Questions are for both separate science and combined science students unless indicated in the question

Q1.

A swimming pool is being filled with water. **(Physics only)**

(a) Calculate the weight of the water in the swimming pool when the mass of the water is 25 000 kg.

gravitational field strength = 9.8 N/kg

Use the equation:

weight = mass × gravitational field strength

Weight = _____ N

(2)

(b) When the swimming pool is full, the weight of the water is 1 960 000 N.

The bottom of the swimming pool has an area of 49 m^2.

Calculate the pressure at the bottom of the swimming pool when it is full.

Use the equation:

$$\text{pressure} = \frac{\text{weight}}{\text{area}}$$

Choose the unit from the box.

m^2	**m^3**	**N**	**Pa**

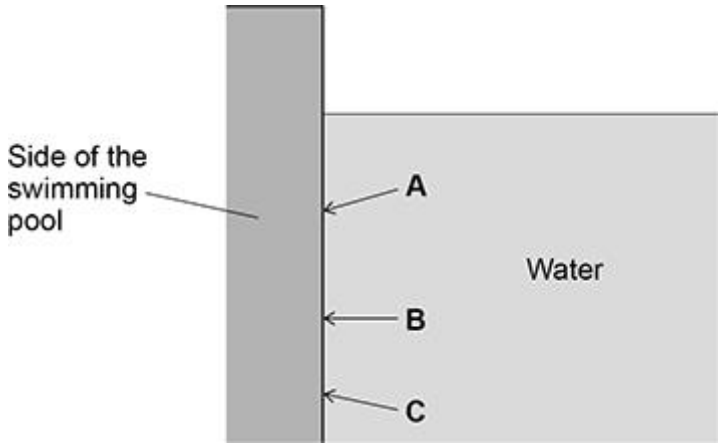
Pressure = _____ Unit _____

(3)

(c) There is a force acting on the side of the swimming pool because of the water pressure.

Figure 1 shows the side of the swimming pool.

Figure 1



Which arrow shows the direction of the force acting on the side of the swimming pool?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

(1)

(d) A child is swimming in the pool. The velocity of the child is 0.70 m/s.

The child then accelerates for 5.0 s, reaching a final velocity of 1.3 m/s.

Calculate the acceleration of the child.

Use the equation:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

_____

_____

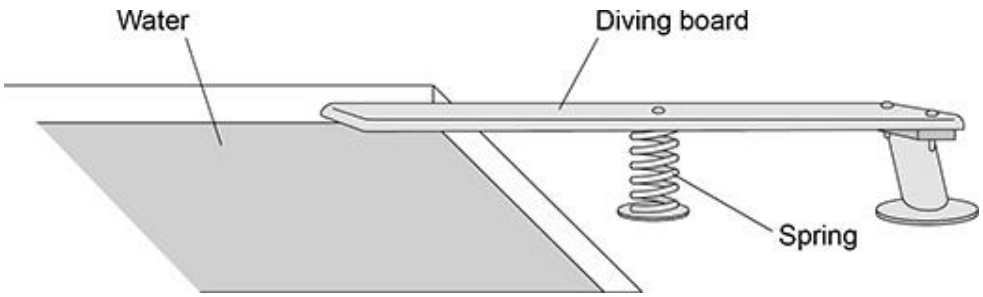
_____

Acceleration = _____ m/s^2

(2)

Figure 2 shows a diving board at the side of the swimming pool.

Figure 2



(e) The original length of the spring is 0.84 m.

When the child stands on the diving board, the length of the spring decreases by 0.21 m.

Calculate the percentage change in the length of the spring.

_____

_____

Percentage change in length = _____ %

(2)

Use the Physics Equations Sheet to answer parts (f) and (g).

(f) Write down the equation which links extension (*e*), force applied to a spring (*F*) and spring constant (*k*).

_____

(1)

(g) The force applied to the spring by the weight of the child is 336 N.

The change in length of the spring is 0.21 m.

Calculate the spring constant of the spring.

_____

_____

_____

_____

_____

Spring constant = _____ N/m

(3)

(h) The child steps off the diving board and falls into the swimming pool.

The initial velocity of the child is 0 m/s.

acceleration due to gravity = 9.8 m/s^2

Calculate the final velocity when the child has fallen a distance of 0.95 m through the air.

