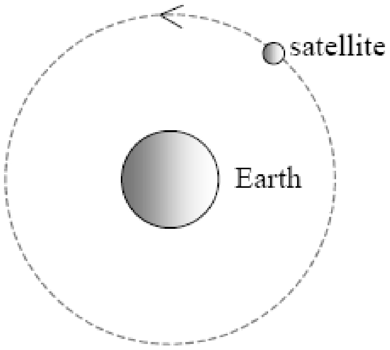
2IB Physics HL only. Training May 2008 TM. With argumentation!

1. N02 H1: 12

A satellite orbits the Earth as shown below.



In the table below, which row gives the correct sign for the satellite's potential and kinetic energies?

	Potential energy	Kinetic energy
A.	Positive	Positive
B.	Negative	Positive
C.	Positive	Negative
D.	Negative	Negative

2. N02 S1: 14

A fixed volume of an ideal gas is at a temperature of 27 °C. In order to **double** the pressure at constant volume the temperature must be

A. decreased to minus 123 °C.

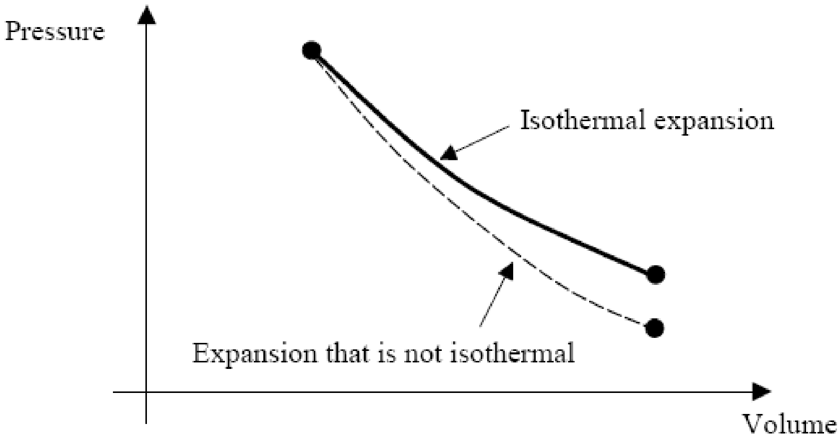
B. decreased to 13.5 °C.

C. increased to 54 °C.

D. increased to 327 °C.

3. N02 H1: 18

The solid line on the graph below represents the pressure-volume changes for an ideal gas undergoing an isothermal expansion. The dashed line on the graph shows the pressure-volume changes for an expansion **that is not isothermal**.



In the expansion that is not isothermal, the internal energy of the gas

A. increases.

B. decreases.

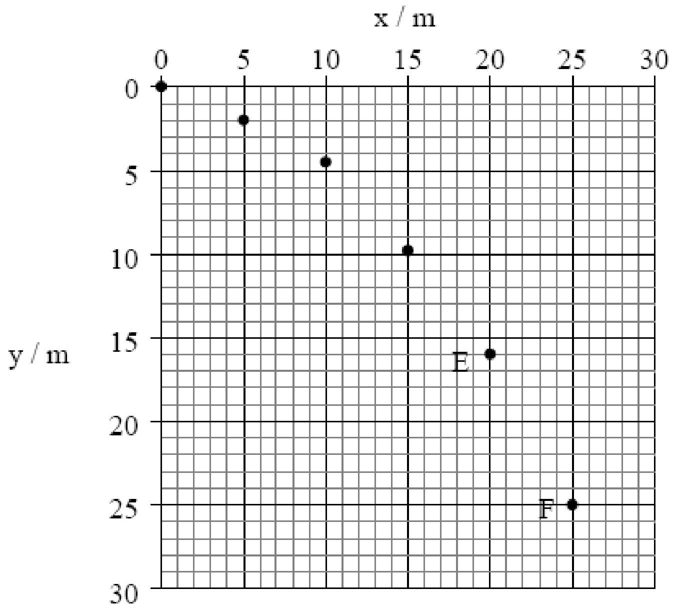
C. stays the same.

