass through the metal film without being deflected.

....

....

(ii) Some alpha particles are deflected by angles greater than 90° from their original direction.

....

....

(2)

(b) Of the alpha particles that are deflected most are deflected through angles much less than 90° from their original direction.

Explain why, from this observation alone, it is impossible to deduce the sign of the charge on the nucleus. You may use a diagram to illustrate your explanation.

....

....

....

....

....

....

(2)

(c) The ratio of atomic diameter to nuclear diameter can be expressed in the form 10^n. Suggest an appropriate value for n.

Value for n = ...

(1)

Q7

(Total 5 marks)

Leave blank

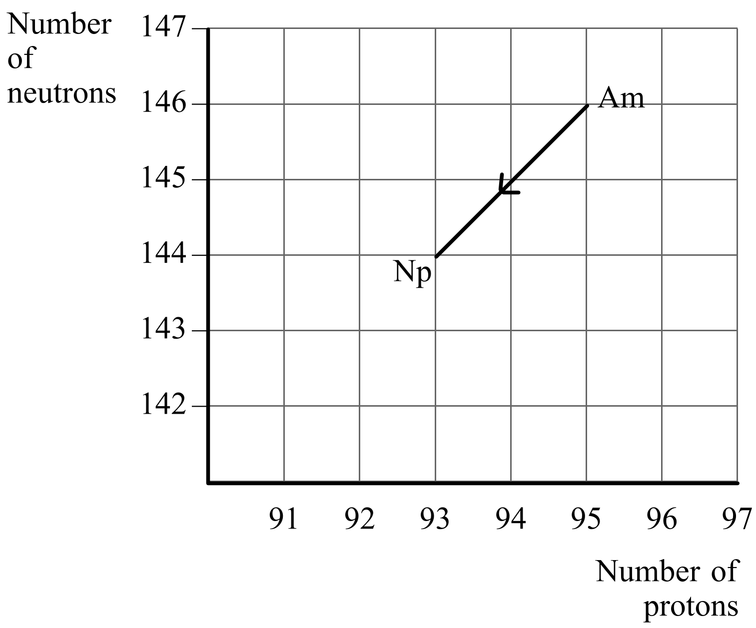
8. (a) 'Radioactivity is a **random process**.' Explain what is meant by a random process in this context.

....

....

....
(1)

(b) The graph shows what happens to the numbers of neutrons and protons when americium (Am) decays into neptunium (Np).



Give the nuclear equation for this decay.

$\longrightarrow$

(3)

N 2 6 1 3 9 A 0 1 4 1 6

Leave blank

(c) Describe an experiment, involving absorption, to demonstrate that a given radioisotope emits beta radiation and no other. Include a diagram of the experimental arrangement you would use.

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

(5) **Q8**

(Total 9 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 $= \frac{4}{3}\pi r^3$

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

$\cos\theta \approx 1$