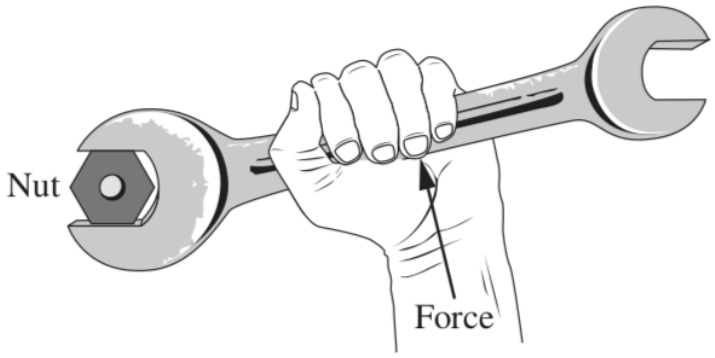
New Syllabus NESA Questions:

1)

A torque is applied to a nut, using a wrench.



Which change will increase the magnitude of applied torque?

A. Increasing the angle between the applied force and the wrench

B. Decreasing the angle between the applied force and the wrench

C. Increasing the distance between the nut and the point of application of the force

D. Decreasing the distance between the nut and the point of application of the force

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2)

A student wants to evaluate the relationship between centripetal force and speed. The student connects a tennis ball to a rope, and swings it in a circle horizontally.

Which of the following needs to be kept constant to ensure a valid experiment?

A. The mass of the ball only

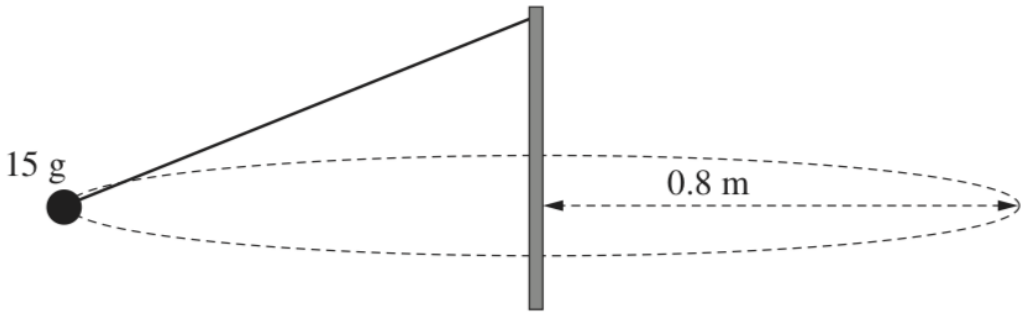
B. The length of the rope only

C. The angular velocity of the ball

D. The mass of the ball and the length of the rope

3)

A 15-gram metal ball bearing on a string is swung around a pole in a circle of radius 0.8 m. The plane of the circular path is horizontal. The angular velocity of the motion is 4π rad s^{-1}.



What is the magnitude of the centripetal force required to maintain the motion of the ball?

A. 0.7 N

B. 1.9 N

C. 2.4 N

D. 3.0 N

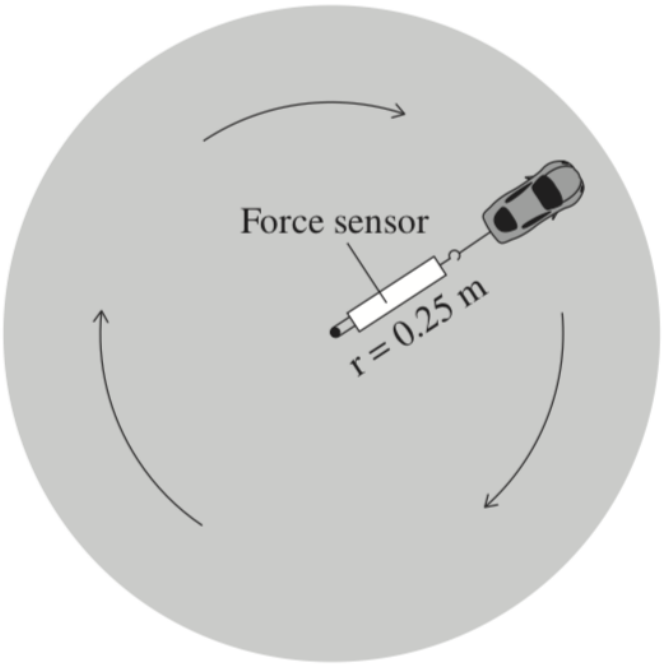
4)

