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

Tuesday 17 January 2006 – Afternoon

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Materials required for examination
Nil

Items included with question papers
Nil

Question Number	Leave Blank
1	
2	
3	
4	
5	
6	
7	
8	
Total	

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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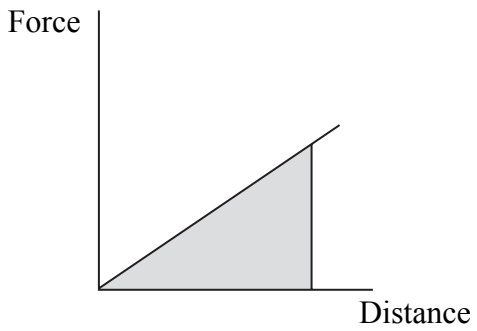
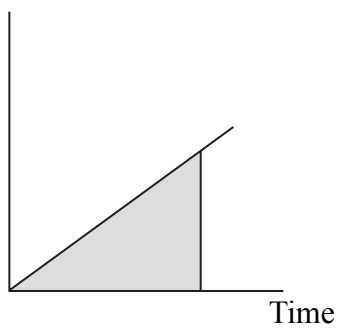
1. Name the physical quantity represented by the area under each of the following graphs. Give your answers in the table below.

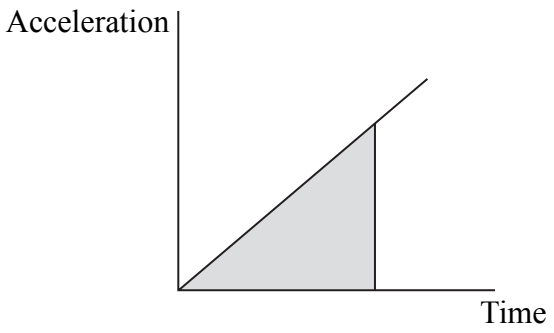
(i)



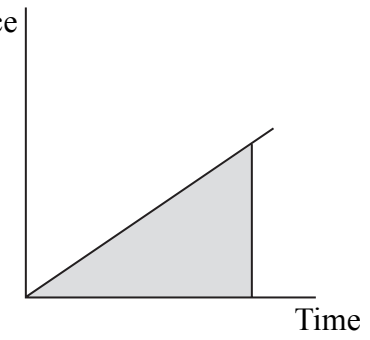
(ii)



(iii)



(iv)



Graph	Physical quantity represented by area under graph
(i)	
(ii)	
(iii)	
(iv)	

Q1

(Total 4 marks)

Leave blank

2. (a) State the **principle of moments**.

