

2IB Physics HL only. Test 29-5-2008 TM – *include working!*

MC-problems count 2 marks each. Total marks for HL paper: 14+26 = 40.

1. M02 S1: 3

The orbital periods T of planets in the solar system are related to their mean distances r from the Sun by

$$T^2 = k r^3 \text{ where } k \text{ is a constant.}$$

What variables should be plotted in order to get a straight line graph?

- A. T^2 versus r^3
- B. T^2 versus r
- C. T versus r
- D. T versus r^3

2. M02 H1: 2

The orbital periods T of planets in the solar system are related to their mean distances r from the Sun by

$$T^2 = k r^3 \text{ where } k \text{ is a constant.}$$

If $\log T$ is plotted against $\log r$, the slope of the graph will be

- A. $\frac{3}{2}$.
- B. 2.
- C. 3.
- D. $\frac{2}{3}$.

3. M02 H1: 17

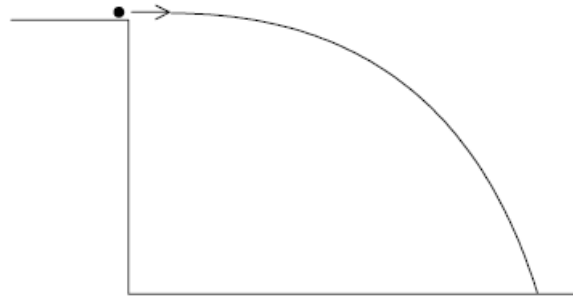
When a gas is compressed adiabatically, the work done on the gas is

- A. zero.
- B. less than the change in internal energy, but not zero.
- C. equal to the change in internal energy.
- D. greater than the change in internal energy.

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4. M02 S1: 7

A projectile is launched horizontally from a cliff and eventually hits the ground below. Assume air resistance is negligible.



How do the downward and horizontal components of the projectile's velocity behave during the motion?

	Downward component	Horizontal component
A.	increases	increases
B.	increases	remains constant
C.	remains constant	increases
D.	remains constant	remains constant

5. M02 H1: 14

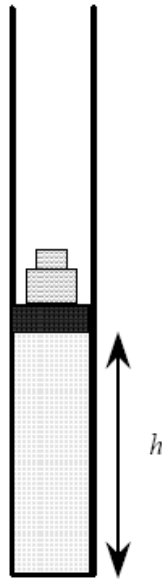
The planet Uranus has a diameter about four times that of the Earth and is about fifteen times more massive than the Earth. Which of the following gives the best approximate value for the acceleration due to gravity near the surface of Uranus?

- A. 2 m s^{-1}
- B. 9 m s^{-2}
- C. 36 m s^{-2}
- D. 150 m s^{-2}

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6. M02 S1: 14, H1: 16

A gas is in a vertical cylinder fitted with a piston. Weights are placed on the piston. When the gas is at 27°C the piston is in equilibrium at height h above the base of the cylinder as shown below.

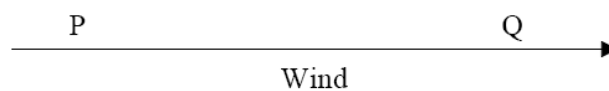


To what value should the gas temperature be increased for the piston to be in equilibrium at a height $2h$ above the base?

- A. 54°C
- B. 150°C
- C. 327°C
- D. 600°C

7. M02 H1: 23

A strong wind is blowing in the direction P to Q as shown, at less than the speed of sound.



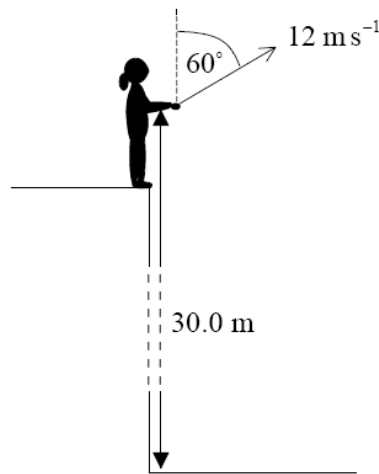
A whistle at Q emits sound of frequency f . Which of the following will be true for a listener at point P?

