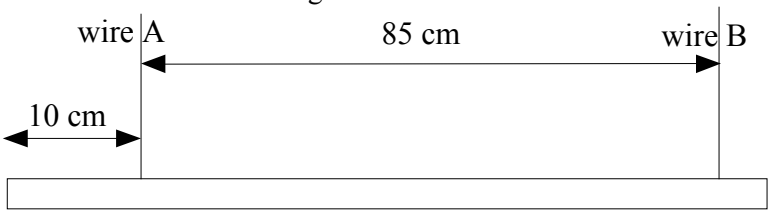
MODULE PHY1 REVISION

1. Define the following and in each case give two examples:
(a) base quantity; (b) base unit; (c) derived quantity; (d) derived unit
2. Give four further examples of a base quantity beyond those you gave in Q1(a).
3. Choose the nearest correct order of magnitude from the following: 10^{-10}; 10^{-7}; 10^{-4}; 10^{0}; 10^{2}; 10^{5}; 10^{7}
(a) the weight of an apple in newtons; (b) the length of a mile in centimetres;
(c) the length of a year in seconds; (d) the mass of an atom in grams.
4. (a) Define speed using one or more word equations.
(b) What is the difference between average and instantaneous speed?
(c) Which of the two types of speed in part (b) is: (i) shown by a car's speedometer; (ii) equal to the gradient of the tangent to the curve on a speed-time graph; (iii) equal to the total distance travelled by the time taken.
5. Plot a velocity against time graph using the following data. Your graph's time axis should include zero seconds.

time (s)	1.0	2.0	3.0	4.0	5.0	6.0
velocity (m/s)	16	14	12	10	8.0	6.0

(a) Explain how you can tell from your graph that it has the form 'y = mx + c'.
(b) Use your graph to find: (i) the values of 'm' and 'c'; (ii) the deceleration after 11 seconds;
(iii) the velocity after 0 seconds; (iv) the distance travelled after 5 seconds.
6. (a) An equation is said to be 'homogeneous'. What does 'homogeneous' mean?
(b) Give an example of an equation that is homogeneous but incorrect.
7 (a) What is the difference between a vector and a scalar?
(b) State whether the following are vectors or scalars:
force; distance; potential-energy; displacement; speed; momentum; kinetic-energy; work; mass
8. Calculate: (a) the vertical and horizontal components of a force of 50N that acts at an angle of 30^{o} upwards from the horizontal. (b) the resultant of two velocities if one is 5m/s north and the other 8m/s east.
9. Use the equations of uniform acceleration to find:
(a) the time taken for a car to accelerate at $2m/s^2$ from 4m/s to 12m/s.
(b) the acceleration required for a car to cover a distance of 50m in 5 seconds if it starts from 1m/s.
(c) the displacement covered by a train decelerating at $1.5m/s^2$ from 30m/s to 25m/s.
10. Describe, with the aid of a diagram, how you would measure the acceleration of free fall in the laboratory. Your explanation should include a graphical method of finding the acceleration.
11. Draw a displacement-time sketch graph showing a body undergoing uniform acceleration.
12. Draw a velocity-time sketch graph showing a body undergoing non-uniform acceleration.
13. A boy throws a stone horizontally at a speed of 30 m/s from the edge of a cliff of height 50m. Ignoring air resistance effects, calculate: (a) the time taken for the stone to fall to the base of the cliff; (b) the vertical speed of the stone as it reaches the base; (c) the distance travelled horizontally by the stone; (d) the velocity of the stone on reaching the base of the cliff. ($g = 9.81\ m/s^2$)
14. If the boy in Q13 had thrown the stone vertically upwards instead;
(a) What height above the boy would the stone attain? (b) For how long in time would the stone be above the boy?
15. (a) Define 'weight'. (b) On Earth a student weighs 600N. Calculate the student's mass on the Moon where gravity is approximately $1/6^{th}$ the strength of that on the Earth.
16. (a) Draw a free-body force diagram for the a person standing still on a flat floor.
(b) Due to a structural fault the floor collapses downwards at a rate of $8.5m/s^2$. How, if at all, would the free-body force diagram be different from part (a)?
17. Define 'centre of gravity'
18. State Newton's first and third laws of motion.
19. Give an example, in each case, of two situations where there are two equal and oppositely directed forces that are:
(a) a Newton's 3^{rd} law pair; (a) NOT a Newton's 3^{rd} law pair.
20. What is the 'principle of moments'? In what ways can a body move and yet still be obeying the principle of moments?
21. The diagram below shows a metre ruler of weight 1.5N. Calculate the tensions in the support wires.