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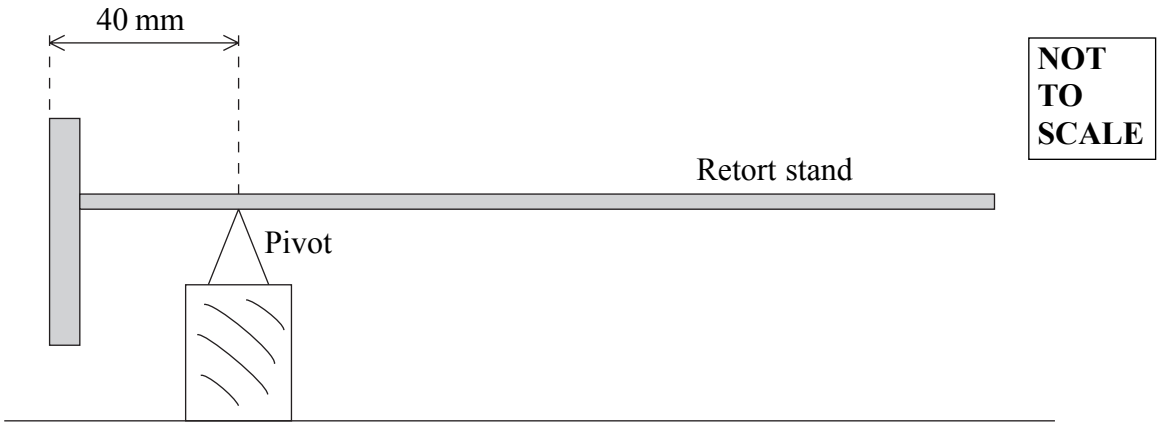
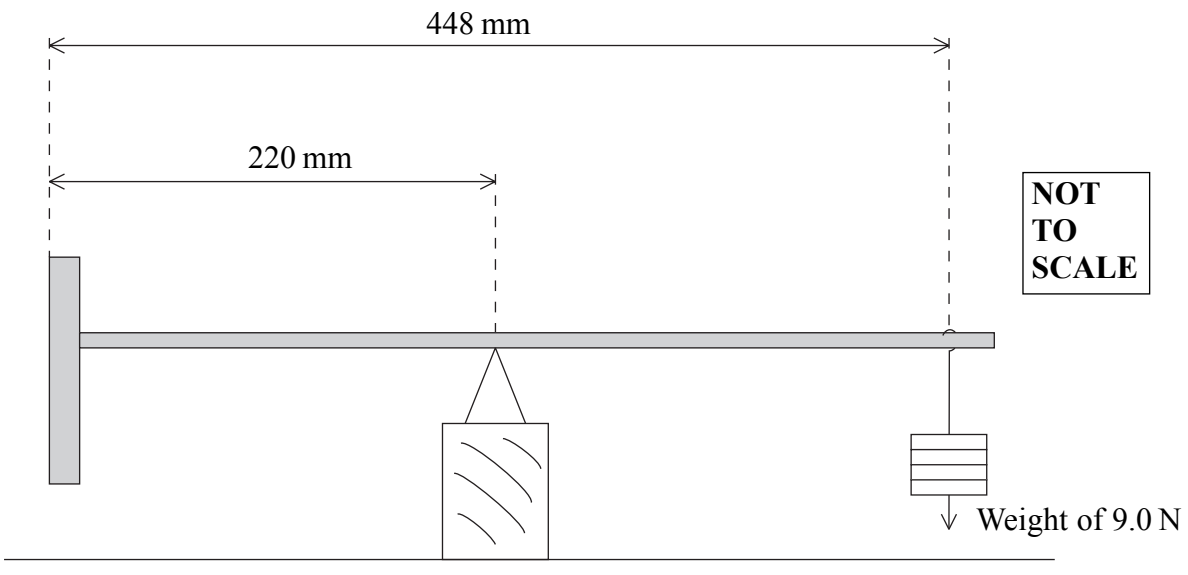
(2)

(b) The diagram below shows a retort stand balanced on a pivot to find the point through which its weight acts. It balances when the pivot is 40 mm from the base.



(i) The weight of this retort stand can be found using a known weight. The diagram below shows the retort stand balanced from a different point by a weight of 9.0 N. It balances when the pivot is 220 mm from the base and the 9.0 N weight is 448 mm from the base.



Show that the weight of the retort stand is about 11 N.

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(2)

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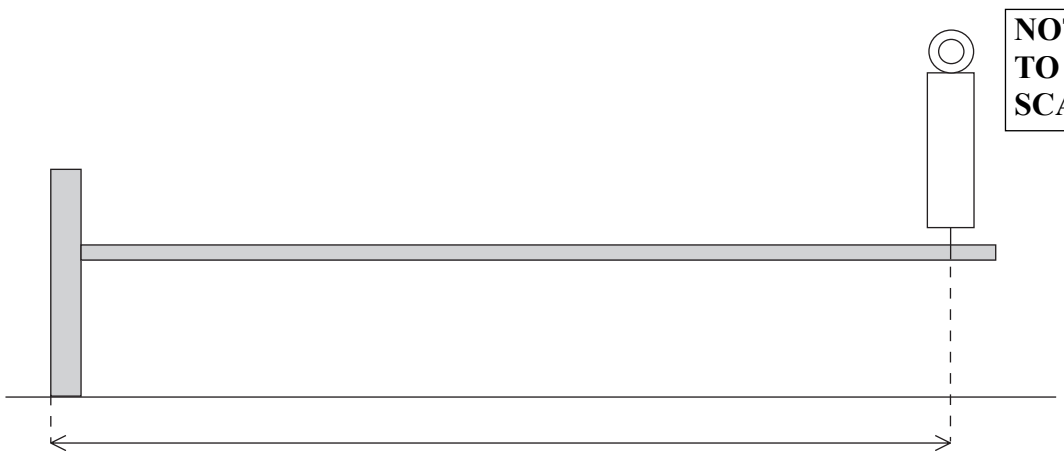
(ii) Another method to find the weight of the retort stand is shown below. The retort stand is balanced on its base and supported horizontally by a Newtonmeter. The meter is calibrated in 0.1 N divisions and can read up to 10 N.



