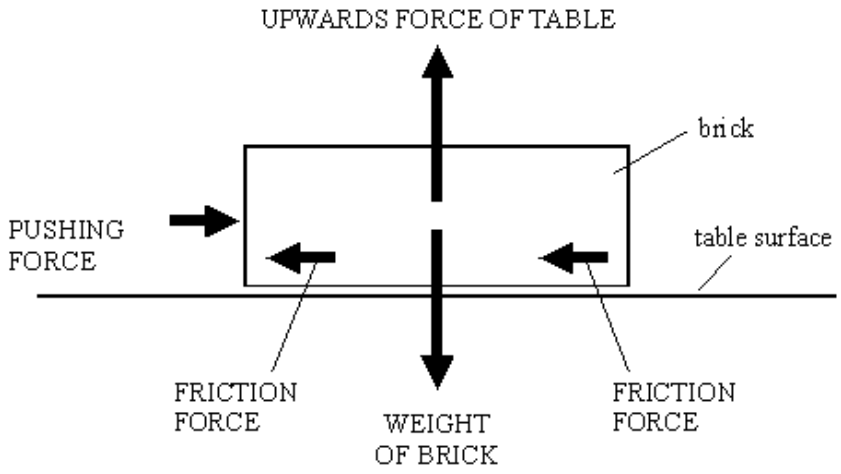
Q1. The brick shown in the diagram is being pushed but it is **not** moving.



(a) The pushing force does **not** make the brick move. Explain why.

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(1)

(b) The weight of the brick does **not** make it move downwards. Explain why.

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(1)

(c) A bigger pushing force **does** make the brick slide across the table.
Write down **one** thing that the sliding brick will do to the surface of the table.

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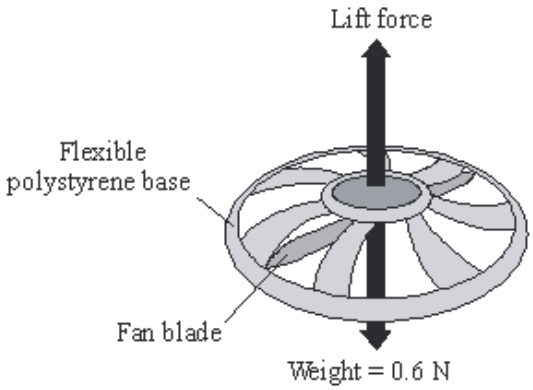
(1)

(Total 3 marks)

Q2. The diagram shows a small, radio-controlled, flying toy. A fan inside the toy pushes air downwards creating the lift force on the toy.



When the toy is hovering in mid-air, the fan is pushing 1.5 kg of air downwards every 10 seconds. Before the toy is switched on, the air is stationary.

(a) Use the equations in the box to calculate the velocity of the air when the toy is hovering.

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

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Velocity = ... m/s

(3)

(b) Explain why the toy accelerates upwards when the fan rotates faster.

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(2)

(c) The toy is not easy to control so it often falls to the ground.

Explain how the flexible polystyrene base helps to protect the toy from being damaged when it crashes into the ground.

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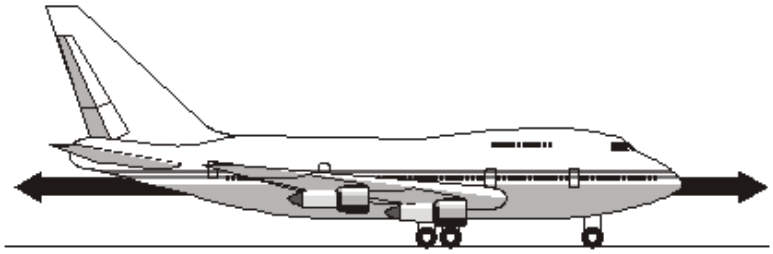
(3)
(Total 8 marks)

Q3. (a) The diagram shows an aircraft and the horizontal forces acting on it as it moves along a runway. The *resultant force* on the aircraft is zero.



(i) What is meant by the term *resultant force*?

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(1)

(ii) Describe the movement of the aircraft when the resultant force is zero.

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.....

(1)

(b) The aircraft has a take-off mass of 320 000 kg. Each of the 4 engines can produce a maximum force of 240 kN.

Use the equation in the box to calculate the maximum acceleration of the aircraft.

resultant force = mass × acceleration

Show clearly how you work out your answer and give the unit.

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Acceleration = ...

(3)

(c) As the aircraft moves along the runway to take off, its acceleration decreases even though the force from the engines is constant.

Explain why.

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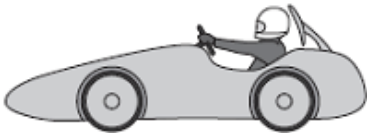
(2)

(Total 7 marks)

Q4. (a) Some students have designed and built an electric-powered go-kart. After testing, the students decided to make changes to the design of their go-kart.

First design **X**

Final design **Y**



The go-kart always had the same mass and used the same motor.

The change in shape from the first design (**X**) to the final design (**Y**) will affect the top speed of the go-kart.

Explain why.

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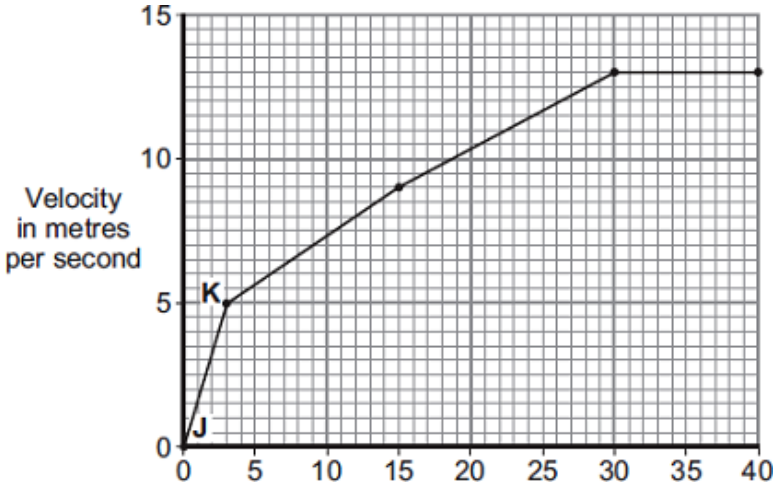
(3)

(b) The final design go-kart, **Y**, is entered into a race.

The graph shows how the velocity of the go-kart changes during the first 40 seconds of the race.



(i) Use the graph to calculate the acceleration of the go-kart between points **J** and **K**.

Give your answer to **two** significant figures.

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Acceleration = ... m/s^2

(2)

(ii) Use the graph to calculate the distance the go-kart travels between points **J** and **K**.

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Distance = ... m

(2)

(iii) What causes most of the resistive forces acting on the go-kart?

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(1)

(Total 8 marks)