Solution 1

(10 marks)

(a)   Draw a free body diagram for M_1.   (3 marks)

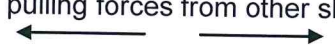| Description	Marks
Force drawn towards the centre of the circle (left)	1
2 forces drawn in opposite direction	1
F_1 is larger than F_2	1
Total	**3**

(b)   Complete the following for M_1 and M_2.

(i)   Write an appropriate expression for the tangential velocity v_1 of M_1 in terms of R_1, R_2 and T.   (2 marks)

Description	Marks
$v = s/t = (2\pi R / T)$	1
$v_1 = (2\pi R_1 / T)$	1
Total	**2**

Solution 2

(3 marks)

Use the stick figure below to draw a free body diagram which clearly shows the forces acting on skater C.

Description	Marks
One or more horizontal forces e.g, pulling forces from other skaters	1
one or more vertical forces e.g. normal and gravitational	1
Zero resultant forces (e.g. magnitudes cancel)	1
Total	**3**

Solution 3

(12 marks)

(a)   Show that the mass of the aircraft must be 1.00×10^4 kg.   (3 marks)

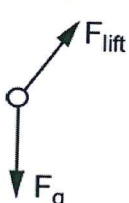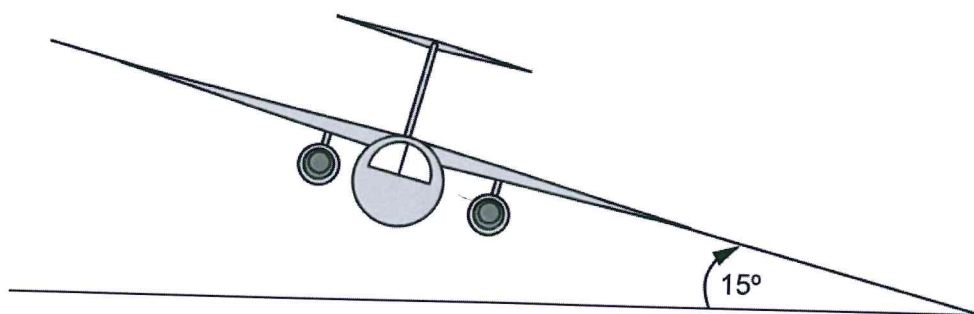| Description	Marks
For the plane to be in level flight, forces need to be balanced $F_{up}=F_g=mg$	1–2
$m=F/g=98000/9.8$ $m=10\ 000$ kg	1
Total	**3**

(b)   The pilot begins a turn by tilting the aircraft so that its wings are at 15.0° to the horizontal as shown. Assume that the airspeed does not change, and that the size and angle to the wing of the lift force remain constant.


15°

Draw a free body diagram below labelling the forces acting on the aircraft. Ignore drag/friction and thrust forces directed into and out of the page.   (2 marks)

Description	Marks
F_{lift} F_g F_{lift} drawn same size as F_g (approximately) Only two forces drawn	1
F_g drawn downwards; F_{lift} drawn perpendicular to wings	1
Total	2

Solution 4
(4 marks)

The photograph below shows a cat called Hamish accelerating to catch a feather blowing in the wind. At this point, Hamish has one foot in contact with the ground. Draw vector arrows of the appropriate length on the photograph to show clearly the forces acting on Hamish.
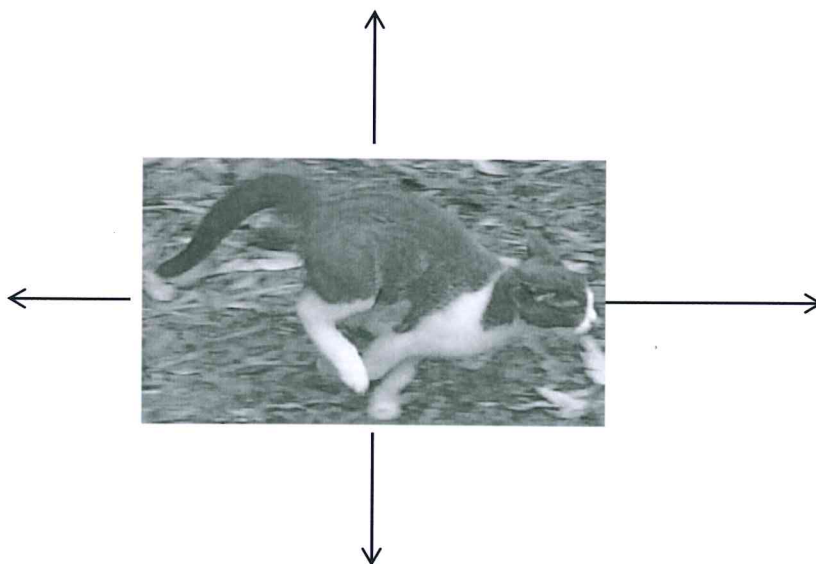
description	Marks
Two vertical forces shown (normal and weight)	1
Two horizontal forces shown (air resistance and accelerating force)	1
Vertical forces same length	1
Accelerating force longer than retarding force	1
Total	4