A Level H2 Physics Tutorial 5: Work, Energy and Power

Syllabus :
(a) define and use work done by a force as the product of the force and displacement in the direction of the force .

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1. A boy pushes a trolley for 3 m, using a force of 2 N. The trolley moves in the direction of his force. Find the work done on the trolley.

(b) calculate the work done in a number of situations including the work done by a gas which is expanding against a constant external pressure: $W = p\Delta V$

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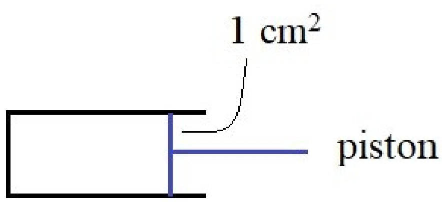
2. The volume of a gas expands at constant pressure. The pressure is atmospheric pressure, 1×10^5 Pa.



The cylinder volume changes from 8 cm^3 to 9 cm^3.

(i) Find the work done by the gas on the piston using the formula $W = p\Delta V$.

(ii) Show how the formula can be derived from the definition of work done.

(c) give examples of energy in different forms, its conversion and conservation, and apply the principle of energy conservation (

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3. A book given a kinetic energy of 50 J slides across the floor for some distance. A student measures its temperature and estimates that 25 J is converted to internal energy in the book. Suggest what happens to the rest of the kinetic energy.

(d) show an appreciation for the implications of energy losses in practical devices and use the concept of efficiency to solve problems

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4. Mary's breakfast this morning has given her 1300 J of energy. She went jogging and did some housework, which together needed only 300 J. But all of her breakfast energy has been used up. What is the efficiency of her body for such physical work.

(e) derive, from the equations for uniformly accelerated motion in a straight line, the equation $E_k = ½\ mv^2$

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5. Using the formula for work done, derive the kinetic energy formula $½mv^2$.

Hint: use the acceleration equation $v^2 = u^2 + 2as$.

(f) recall and use the equation $E_k = ½\ mv^2$

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6. A stone is dropped from a height od 1 m. Mass of the stone is 0.2 kg.

(i) Find the initial potential energy of the stone.

(ii) State, without calculation, the kinetic energy just before it hits the ground.

(iii) Using the formula $E_k = ½\ mv^2$, find the velocity just before it hits the ground.

(g) distinguish between gravitational potential energy, electric potential energy and elastic potential energy

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7. Give an example of each of the following :

(a) gravitational potential energy,

(b) elastic potential energy,

(c) electric potential energy.

(h) deduce that the elastic potential energy in a deformed material is related to the area under the force extension graph
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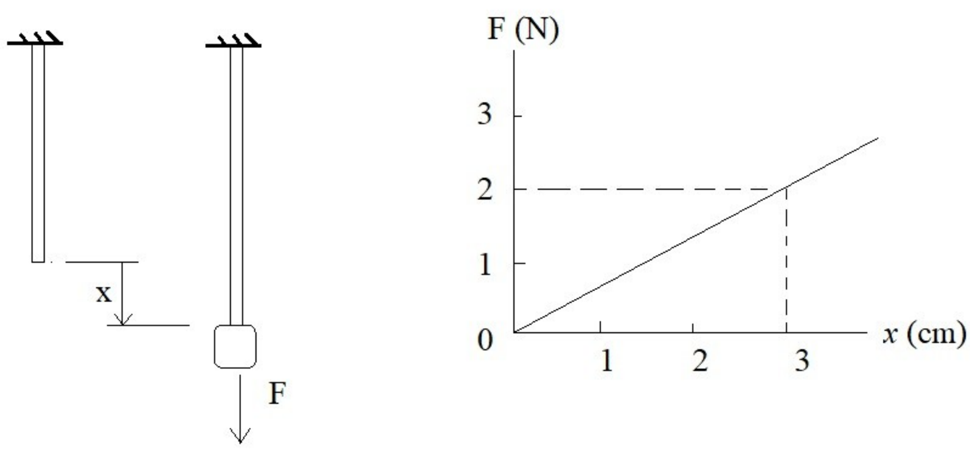
8.



(a) (b)

(a) From the graph, obtain an expression relating force F to extension x.

(b) Deduce an expression for elastic potential energy in terms of x, using area under the graph.

(c) Find the elastic potantial energy for an extension of 3 cm.

(i) show an understanding of and use the relationship between force and potential energy in a uniform field to solve problems
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9(a) The gravitational force on an object, mg, is approximately constant at different height near Earth's surface. Assuming that its potential energy E_p on the ground is 0 J, find the expression for its potential at height h.

(b) Sketch a graph of E_p againsst h, and find an expression for its gradient.

(c) Suggest a relationship between force and potential energy.

(j) derive, from the definition of work done by a force, the equation E_p = mgh for gravitational potential energy changes near the Earth's surface

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(see previous example)

(k) recall and use the equation E_p = mgh for gravitational potential energy changes near the Earth's surface

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(see previous example)

(l) define power as work done per unit time and derive power as the product of a force and velocity in the direction of the force.

10.

(a) Jack was pushing a box along the ground. After pushing for 10 s, he has used up 1000 J of his energy. What is his average power used?

(b) If I push the box with force F at velocity v, derive an expression for the power P on the box in terms of F and v.

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