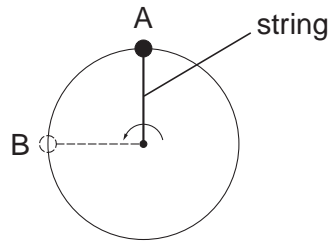


1 Fig. 4.1 illustrates an object on a string being whirled anticlockwise in a vertical circle.



**Fig. 4.1**

The lowest point of the circle is a small distance above the ground. The diagram shows the object at the top A of the circle, and at B, when it is at the same height as the centre of the circle.

**(a)** On Fig. 4.1, mark clearly

**(i)** the force of the string on the object

1. at A,

2. at B.

[2]

**(ii)** the path the object would take until it hit the ground, if the string broke

1. at A,

2. at B.

[3]

**(b)** The mass of the object is 0.05 kg. At A, the tension in the string is 3.6 N.

**(i)** Calculate the weight of the object.

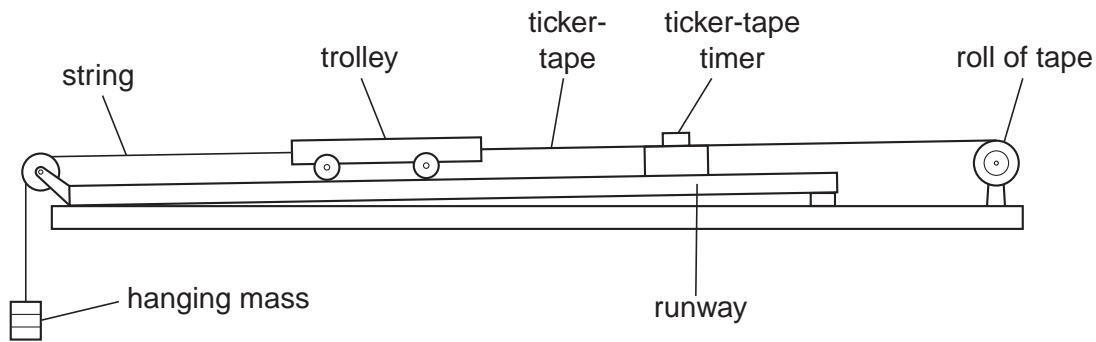
weight = ..... [1]

**(ii)** Calculate the total force on the object at A.

total force = ..... [2]

[Total: 8]

- 2 Fig. 1.1 shows apparatus used to find a relationship between the force applied to a trolley and the acceleration caused by the force.



**Fig. 1.1**

For each mass, hung as shown, the acceleration of the trolley is determined from the tape. Some of the results are given in the table below.

weight of the hanging mass/N	acceleration of the trolley $\text{m/s}^2$
0.20	0.25
0.40	0.50
0.70	
0.80	1.0

- (a) (i) Explain why the trolley accelerates.

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

- (ii) Suggest why the runway has a slight slope as shown.

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

- (b) Calculate the mass of the trolley, assuming that the accelerating force is equal to the weight of the hanging mass.

mass = ..... [2]

**(c)** Calculate the value missing from the table. Show your working.

value = ..... [2]

**(d)** In one experiment, the hanging mass has a weight of 0.4 N and the trolley starts from rest.

Use data from the table to calculate

**(i)** the speed of the trolley after 1.2 s,

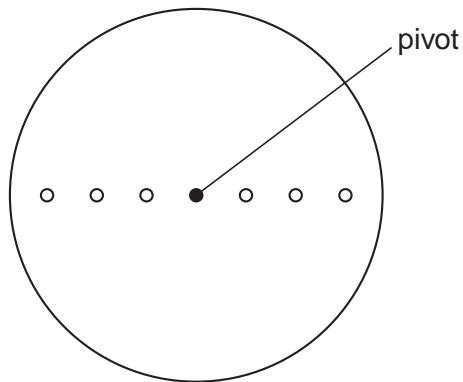
speed = ..... [2]

**(ii)** the distance travelled by the trolley in 1.2 s.

distance = ..... [2]

[Total: 11]

3 Fig. 2.1 shows a circular metal disc of mass 200g, freely pivoted at its centre.



**Fig. 2.1**

Masses of 100g, 200g, 300g, 400g, 500g and 600g are available, but only one of each value. These may be hung with string from any of the holes. There are three small holes on each side of the centre, one at 4.0 cm from the pivot, one at 8.0 cm from the pivot and one at 12.0 cm from the pivot.