Give your answer to 2 significant figures.

Use the Physics Equations Sheet.

_____

_____

_____

_____

_____

_____

_____

Final velocity of child (2 significant figures) = _____ m/s

(4)

(Total 18 marks)

Q2.

Figure 1 shows a young child using a baby walker.

Figure 1

(a) The child is standing still.

What is the resultant **vertical** force on the child?

Give a reason for your answer.

Resultant vertical force = _____ N

Reason _____

_____

(2)

Use the Physics Equations Sheet to answer parts (b) and (c).

(b) Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

_____

(1)

(c) The child pushed the baby walker 2.8 m across a horizontal floor.

The work done by the child was 35 J.

Calculate the horizontal force the child applied to the baby walker.

_____

_____

_____

_____

Horizontal force = _____ N

(3)

(d) The child pushed the baby walker from a carpet onto a hard floor.

The child applied the same horizontal force to the baby walker.

Explain why the speed of the baby walker increased.

_____

_____

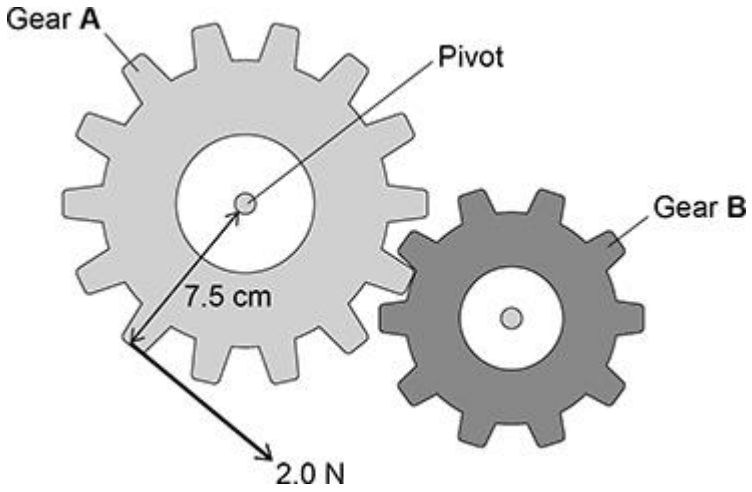
_____

(2)

There are some toy gears on the front of the baby walker.

Figure 2 shows the gears. **(Physics only)**

Figure 2



The child applies a force to gear **A**.

This causes a moment about the pivot, so gear **A** rotates.

Use the Physics Equations Sheet to answer parts (e) and (f).

(e) Write down the equation which links distance (*d*), force (*F*) and moment of a force (*M*).

_____

(1)

(f) The child applies a force of 2.0 N on gear **A**.

The perpendicular distance between the force and the pivot is 7.5 cm.

Calculate the moment of the force about the pivot.

_____

_____

_____

_____

_____

Moment of force = _____ N m

(3)

(g) Explain what happens to gear **B** when the child applies the force to gear **A**.

_____

_____

_____

_____

(2)

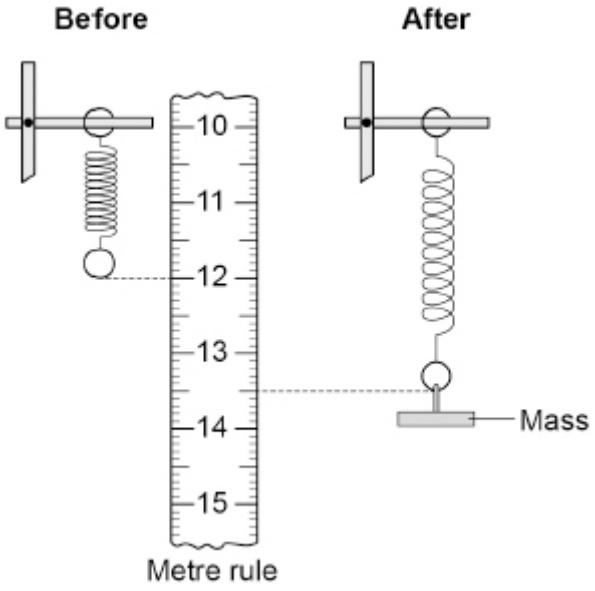
(Total 14 marks)

Q3.