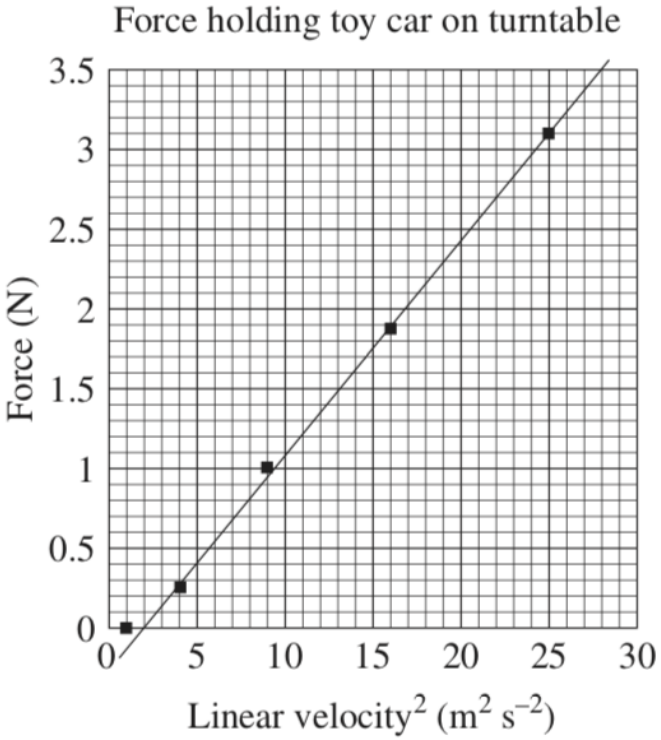
A horizontal disc is rotating clockwise on a table when viewed from above. Two small blocks are attached to the disc at different radii from the centre. **3**

Draw a diagram of this scenario, using vector arrows to show the relative linear velocities and centripetal forces for each block as the disc rotates.

5)

A toy car was placed facing outwards on a rotating turntable. The car was held in place by a force sensor connected to the centre of the turntable. The centre of mass of the car was 0.25 metres from the centre of the turntable. The reading from the force sensor was recorded at varying speeds of rotation. A stopwatch was used to time the rotation of the turntable. The linear velocity was calculated from the period of rotation. The graph shows the force on the car versus the square of the linear velocity of the car.





(a) Use the graph to determine the mass of the car. **3**

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(b) Identify possible errors in the data and outline how to reduce their effects on the estimation of the mass of the car. **4**

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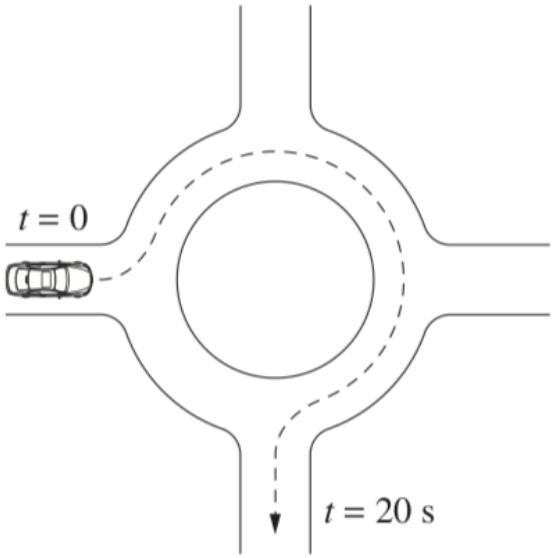
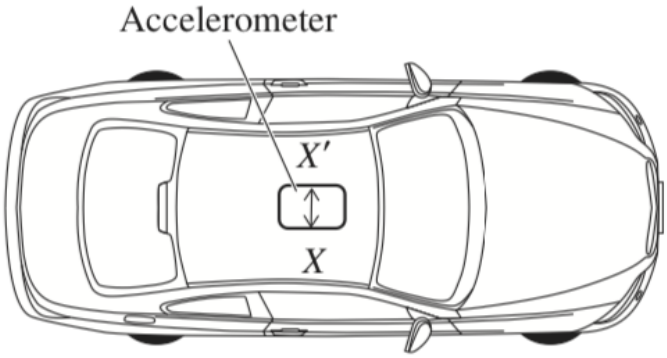
Past HSC Questions:
2017:

15 A car travelling at a constant speed follows the path shown.

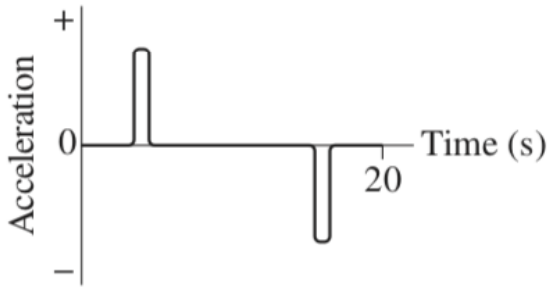




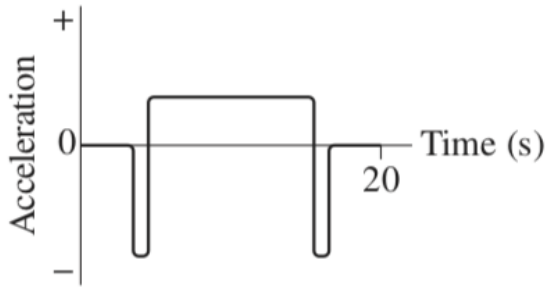
An accelerometer that measures acceleration along the X–X' direction is fixed in the car.