The apparatus is to be used to show that there is no net moment of force acting on a body when it is in equilibrium.

**(a)** On Fig. 2.1, draw in **two different** value masses hanging from appropriate holes. The values of the masses should be chosen so that there is no net moment. Alongside the masses chosen, write down their values. [2]

**(b)** Explain how you would test that your chosen masses give no net moment to the disc.

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

(c) Calculate the moments about the pivot due to the two masses chosen.

moment due to first mass = .....

moment due to second mass = .....

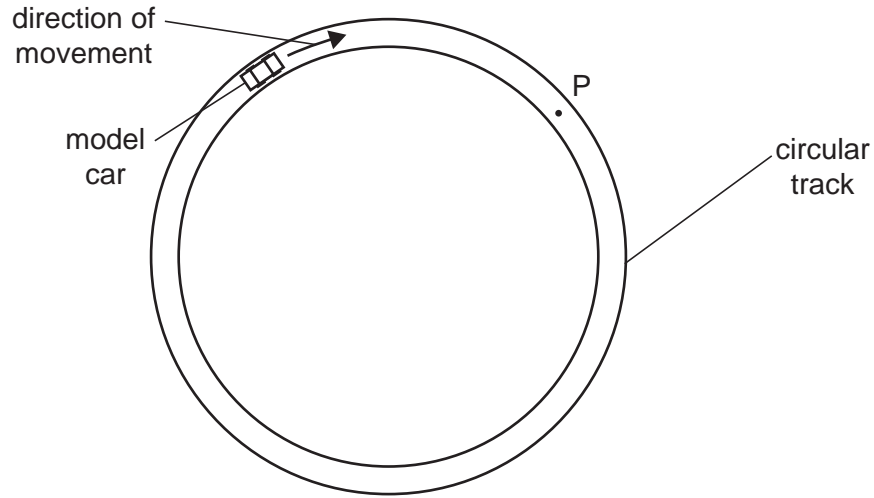
[2]

(d) Calculate the force on the pivot when the two masses chosen are hanging from the disc.

force = ..... [2]

[Total: 7]

4 Fig. 1.1 shows a model car moving clockwise around a horizontal circular track.



**Fig. 1.1**

**(a)** A force acts on the car to keep it moving in a circle.

**(i)** Draw an arrow on Fig. 1.1 to show the direction of this force. [1]

**(ii)** The speed of the car increases. State what happens to the magnitude of this force.

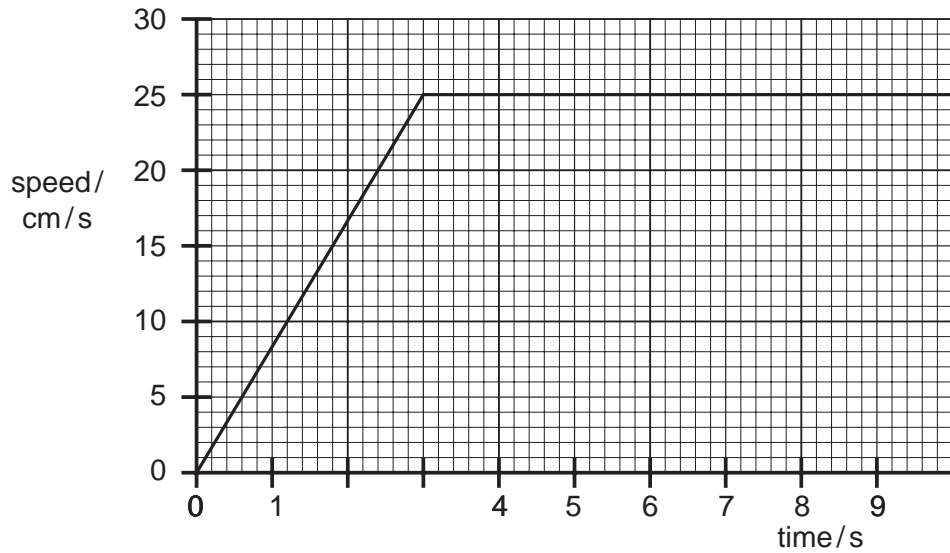
..... [1]