- A. No sound will be heard.
- B. The sound heard will have frequency less than f .
- C. The sound heard will have frequency f .
- D. The sound heard will have frequency greater than f .

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8. M02 H2: A2. Marks: 11.

- (a) A girl stands on the edge of a vertical cliff and throws a stone upwards at an angle of 60° to the vertical such that the stone eventually lands in the sea below. The stone leaves her hand with a speed of 12 m s^{-1} at a height of 30.0 m above the sea.



Taking the acceleration due to gravity to be 10 m s^{-2} and ignoring air resistance determine

- (i) the maximum height, measured from sea-level, reached by the stone. [4]
- (ii) the **speed** with which the stone hits the sea. [5]
- (b) In the space provided below sketch, using the same axes, graphs to show how the horizontal and the vertical components of velocity of the stone vary with **time** from the moment it leaves her hand to just before it hits the sea. (*Note that this is a sketch graph; you do not need to add values to the axes.*) [2]
- (Graph here or on your own answering paper)

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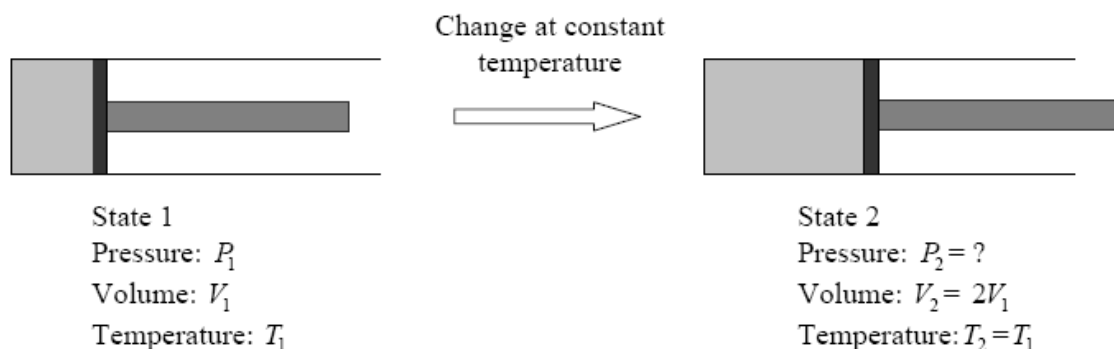
9. N02 S2: B2p1, (H2: B1p1). Marks: 15.

This question is about pressure, volume and temperature changes of an ideal gas.

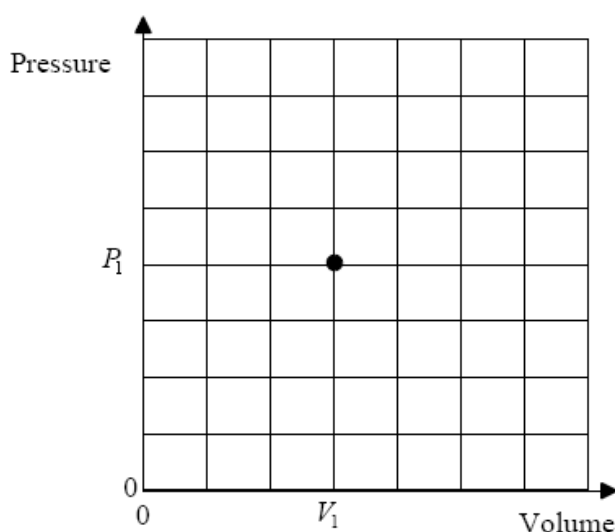
An ideal gas is enclosed in a cylinder fitted with a moveable piston. The gas undergoes two processes, as follows:

First process:

The gas, initially in state 1, is **expanded at constant temperature** T_1 until its volume is doubled. This is state 2. The two states are represented in the diagram below.