A student carried out an investigation to determine the spring constant of a spring.

Figure 1 shows the spring before and after a mass was hung from the end of the spring.

Figure 1



(a) What is the extension of the spring in **Figure 1**?

Tick (✓) **one** box.

1.5 cm ☐

3.5 cm ☐

13.5 cm ☐

(1)

(b) Give **one** safety precaution the student should have taken during this investigation.

_____

_____

(1)

(c) The student hung a mass of 0.050 kg from the spring.

gravitational field strength = 9.8 N/kg

Calculate the weight of the 0.050 kg mass.

Use the equation:

weight = mass × gravitational field strength

_____

_____

Weight = _____ N

(2)

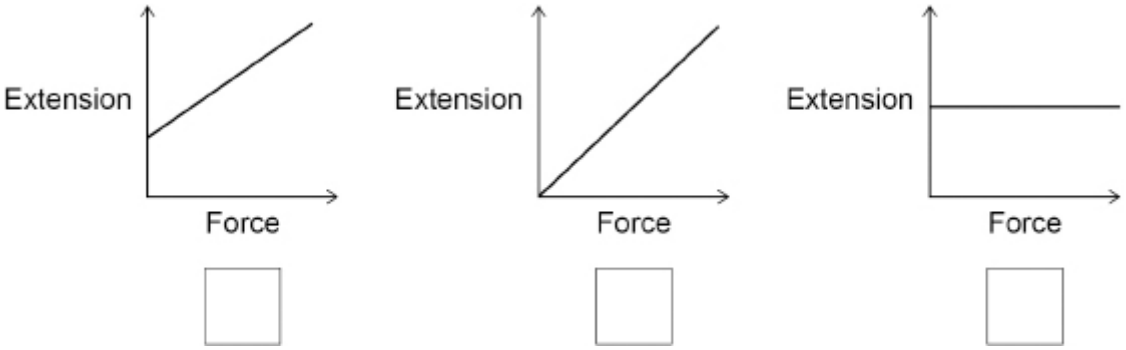
(d) The weight of the mass applies a force to the spring.

The student added more masses and recorded the extension of the spring.

Which graph in **Figure 2** shows the relationship between the force applied to the spring and the extension of the spring?

Tick (✓) **one** box.

Figure 2



(1)

(e) A force of 2.0 N was applied to a different spring.

The extension of the spring was 0.080 m.

Calculate the spring constant of the spring.

Use the equation:

$$\text{spring constant} = \frac{\text{force}}{\text{extension}}$$

_____

_____

_____

Spring constant = _____ N/m

(2)

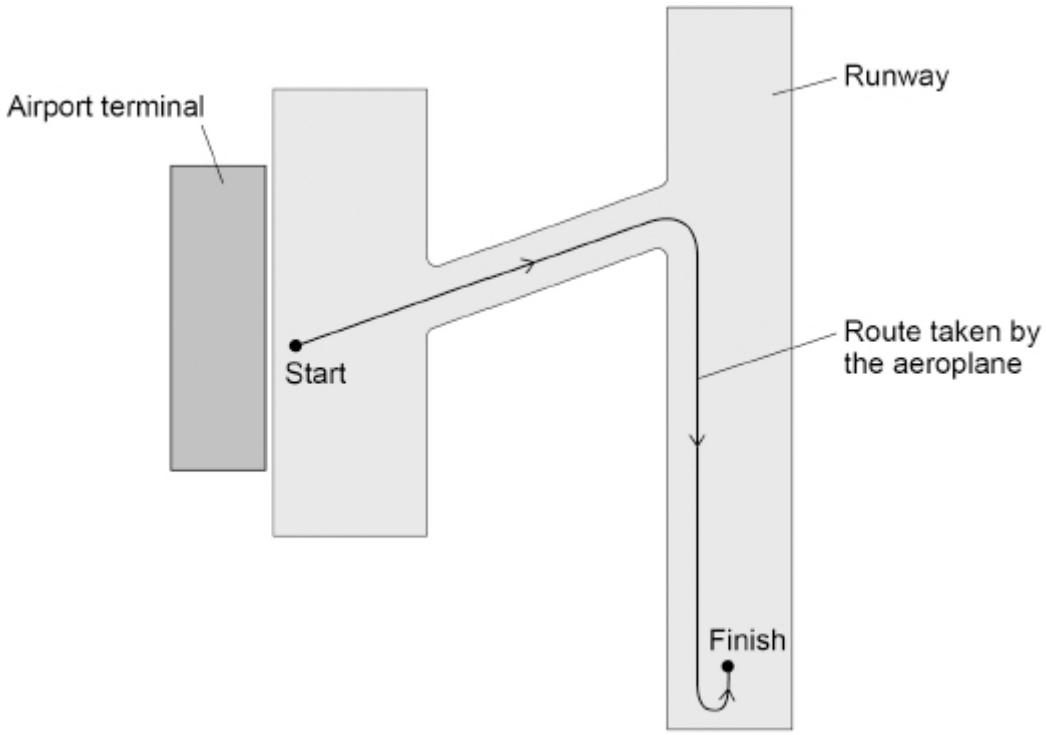
(Total 7 marks)

