Name: ____

Edexcel_Gas_laws

Questions

Date:

Time:

Total marks available:

Total marks achieved: ______

Questions

Q1.

A sample of an ideal gas at 27 °C is placed in a sealed container. The gas is heated at constant volume to a temperature of 324 °C.
The ratio of the final pressure to the initial pressure exerted by the gas is approximately

☐ **A** 1

☐ **B** 2

☐ **C** 4

☐ **D** 12

(Total for question = 1 mark)

Q2.

The average kinetic energy of the molecules in an ideal gas is

☐ **A** directly proportional to the square root of the absolute temperature.

☐ **B** directly proportional to the absolute temperature.

☐ **C** independent of the absolute temperature.

☐ **D** inversely proportional to the absolute temperature.

(Total for question = 1 mark)

Q3.

When an ideal gas reaches the absolute zero of temperature, the gas

☐ **A** becomes a superfluid.

☐ **B** condenses to a liquid.

☐ **C** has maximum molecular potential energy.

☐ **D** exerts no pressure.

(Total for question = 1 mark)

Q4. Air is a mixture of mostly nitrogen and oxygen molecules. The mass of an oxygen molecule is slightly greater than the mass of a nitrogen molecule.

On average, in a sample of air at a given temperature

☒ **A** the nitrogen and oxygen molecules have the same speed.

☒ **B** the nitrogen molecules are travelling more slowly than the oxygen molecules.

☒ **C** the oxygen molecules are travelling more slowly than the nitrogen molecules.

☒ **D** the molecules have relative speeds that depend upon the amount of each gas present.

(Total for Question = 1 mark)

Q5.

When the absolute temperature of an ideal gas is doubled, the internal energy of the gas changes by a factor of

☒ **A** 1

☒ **B** $\sqrt{2}$

☒ **C** 2

☒ **D** 4

(Total for question = 1 mark)

Q6.

A gas cylinder of volume 0.052 m^3 contains oxygen gas at a temperature of 22°C and a pressure of 2.0×10^5 Pa.
Some of the oxygen in the cylinder is used and the gas pressure falls to 1.6×10^5 Pa.

The temperature remains constant.

Calculate the number of molecules removed from the cylinder

(3)

....

....

....

....

Number of molecules removed = ...

(Total for question = 3 marks)

Q7.

Barnard's star is a red dwarf star in the vicinity of the Sun. The wavelength of a line in the spectrum of light emitted from Barnard's star is measured to be 656.0 nm. The same light produced by a source in a laboratory has a wavelength of 656.2 nm.

Visible light from the star originates from the photosphere. In the photosphere of Barnard's star, hydrogen and helium atoms are at a temperature of 3100 K.

(i) Calculate the mean kinetic energy of an atom in the photosphere at a temperature of 3100 K.

(2)

....

....

....

....

Mean kinetic energy = ...

(ii) Describe how these atoms emit visible light.

(2)

....

....

....

....

....

....

(Total for question = 4 marks)

Q8.

A student carries out an experiment to investigate how the volume occupied by a gas depends upon the temperature.

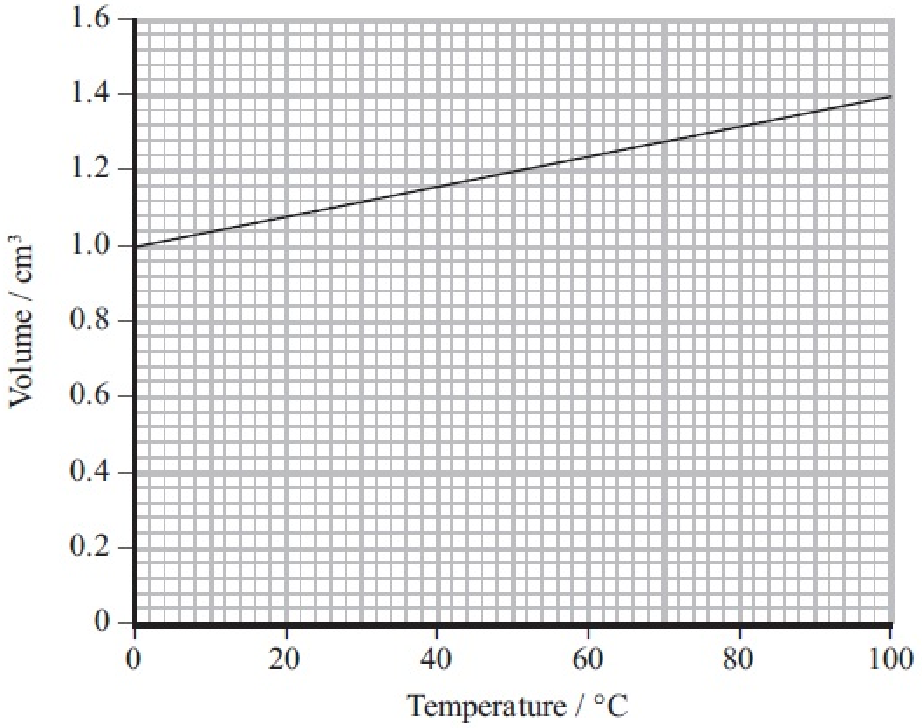
(a) What variables must the student control in this investigation?

