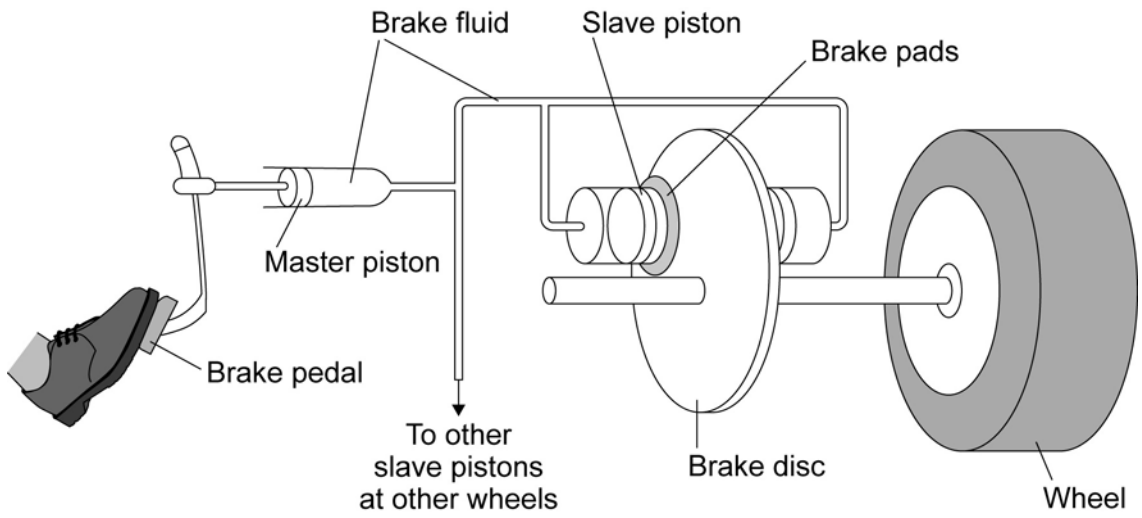
Do not write outside the box

5 (a) The diagram shows part of the hydraulic brake system for a car.



What property of a liquid is essential for a hydraulic brake system to work?

.....

(1 mark)

5 (b) Describe how a force exerted on the brake pedal leads to a force acting on each of the brake discs.

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(5 marks)

Do not write outside the box

5 (c) Applying the brakes of a car leads to an increase in the temperature of the brakes.

Explain why.

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(4 marks)

10

Turn over for the next question

Do not write outside the box

6 (a) **Table 1** gives some properties of alpha, beta and gamma radiation.

Table 1

Radiation	Range in air	Effect of a magnetic field
Alpha particle	.....	deflected a small amount
Beta particle	about 1m	deflected a lot
Gamma ray	unlimited	.....

6 (a) (i) Which **one** of the following describes an alpha particle?

Tick (✓) **one** box.

It is the same as the nucleus of a helium atom. ☐

It is an electron. ☐

It is a negative ion. ☐

(1 mark)

6 (a) (ii) Complete **Table 1** by adding the missing information.

(2 marks)

6 (b) **Table 2** gives information about four radioactive isotopes.

Table 2

Isotope	Type of radiation emitted	Half-life
iridium-192	gamma ray	74 days
polonium-210	alpha particle	138 days
polonium-213	alpha particle	less than 1 second
technetium-99	gamma ray	6 hours

Do not write outside the box

6 (b) Two isotopes of polonium are given in the table. In terms of particles in the nucleus:

6 (b) (i) how are these two isotopes the same

.....

(1 mark)

6 (b) (ii) how are these two isotopes different?

.....

(1 mark)

6 (c) To monitor the blood flow through a patient's heart, a doctor injects the patient with a very small dose of technetium-99. The gamma radiation detected outside of the patient's body allows the doctor to see if the heart is working correctly.

6 (c) (i) Explain why technetium-99 is more suitable for this use than polonium-210.

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(2 marks)

6 (c) (ii) Explain why technetium-99 is more suitable for this use than iridium-192.

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(2 marks)

6 (d) Technetium-99 (Tc) is produced by the beta decay (β) of an isotope of molybdenum (Mo).