Calculate the value you would expect the Newtonmeter to read.

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(2)

Hence determine the normal contact force acting on the base of the retort stand.

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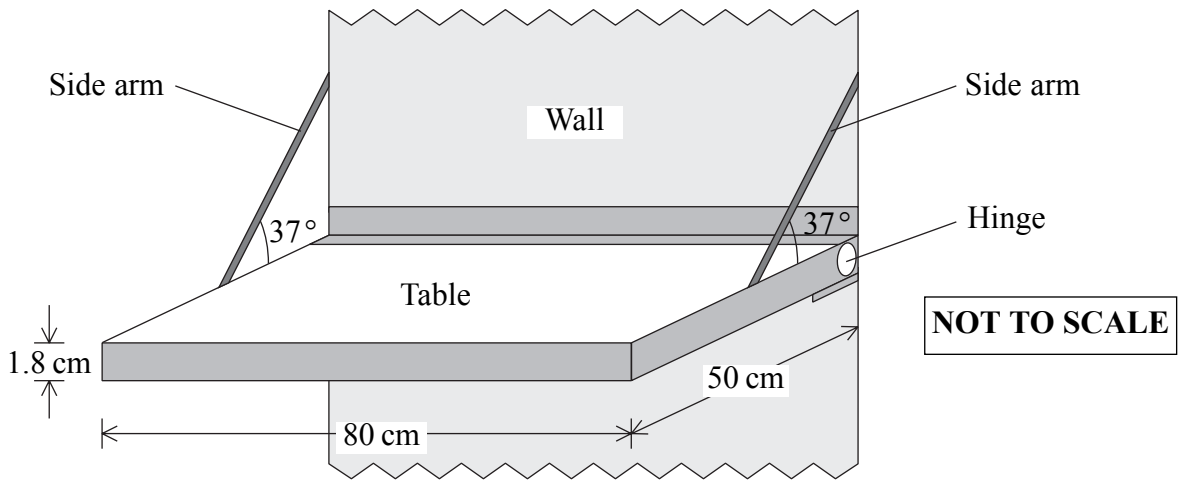
(1)

(Total 7 marks)

Q2

Leave blank

3. (a) The diagram below shows a drop-down table attached to a wall. The table is supported horizontally by two side arms attached to the mid-points of the sides of the table.



The table surface is 80 cm long, 50 cm deep and 1.8 cm thick. It is made from wood of density 0.70 g cm^{-3}. Show that its weight is about 50 N.