Q4.

Figure 1 shows the route an aeroplane takes as it travels from an airport terminal to the runway.

Figure 1 has been drawn to scale.

Figure 1



(a) Determine the magnitude of the aeroplane's displacement from the start point to the finish point on **Figure 1**.

_____

_____

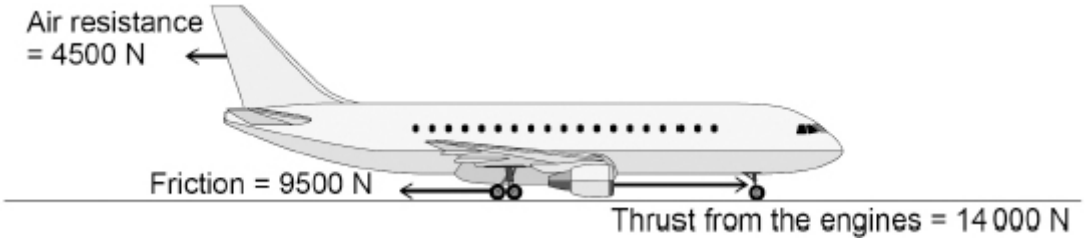
_____

Displacement = _____ m

(2)

Figure 2 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

Figure 2



(b) Determine the magnitude of the resultant horizontal force on the aeroplane.

_____

_____

Resultant horizontal force = _____ N

(1)

(c) Describe the motion of the aeroplane as it moves towards the runway.

_____

_____

(1)

(d) Air resistance and friction are contact forces.

Give **one** other example of a contact force.

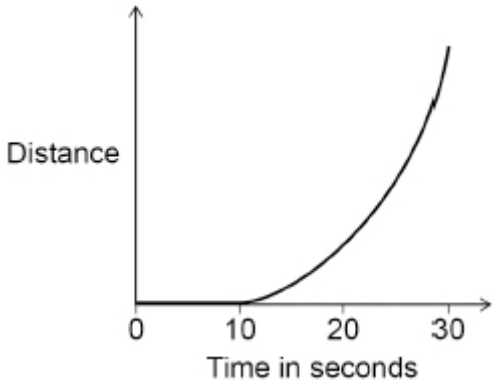
_____

(1)

(e) The aeroplane stops for a short time and then accelerates along the runway.

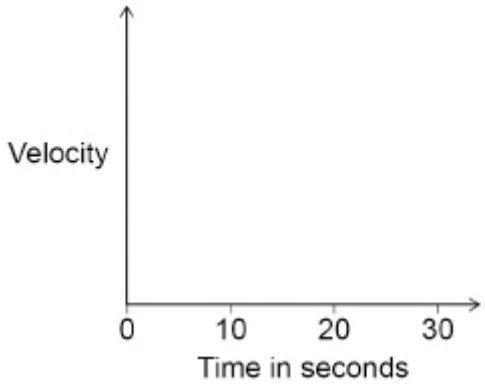
Figure 3 shows a distance–time sketch-graph for this stage of the journey.

Figure 3



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 4**.

Figure 4



(2)

(Total 7 marks)

Q5.

Hailstones are small balls of ice. Hailstones form in clouds and fall to the ground.

Figure 1 shows different-sized hailstones.

Figure 1

(a) Which force causes the hailstones to fall to the ground?