**(b) (i)** The car travels too quickly and leaves the track at P. On Fig. 1.1, draw an arrow to show the direction of travel after it has left the track. [1]

**(ii)** In terms of the forces acting on the car, suggest why it left the track at P.

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

- (c) The car, starting from rest, completes one lap of the track in 10s. Its motion is shown graphically in Fig. 1.2.



**Fig. 1.2**

- (i) Describe the motion between 3.0s and 10.0s after the car has started.

..... [1]

- (ii) Use Fig. 1.2 to calculate the circumference of the track.

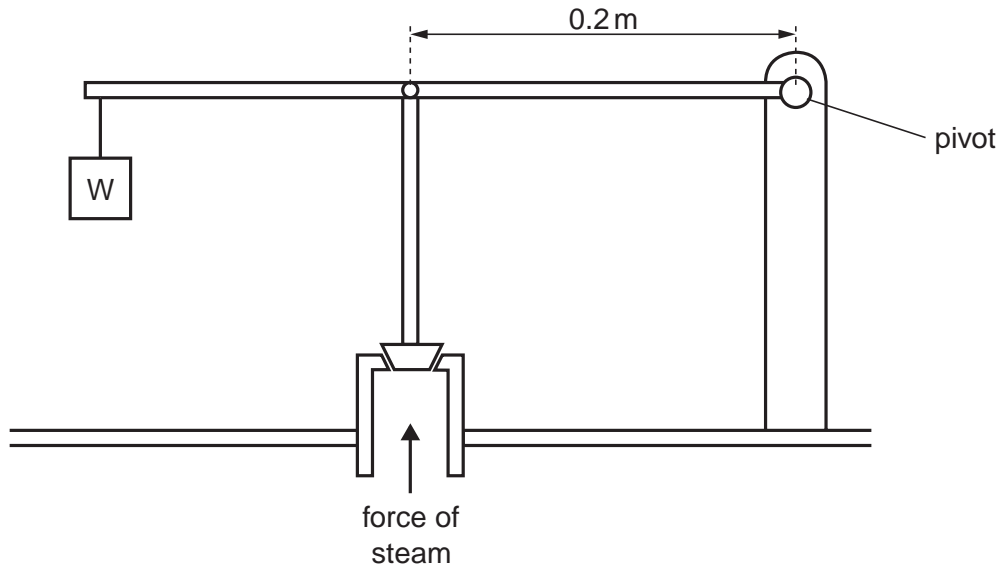
circumference = ..... [2]

- (iii) Calculate the increase in speed per second during the time 0 to 3.0s.

increase in speed per second = ..... [2]

[Total: 10]

- 5 Fig. 2.1 shows a steam safety valve. When the pressure gets too high, the steam lifts the weight  $W$  and allows steam to escape.



**Fig. 2.1**

- (a) Explain, in terms of moments of forces, how the valve works.

.....

.....

.....

..... [2]



- (b)** The moment of weight  $W$  about the pivot is  $12\text{ Nm}$ . The perpendicular distance of the line of action of the force of the steam on the valve from the pivot is  $0.2\text{ m}$ .

The area of the piston is  $0.0003\text{ m}^2$ .

Calculate

- (i)** the minimum steam force needed for the steam to escape,

force = ..... [2]

- (ii)** the minimum steam pressure for the steam to escape.

pressure = ..... [2]

[Total: 6]