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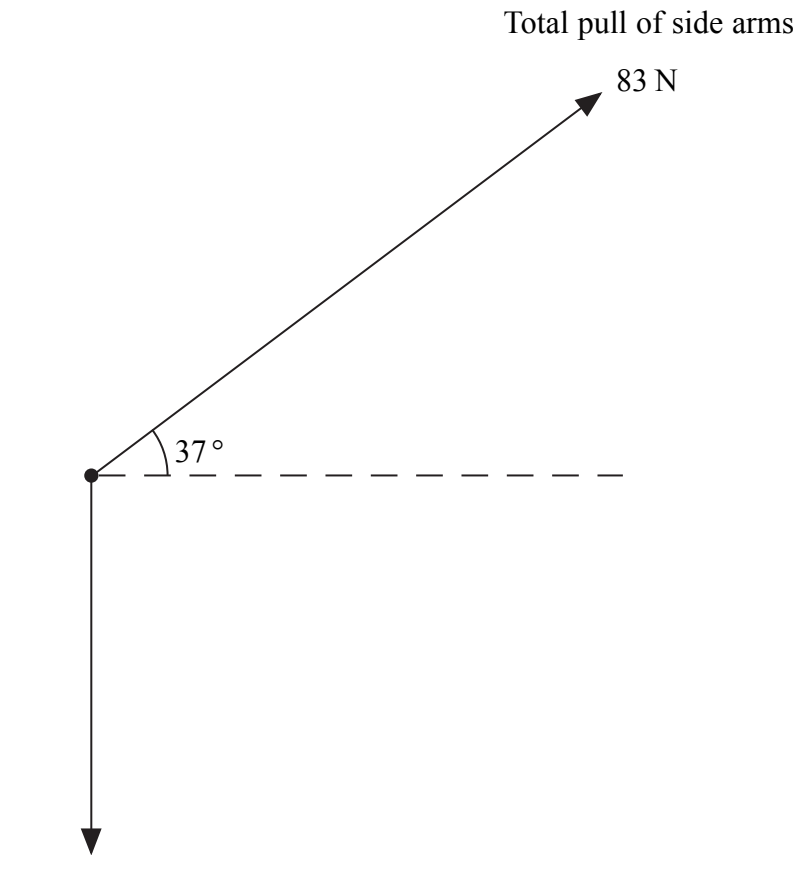
(3)

Leave blank

(b) The free-body force diagram below shows two of the three forces acting on the table top.



(i) Calculate the horizontal and vertical components of the 83 N force.

Horizontal component: .....

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Vertical component: .....

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(2)

(ii) Add appropriately labelled arrows to the free-body force diagram to show these components.

(1)

(iii) Hence find the magnitude of the horizontal force that the hinge applies to the table top and state its direction.

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(1)

Q3

(Total 7 marks)

Leave blank

4. (a) A car of mass m is travelling in a straight line along a horizontal road at a speed u when the driver applies the brakes. They exert a constant force F on the car to bring the car to rest after a distance d.

(i) Write down expressions for the initial kinetic energy of the car and the work done by the brakes in bringing the car to rest.

Kinetic energy .....

Work done .....

(1)

(ii) Show that the base units for your expressions for kinetic energy and work done are the same.

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(2)

(b) A car is travelling at 13.4 m s^{-1}. The driver applies the brakes to decelerate the car at 6.5 m s^{-2}. Show that the car travels about 14 m before coming to rest.

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(3)

Leave blank

(c) On another occasion, the same car is travelling at twice the speed. The driver again applies the brakes and the car decelerates at 6.5 m s^{-2}. The car travels just over 55 m before coming to rest. Explain why the braking distance has more than doubled. You may be awarded a mark for the clarity of your answer.

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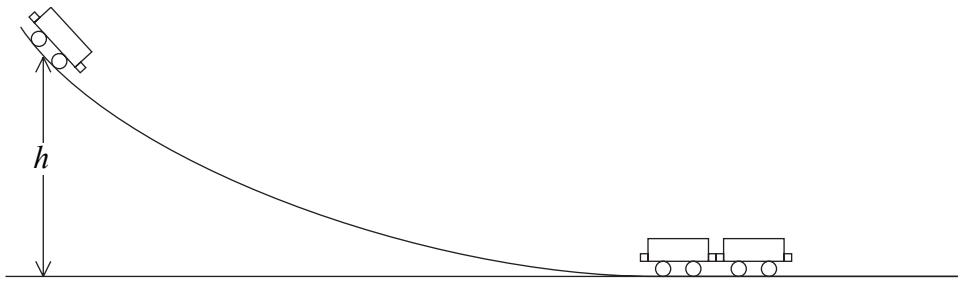
(4)

Q4

(Total 10 marks)

Leave blank

5. (a) A toy truck of mass 80 g is released from a height h and rolls down a slope as shown below.



What would the height h have to be for the truck to reach a speed of 4.0 m s^{-1} at the bottom of the slope? You may assume that any friction at its axles is negligible.

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Height = ...

(3)

(b) On reaching the bottom, it joins magnetically to two stationary trucks, identical to the first, and the trucks all move off together.