Tick (✓) **one** box.

- Air resistance ☐
- Gravitational force ☐
- Magnetic force ☐
- Tension ☐

(1)

(b) As the hailstones begin to fall they accelerate.
Which force increases as the hailstones accelerate?

Tick (✓) **one** box.

- Air resistance ☐
- Gravitational force ☐
- Magnetic force ☐
- Tension ☐

(1)

(c) After a short time hailstones fall at terminal velocity.

Which of the following statements is true at terminal velocity?

Tick (✓) **one** box.

The hailstones begin to slow down. ☐

The mass of the hailstones increases. ☐

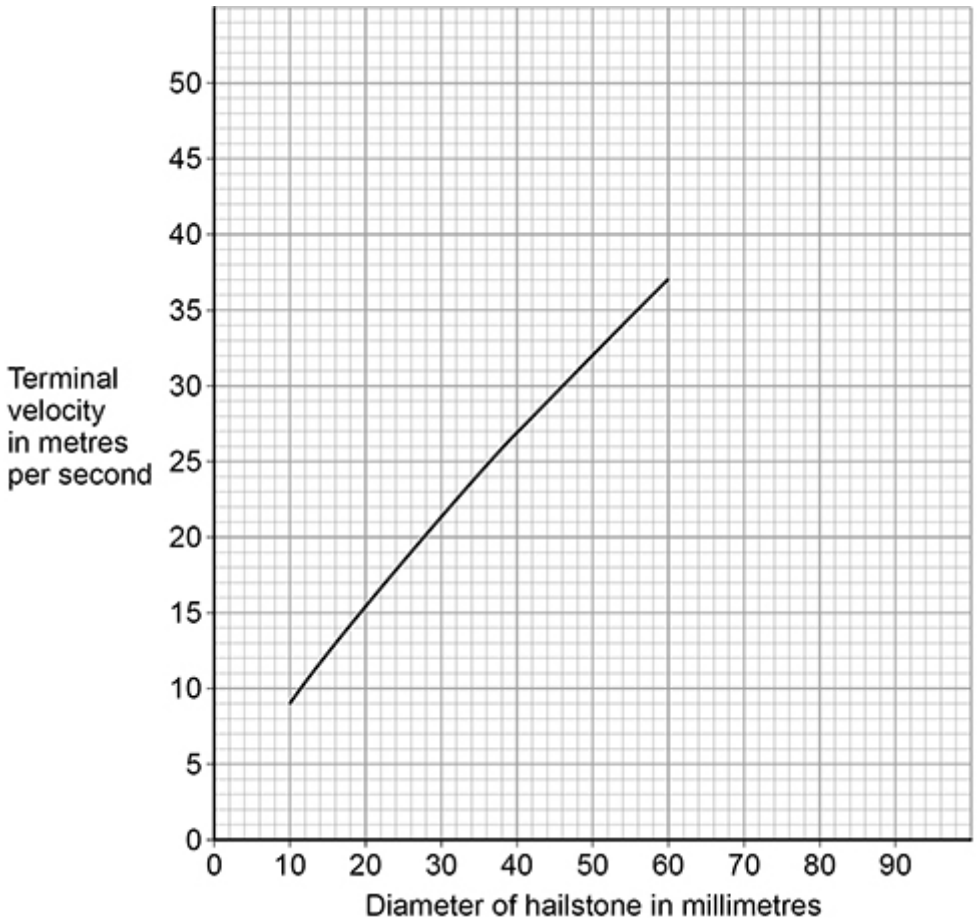
The resultant force on the hailstones is zero. ☐

(1)

A scientist investigated how the terminal velocity of hailstones varies with their diameter.

Figure 2 shows the results.

Figure 2



(d) Estimate the terminal velocity for a hailstone with a diameter of 80 mm.

Show how you obtain your answer.

_____

_____

_____

Terminal velocity = _____ m/s

(2)

(e) Give **one** reason why a hailstone with a large diameter has a greater terminal velocity than a hailstone with a smaller diameter.

Tick (✓) **one** box.