D. changes but whether it decreases or increases cannot be determined from the graph alone.

4. N02 S2: A1, H2: A1

Projectile motion on a planet

A projectile is launched horizontally from a cliff on a planet in a distant solar system. The graph below plots the horizontal (x) and vertical (y) positions of the projectile **every 0.5 seconds**.



(a) Determine the initial velocity with which the projectile was launched. *[2]*

(b) How can you tell from the plotted data that the planet's atmosphere had no significant effect on the motion of the projectile? *[2]*

(c) State **two** reasons why the value of the acceleration due to gravity on this or any other planet is likely to be different from that on Earth. *[2]*

(d) Draw a vector on the graph to represent the **displacement** of the projectile between points E and F of the motion. Then draw vectors to represent the horizontal and vertical **components** of this displacement. *[3]*

(e) Determine the **vertical** component of the average velocity of the projectile between points E and F. *[2]*

(f) Another projectile is fired at **half the speed** of the first one. On the graph opposite, plot the positions of this projectile for time intervals of 0.5 s. *[2]*

5. M02 S2: B2

This problem is a continuation of the problem in SL+HL paper problem 34, where you was asked questions ai, aii, bi.

In (b) you get some more informations for use in bii and on.

(b) An ideal gas is contained in a cylinder fitted with a moveable piston. The mass of the gas is 4.0×10^{-3} kg and the specific heat of the gas at constant volume is $3.1\times10^{3}\ \mathrm{J\,kg^{-1}\,K^{-1}}$. The gas is initially at a temperature of 27 °C and pressure 1.0×10^{5} Pa.

The gas is now heated at constant volume until its pressure becomes 2.0×10^{5} Pa.

(ii) Calculate the temperature of the gas after it has been heated at constant volume. *[2]*

(iii) Determine the thermal energy given to the gas when it is heated. *[3]*

(c) The gas is now compressed at constant temperature until its volume is half its original volume.

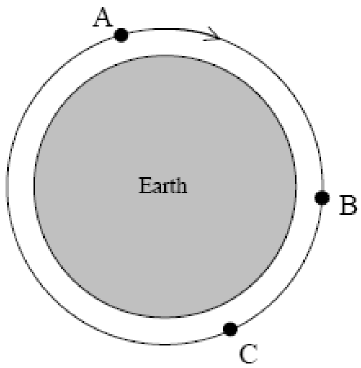
(i) What is the change in internal energy of the gas resulting from this compression? *[1]*

(ii) Calculate the pressure of the gas. *[3]*

(d) During this heating at constant volume and compression at constant temperature, 3500 J of work is done on the gas. How much energy does the gas lose to the surroundings during this change? *[1]*

6. N02 H2: B4p1

A satellite of mass m is in a circular orbit about the Earth. The satellite is at a height of a few hundred kilometres above the surface of the Earth and the radius of the Earth is 6.4×10^3 km.



(a) On the diagram above, draw vectors representing the force(s) acting on the satellite when it is at the points A, B and C of its orbit. *[2]*

(b) Explain why, provided that the satellite is only a few hundred kilometres above the surface of the Earth, the gravitational force acting on the satellite can be estimated as mg, where g is the gravitational field strength at the surface of the Earth. *[3]*

(c) Show that the orbital period of the satellite is about 84 min. *[6]*

(d) Show that for any satellite in an orbit of radius R measured from the centre of the Earth

$$\frac{R^3}{T^2} = \text{constant}$$

where T is the orbital period of the satellite. *[5]*

(e) A geostationary satellite is one that orbits the Earth with a period equal to the period of rotation of the Earth about its axis. Calculate the orbital radius of such a satellite in terms of R_E, the radius of the Earth. *[3]*