Which graph shows the measurements recorded by the accelerometer over the 20-second interval?

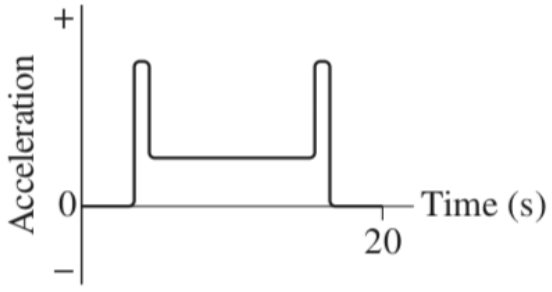
A.



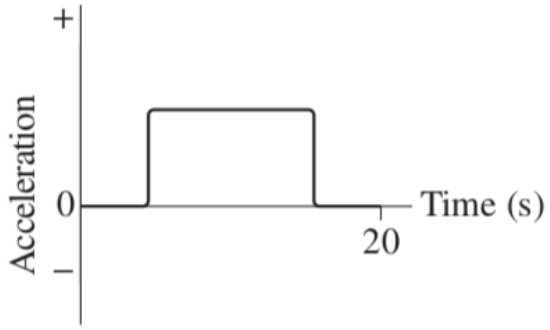
B.



C.

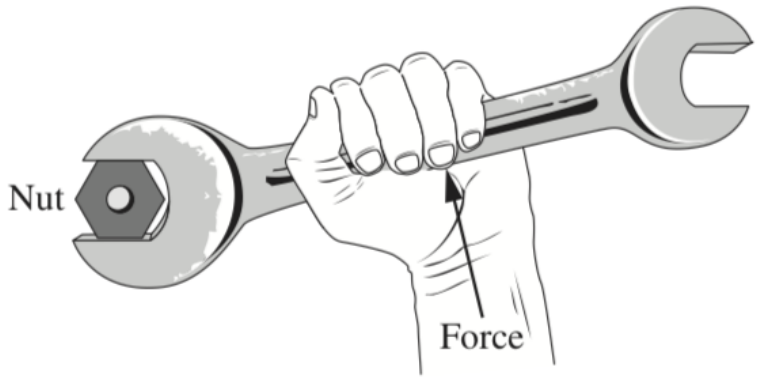


D.



Question 22 (5 marks)

(a) A torque is applied to a nut, using a wrench, as shown. **2**



Suggest TWO ways that the applied torque could be increased.

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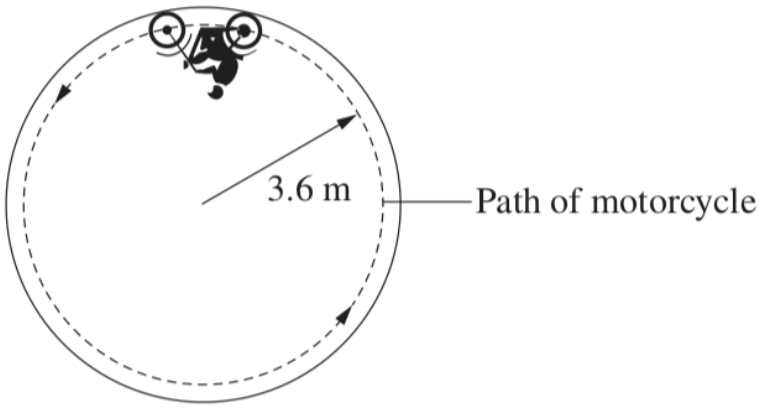
2016:

18 A motorcycle travels around a vertical circular path of radius 3.6 m at a constant speed. The combined mass of the rider and motorcycle is 200 kg.



What is the minimum speed, in m s^{-1}, at which the motorcycle must travel to maintain the circular path?