It has a greater power. ☐

It has a greater pressure. ☐

It has a greater temperature. ☐

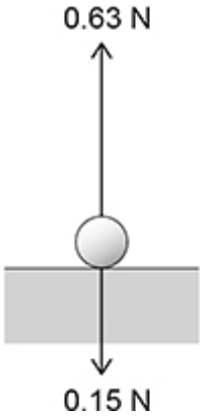
It has a greater weight. ☐

(1)

After falling, the hailstone hits the ground.

Figure 3 shows the forces acting on the hailstone at the moment it hits the ground.

Figure 3



(f) What is the magnitude of the resultant force on the hailstone in **Figure 3**?

Tick (✓) **one** box.

0.15 N ☐

0.48 N ☐

0.63 N ☐

0.78 N ☐

(1)

(g) What is the direction of the resultant force on the hailstone in **Figure 3**?

_____

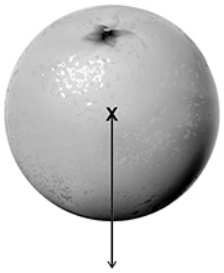
(1)

(Total 8 marks)

Q6.

Figure 1 shows the weight of an orange acting from a point labelled **X**.

Figure 1



(a) What name is given to point **X** in **Figure 1**?

Tick (✓) **one** box.

Centre of force ☐

Centre of mass ☐

Centre of balance ☐

Centre of weight ☐

(1)

(b) Weight and mass are not the same.

The relationship between weight and mass for an object can be written as:

$$\text{weight} \propto \text{mass}$$

Which sentence describes the relationship between weight and mass?

Tick (✓) **one** box.

Weight is approximately equal to mass. ☐

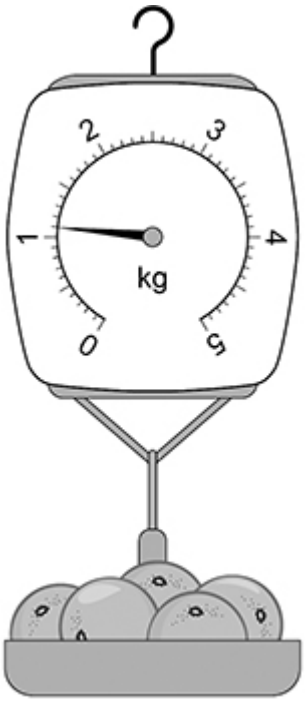
Weight is directly proportional to mass. ☐

Weight is less than mass. ☐

(1)

Figure 2 shows a balance used to measure the mass of 5 oranges.

Figure 2



(c) All 5 of the oranges have the same mass.

Determine the mass of 1 orange.

_____

Mass = _____ kg

(2)

(d) Calculate the weight of 1 orange.

gravitational field strength = 9.8 N/kg

Use the equation:

weight = mass × gravitational field strength

_____

_____

_____

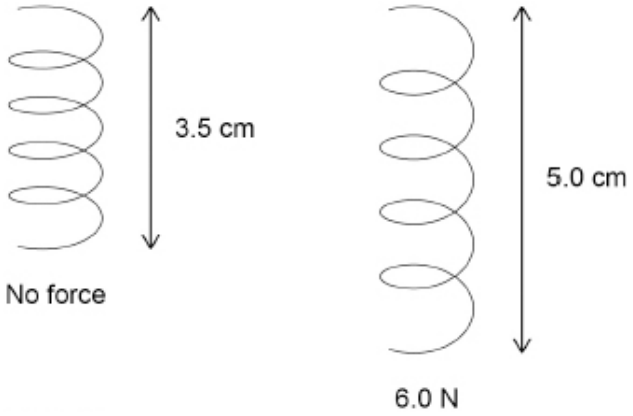
Weight = _____ N

(2)

The balance shown in **Figure 2** contains a spring.

Figure 3 shows the spring with no force acting on it and with a force of 6.0 N acting on it.

Figure 3



(e) What is the extension of the spring when a force of 6.0 N acts on it?

Tick (✓) **one** box.

0.015 m ☐

0.035 m ☐

0.050 m ☐

0.085 m ☐

(1)

(f) Calculate the spring constant of the spring.

Use the equation:

$$\text{spring constant} = \frac{\text{force}}{\text{extension}}$$

_____

_____

_____

Spring constant = _____ N/m

(2)

(g) What will happen to the spring when the force is removed?

_____

_____

(1)

(Total 10 marks)