(i) State the law of conservation of linear momentum.

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(2)

Leave blank

(ii) Use this law to calculate the speed of the trucks immediately after the collision.

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Speed = ...

(2)

(c) One of the stationary trucks has a total frictional force of 0.12 N at its axles. How much time does it take for the three trucks to stop moving if this is the only frictional force acting?

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Time = ...

(3)

(Total 10 marks)

Q5

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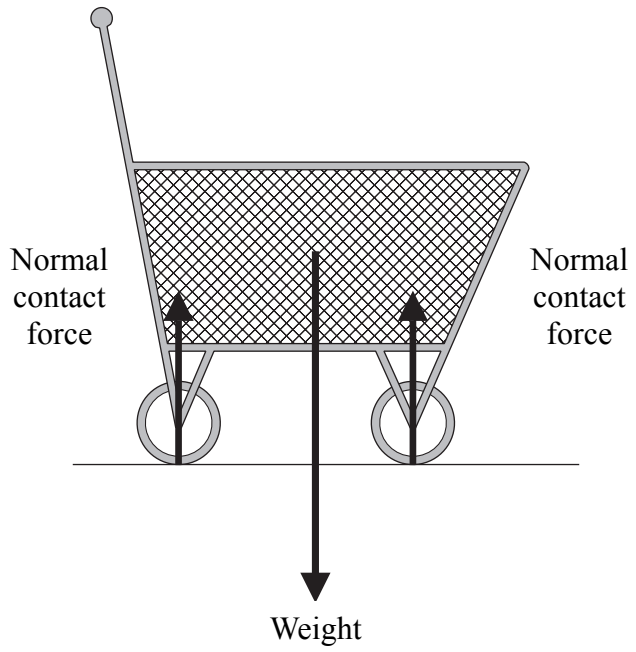
6. (a) The diagram below shows the forces acting on a shopping trolley at rest.



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

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(1)

(ii) In everyday situations, it does seem that a force is needed to keep an object, for example the shopping trolley, moving at constant speed in a straight line. Explain why.

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(1)

(iii) The vertical forces acting on the trolley are in equilibrium. Explain what **equilibrium** means.

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(1)

Leave blank

(b) (i) The weight of the trolley is one of a Newton's third law force pair. Identify what the other force in this pair acts upon and what type of force it is.

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(2)

(ii) Give two reasons why the two normal contact forces do **not** form a Newton's third law pair.

1 .....

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2 .....

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(2)

Q6

(Total 7 marks)

Leave blank

7. (a) Name two sources of background radiation.

1 .....

2 .....

(2)

(b) (i) A student is doing an experiment using radioactive material. She uses a counter to record the total count. Her teacher points out that she has forgotten to measure the background count rate. Describe the procedure the student should follow. You must mention any additional equipment she might need to use.

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(4)

(ii) Why might it have been unnecessary to measure the background count rate?

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(1)

Q7

(Total 7 marks)

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8. (a) (i) Carbon has two important isotopes, $^{12}_{6}C$ and $^{14}_{6}C$. Carbon-14 is unstable but carbon-12 is stable.

What is meant by saying that carbon-12 is stable?

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(1)

(ii) Carbon-14 is formed in the atmosphere when a particle $^{1}_{0}X$ collides with an atom of nitrogen.

Complete the equation to show the missing nucleon and proton numbers:

$$^{14}_{7}N + {}^{1}_{0}X \rightarrow {}^{14}_{6}C + {}^{\cdots\cdots}_{\cdots\cdots}Y$$

(1)

(iii) Identify the particles X and Y.

X = ... Y = ...

(2)

Leave blank

(b) (i) The half-life of carbon-14 is 5568 years. Show that the decay constant of carbon-14 is about 4×10^{-12} s^{-1}. (You may assume 1 year = 3.2×10^{7} s.)

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(2)

(ii) A sample of carbon-14 has an activity of 16 counts min^{-1}. Calculate the number of nuclei of carbon-14 in this sample.

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Number of nuclei = ...

(2)

Q8

(Total 8 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

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

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

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)

$\cos\theta \approx 1$