- (a) Using the axes below, sketch a graph to show how **pressure** and **volume** are related for this process. The data point for state 1 is shown plotted. Label the state reached as state 2. [2]

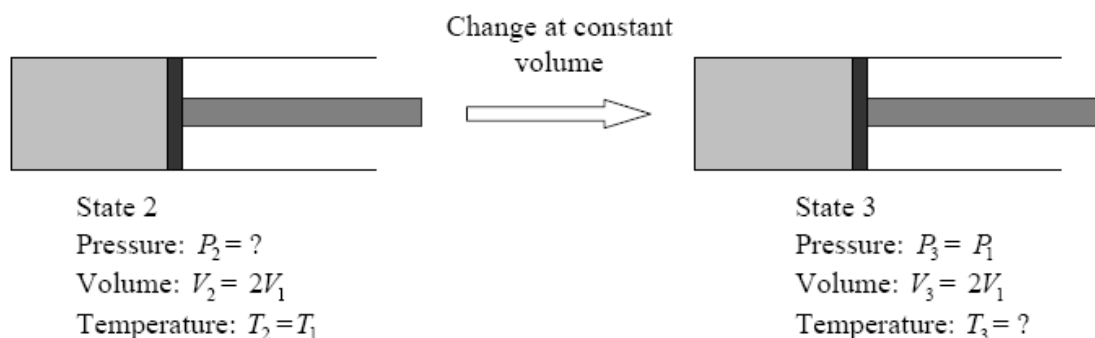


- (b) Explain in terms of motions of the gas molecules, why the pressure decreases when the volume increases. [2]
- (c) Explain whether or not the average kinetic energy of the molecules of the gas changes in the process. [2]

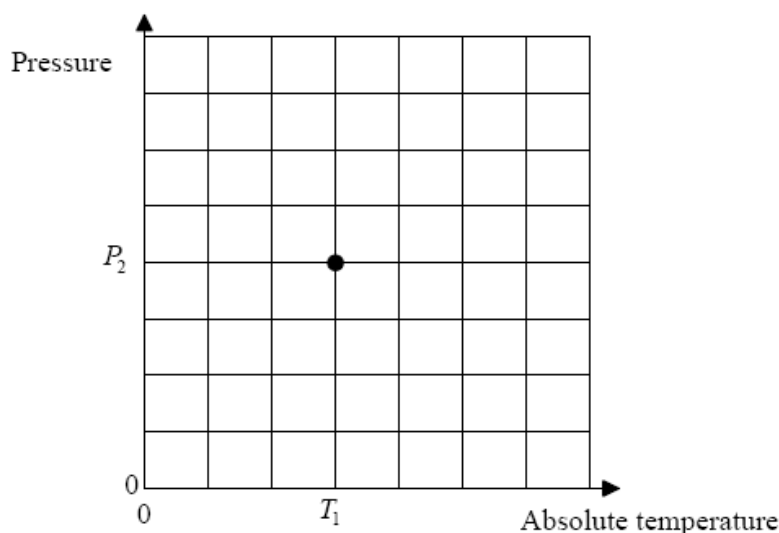
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Second process:

The piston is now kept fixed, and the gas is heated until the pressure returns to its original value P_1 . This is state 3 and is represented in the diagram below.



- (d) Using the axes below sketch a graph to show how **pressure** varies with **absolute temperature** for this process. The data point for state 2 is shown plotted. Label the state reached as state 3. [2]



- (e) Explain in terms of the motions of the gas molecules, why the pressure increases when the gas is heated. [3]
- (f) Explain whether or not the average kinetic energy of the gas molecules changes in this process. [1]
- (g) If the initial temperature of the gas in state 1 is 20°C , determine the final temperature of the gas in state 3, after both processes. [3]