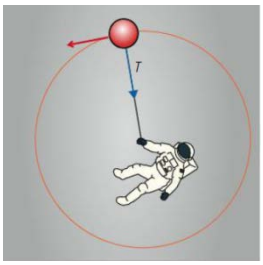

Motion in a circular path due to a perpendicular force

- Objects may travel at a constant speed in a circular path, but their velocity changes because their direction changes.
- Since the object's velocity is changing , it experiences an acceleration. This acceleration is called as the centripetal acceleration and is directed towards the centre of the circular path.
- This implies in a circular motion, the acceleration is perpendicular to the velocity.
- The value of this centripetal force is F= ma=$\frac{mv^2}{r}$; where;

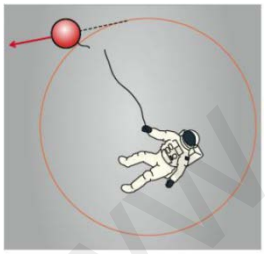
m= mass of the object ; v = linear velocity of the object and r= radius of the circular path.

- When a body moves with a constant speed in a circular path, it will have a constant kinetic energy.



- The force that keeps an object in a circular path is the tension force in a string(if the object is being whirled around)

- Sun's gravitational force keeps the planets orbiting around it in circular paths



- If the string breaks, the object continues to move in the direction of velocity and is then later acted upon by gravity.

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

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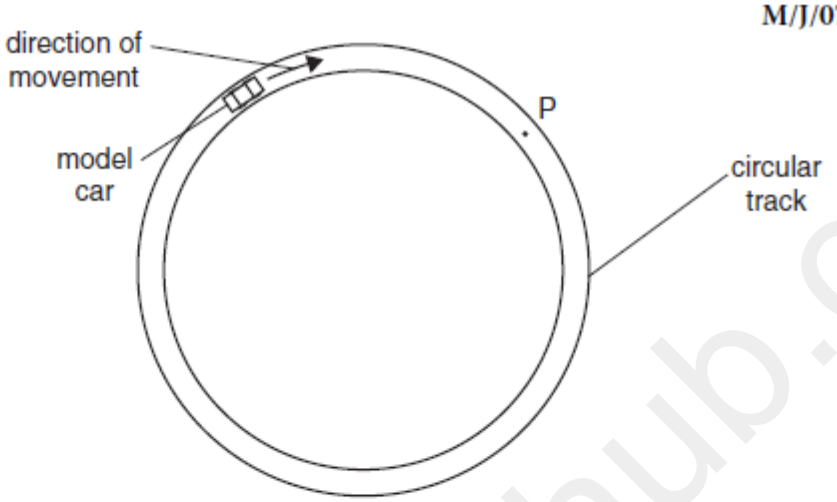

Fig. 1.1

(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.

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..... [2]

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

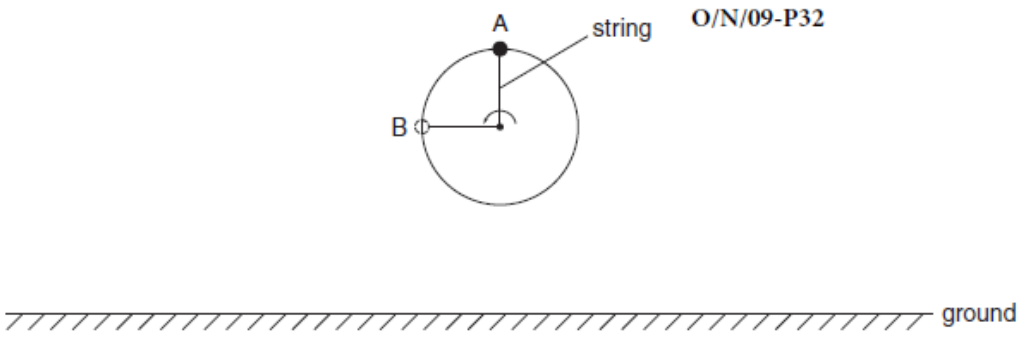

Fig. 4.1

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]

(c) After travelling 4.0 km, the train reaches its maximum speed. It continues at this constant speed on the next section of the track where the track follows a curve which is part of a circle.

State the direction of the resultant force on the train as it follows the curved path.

.....[1]

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