(2)

....

....

(b) The following graph is obtained.



Explain how graphs such as this provide evidence for an absolute zero of temperature.

(2)

....

....

....

....

....

(Total for question = 4 marks)

Q9.

A bicycle tyre contains air at 20 °C. The volume occupied by the air is 2.9×10^{-4} m^3. Assume that this volume remains fixed.

(a) The pressure of the air in the tyre is 5.8×10^5 Pa. In an attempt to improve performance air is pumped into the tyre until the pressure at 20 °C is 6.5×10^5 Pa.

Calculate the number of air molecules that must be pumped into the tyre.

(3)

....

....

....

....

....

....

Number of molecules = ...

(b) After cycling in a race the air pressure in the tyre has risen from 6.5×10^5 Pa to 6.8×10^5 Pa.

Calculate the increase in temperature of the air in the tyre.

(3)

....

....

....

....

....

Increase in temperature = ...

(c) Explain why the pressure increases when the air is heated in a tyre of fixed volume.

(3)

....

....

....

....

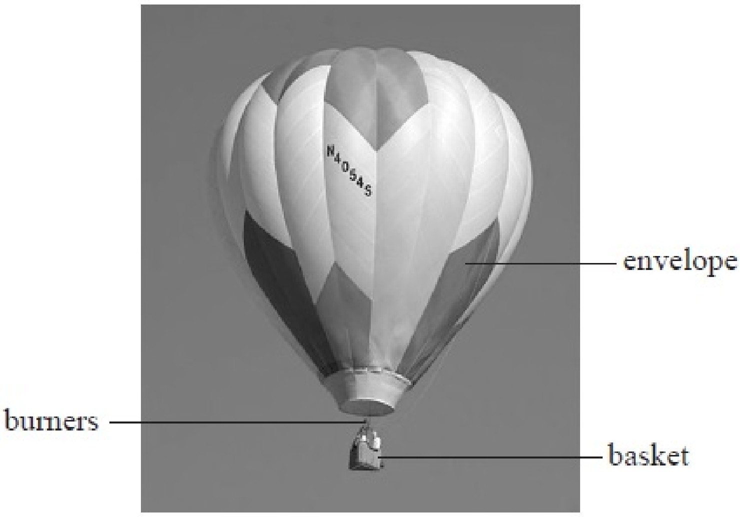
....

....

(Total for question = 9 marks)

Q10.

Hot air ballooning is one way to explore the landscape. Air in a balloon is heated from underneath by a set of burners and the balloon starts to rise.



(a) Explain why heating the air causes the balloon to rise.

(2)

....

....

....

....

(b) In 1991, Per Lindstrand and Richard Branson become the first people to cross the Pacific in a hot air balloon.

With a volume of 7.4×10^4 m^3 the balloon was, at the time, the largest ever built.

Calculate the energy supplied by the burners to heat the air from 20.0 °C to 35.0 °C.

average density of air in the balloon = 1.20 kg m^{-3}

specific heat capacity of air = 1010 J kg^{-1} K^{-1}

(3)

....

....

....

....

....

....

Energy = ...

(c) The first balloons used were filled with hydrogen and sealed to keep the volume constant. As the balloon rose there would be changes in the pressure of the hydrogen due to the temperature changes of the atmosphere.

(i) Calculate the new pressure exerted by the hydrogen if the temperature changed from 20.0 °C to −5.0 °C, as the balloon rose from ground level.

pressure exerted by the hydrogen in the balloon at ground level = 1.01×10^5 Pa

(2)

....

....

....

....

New pressure = ...

(ii) State **two** assumptions that you must make to calculate this change.

(2)

....

....

....

....

*(iii) By considering the motion of molecules in the gas, explain why the pressure exerted by the gas decreases as it cools.

(3)

....

....

....

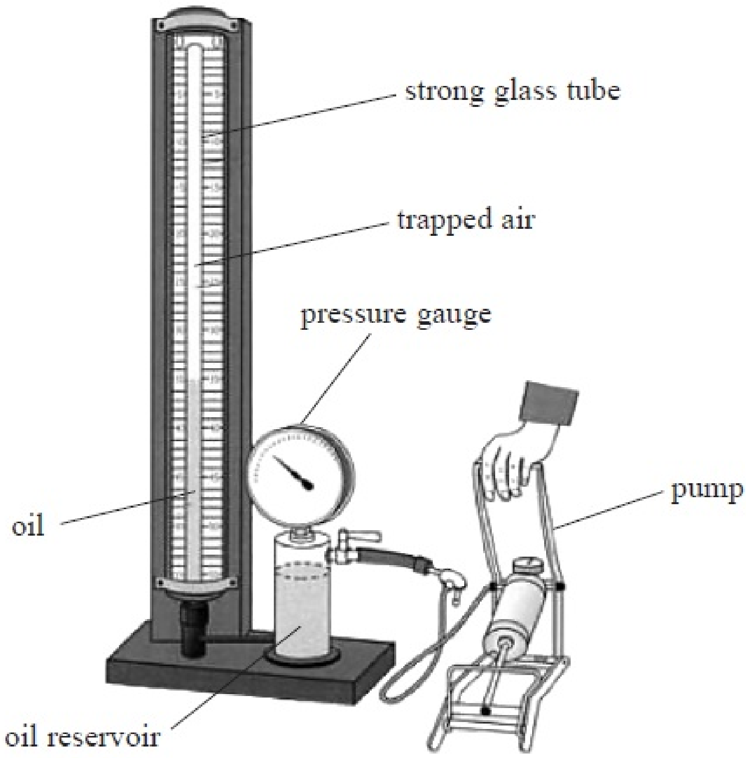
....

