1 **(a)** A particular collision between two objects is *inelastic*. Place a tick (✓) at the end of each statement that applies to such a collision. **[2]**

Statement	
The magnitude of the impulse on each object is the same.	
Kinetic energy and momentum for the objects are conserved.	
Total energy is conserved.	
After the collision, the objects have the same momentum.	

(b) Fig. 1.1 shows a tennis ball before and after striking a wall at right angles.

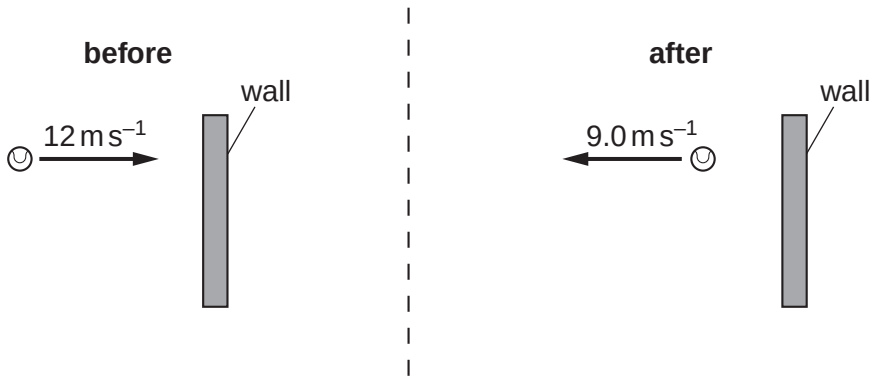

Fig. 1.1

The ball of mass 0.060 kg hits the wall at a speed of 12 m s^{-1}. The ball is in contact with the wall for 0.15 s. It rebounds with a speed of 9.0 m s^{-1}. Calculate

(i) the loss of kinetic energy during the collision

loss of kinetic energy = ... J **[2]**

(ii) the magnitude of the average force exerted on the ball by the wall

average force on ball = ... N **[2]**

(iii) the magnitude of the average force exerted on the wall by the ball during this collision.

average force on wall = ... N **[1]**

(c) (i) State **three** assumptions of the kinetic model of ideal gases.

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..... **[3]**

(ii) Use the kinetic theory of gases to explain how a gas exerts a pressure.

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..... **[3]**

[Total: 13]

2 A car of mass 970 kg is travelling at 27 m s^{-1} when the brakes are applied. The car is brought to rest in a distance of 40 m.

(a) **(i)** Calculate the kinetic energy of the car when it is travelling at 27 m s^{-1}.

kinetic energy = ... J **[1]**

(ii) Hence calculate the average braking force on the car stating any assumption that you make.

average braking force = ... N

assumption .....

..... **[3]**

(b) The car has four brake discs each of mass 1.2 kg. The material from which the discs are made has a specific heat capacity of 520 J kg^{-1} K^{-1}.

(i) Calculate the temperature rise of each disc after braking from a speed of 27 m s^{-1}. Assume all the kinetic energy of the car is converted into internal energy of the brake discs equally during braking.

temperature rise = ... °C **[2]**

(ii) State and explain **two** reasons why the actual temperature rise will be different.

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..... **[4]**

(iii) Suggest one modification to the design of the disc braking system that could reduce the temperature rise of the discs.

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..... **[1]**

[Total: 11]

3 **(a)** **(i)** State what is meant by a *perfectly elastic collision*.

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..... **[1]**

(ii) Explain, in terms of the behaviour of **molecules**, how a gas exerts a pressure on the walls of its container.

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..... **[4]**

(iii) Explain, in terms of the behaviour of **molecules**, why the pressure of a gas in a container of constant volume increases when the temperature of the gas is increased.

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..... **[2]**

(b) A weather balloon is filled with helium gas. Just before take-off the pressure inside the balloon is 105 kPa and its internal volume is $5.0 \times 10^3\,m^3$. The temperature inside the balloon is 20 °C. The pressure, volume and temperature of the helium gas change as the balloon rises into the upper atmosphere.

(i) The balloon expands to a volume of $1.2 \times 10^4\,m^3$ in the upper atmosphere where the temperature inside the balloon is –30° C. Calculate the pressure inside the balloon.

(ii) Suggest why it is necessary to release helium from the balloon as it continues to rise.

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..... **[1]**

[Total: 11]