The decay can be represented by the equation below.

Complete the equation by writing the correct number in each of the **two** boxes.

$$\square \quad \text{Mo} \longrightarrow {}^{99}_{43}\text{Tc} + {}^{0}_{-1}\beta$$

$$\square$$

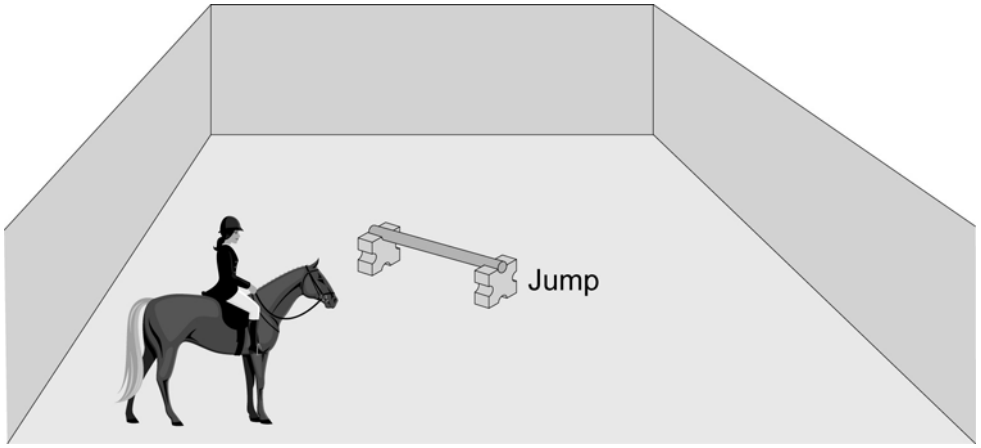
(2 marks)

11

Do not write outside the box

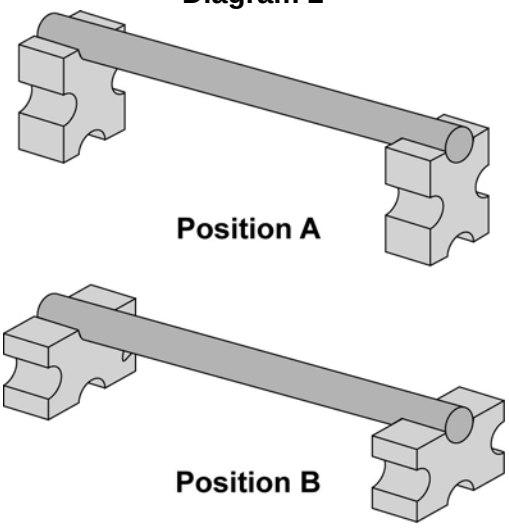
7 **Diagram 1** shows a horse rider in a jumping arena.

Diagram 1



The jump has a pole support that can be in either position **A** or position **B**, giving two different jumping heights, as shown in **Diagram 2**.

Diagram 2

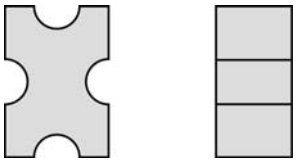


Do not write outside the box

7 (a) (i) **Diagram 3** shows a front and side view of the pole support in position **A**.

Draw an **X** on both views in **Diagram 3** so that the centre of the **X** is at the *centre of mass* of the pole support.

Diagram 3



Front View Side View

(1 mark)

7 (a) (ii) Explain why the pole support is more stable in position **B** than in position **A**.

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(2 marks)

Question 7 continues on the next page

Do not write outside the box

7 (b) The combined mass of the horse and rider is 480 kg. As they approach the jump they are moving at 4 m/s.

7 (b) (i) Calculate the kinetic energy, in joules, of the horse and rider as they approach the jump.

.....

.....

.....

.....

Kinetic energy = ... J

(2 marks)

7 (b) (ii) Calculate the **maximum** height, in metres, that the centre of mass of the horse and rider can be lifted off the ground when the horse approaches the jump at 4 m/s.

acceleration of free fall = 10 m/s^2

.....

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.....

.....

Maximum height = ... m

(3 marks)

8