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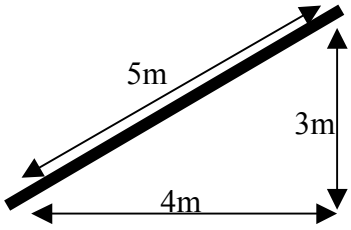
22. State the typical value of the density of:
(a) a liquid in g/cm^3; (b) a metallic solid in g/cm^3; (c) a gas in kg/m^3; (d) an atomic nucleus in g/cm^3;
23. How would you measure the density of air in the laboratory?
24. A truck of mass 2000kg collides with another stationary truck of mass 3000kg. If after the collision both trucks move of together with a speed of 5m/s what was the initial speed of the first truck?
25. Define Newton's second law of motion and show how it leads on to the equation $\Sigma F = ma$ for a body of constant mass m.
26. What is meant by 'impulse'?
27. Calculate the final speed of a car of mass 800kg if it is accelerated from rest by a resultant force of 1600N for 6 seconds.
28. Define 'work', using a word equation.
29. Calculate the work done against gravity in pushing a mass of 40kg up the slope shown opposite.



30. Calculate the kinetic energy of a ball, mass 200g, moving at a speed of 30m/s.
31. A child of mass 35kg climbs up a wall of height 2.5m and then steps off.
Calculate or state:
(a) the work done against gravity by the child in climbing the wall.
(b) the gravitational potential energy gained by the child in climbing the wall.
(c) the maximum kinetic energy gained by the child after stepping off the wall.
(d) the maximum speed reached by the child after stepping off the wall.
(e) what you have assumed in parts (c) & (d).
32. Calculate: (a) the time taken for a light bulb of power 60W to use one million joules of electrical energy.
(b) the maximum power developed by the car in question 27.
(c) the average power of this car during the first 6 seconds.
33. What is 'radioactivity'?
34. Give two different examples in each case of:
(a) natural & (b) man-made sources of background radiation.
35. What are: (a) alpha particles; (b) beta-plus particles; (c) beta-minus particles; (d) gamma rays?
36. How could you show in the laboratory that a radioactive source was only emitting alpha & gamma radiation?
37. Define: (a) nucleon number; (b) proton number; (c) isotopes; (d) half-life; (e) decay constant
38. A atom of oxygen contains 8 protons and 10 neutrons. (a) how many electrons does it contain; (b) what is its nucleon number?
39. The atom of oxygen (O) above undergoes beta-minus decay and decays to form fluorine (F). Write a balanced decay equation for this case.
40. Repeat question 39, this time for fluorine-16 undergoing beta-plus decay.
41. How could you demonstrate that radioactive decay is a random process.
42. An isotope of half-life 5 days has an initial activity of 800 decays per minute. What would you expect its activity in BECQUEREL to be after 10 days?
43. Another isotope decays to one fifth of its original activity after one second. What is its (a) decay constant? (b) half-life?
44. A sample of uranium of half-life 4500 million years has an activity of 6.0×10^7 Bq.
(a) What is its decay constant? (b) How many atoms of Uranium did it contain when its activity was measured?
45. The table below shows how the activity of an isotope, plus background radiation of 0.40 Bq, varies over a period of time. Plot an appropriate graph and then use this graph to find the decay constant of the isotope.

time (minutes)	0	1	2	3	4	5	6
activity (Bq)	5.90	4.47	3.42	2.64	2.06	1.63	1.31

46. What are the approximate diameters of (a) atoms? (b) nuclei?
47. (a) Describe, with the aid of diagrams, the experiment that was performed to verify the existence of the nucleus.
(b) Why were alpha particles rather than neutrons used in this experiment?
(c) More recently experiments have been performed to show that protons and neutrons also have an internal structure. What is used instead of alpha particles in this case?