....

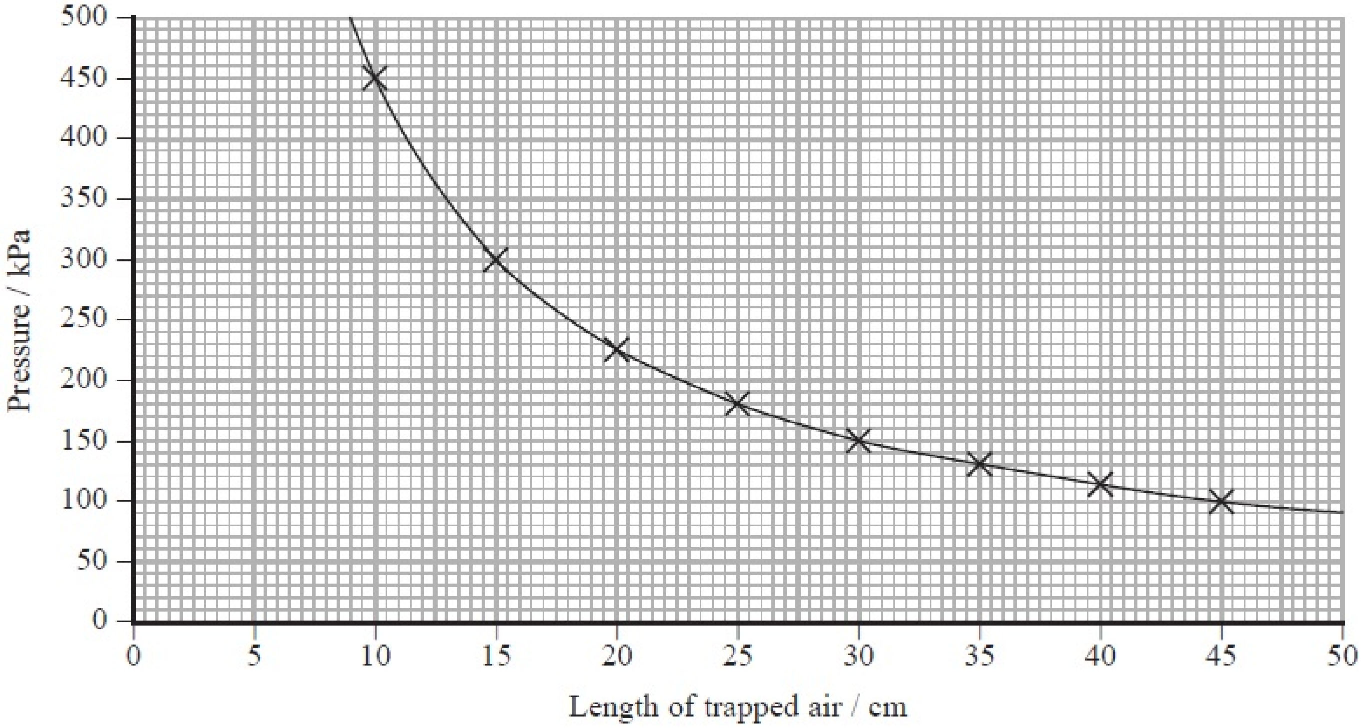
....

(Total for Question = 12 marks)

Q11. A student uses the apparatus shown to investigate the relationship between pressure and volume of a gas.



Air is trapped in a glass tube of uniform cross-sectional area. As the pressure of the trapped air is increased, the length of trapped air decreases. The student collects data and plots the following graph.



(a) State the variables that should be controlled in this investigation.

(2)

....

....

....

....

(b) Theory suggests that, for the air trapped in the tube, the pressure *p* is inversely proportional to the volume *V*.

Use the graph to show that this relationship is correct. State an assumption that you are making.

(4)

....

....

....

....

....

....

....

....

(c) the day that the investigation was carried out, the temperature in the laboratory was 20 °C.

Calculate the number of air molecules trapped in the tube.

cross-sectional area of tube = 7.5×10^{-5} m^2

(3)

....

....

....

....

....

....

....

Number of air molecules = ...

(d) State how the graph would change if

(i) the air molecules in the tube were replaced by the same number of molecules of hydrogen gas.

(1)

....

....

(ii) the temperature of the laboratory was substantially higher.

(2)

....

....

....

....

(Total for Question = 12 marks)