(A) 0.42

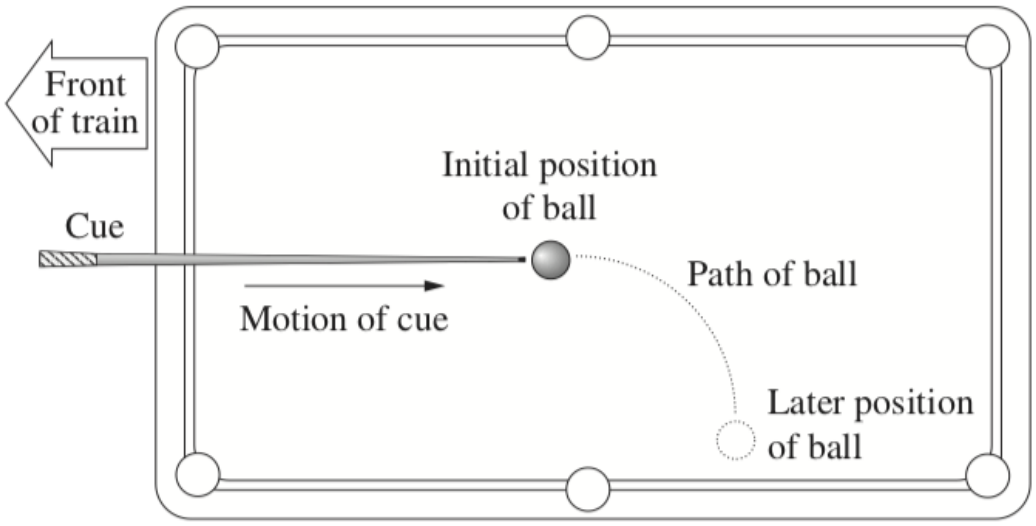
(B) 1.9

(C) 5.9

(D) 35

2015:

14 A passenger is playing billiards on a train that is travelling forwards on a level track. The ball takes the path shown when hit by the cue.



What can be inferred about the motion of the train?

(A) It is turning left.

(B) It is speeding up.

(C) It is turning right.

(D) It is slowing down.

2014:

3 A pendulum is used to determine the value of acceleration due to gravity. The length of the pendulum is varied, and the time taken for the same number of oscillations is recorded.

Which of the following could increase the reliability of the results?

(A) Changing the mass of the pendulum

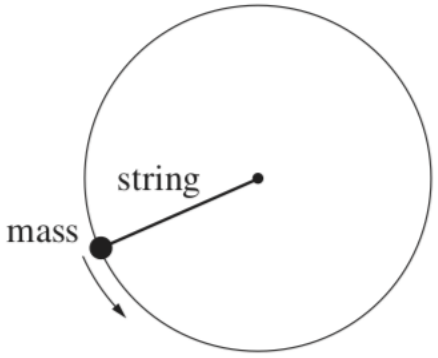
(B) Identifying the independent and dependent variables

(C) Recording all measurements to at least four significant figures

(D) Repeating each measurement several times and recording the average

2010:

5 A 200 g mass is swung in a horizontal circle as shown. It completes 5 revolutions in 3 seconds. The circle has a 2 m diameter.



NOT TO SCALE

Which of the following forces is closest to that required to keep the mass moving in this circle?

(A) 0.50 N

(B) 2.5 N

(C) 10 N

(D) 20 N

2009:

2 A satellite is moving in a circular orbit of radius 7.0×10^6 m around Earth.

If the speed of the satellite is 8.1×10^3 m s^{-1}, what is its centripetal acceleration?

(A) 9.4 m s^{-2}

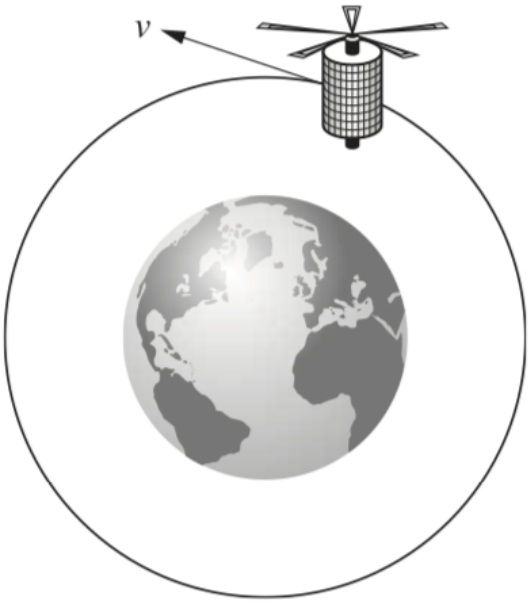
(B) 9.8 m s^{-2}

(C) 5.6×10^{25} m s^{-2}

(D) 3.9×10^{32} m s^{-2}

2007:

1 A satellite is in orbit around Earth with tangential velocity v as shown.



Which of the following describes the direction of the centripetal force acting on the satellite?

(A) Same direction as the gravitational force

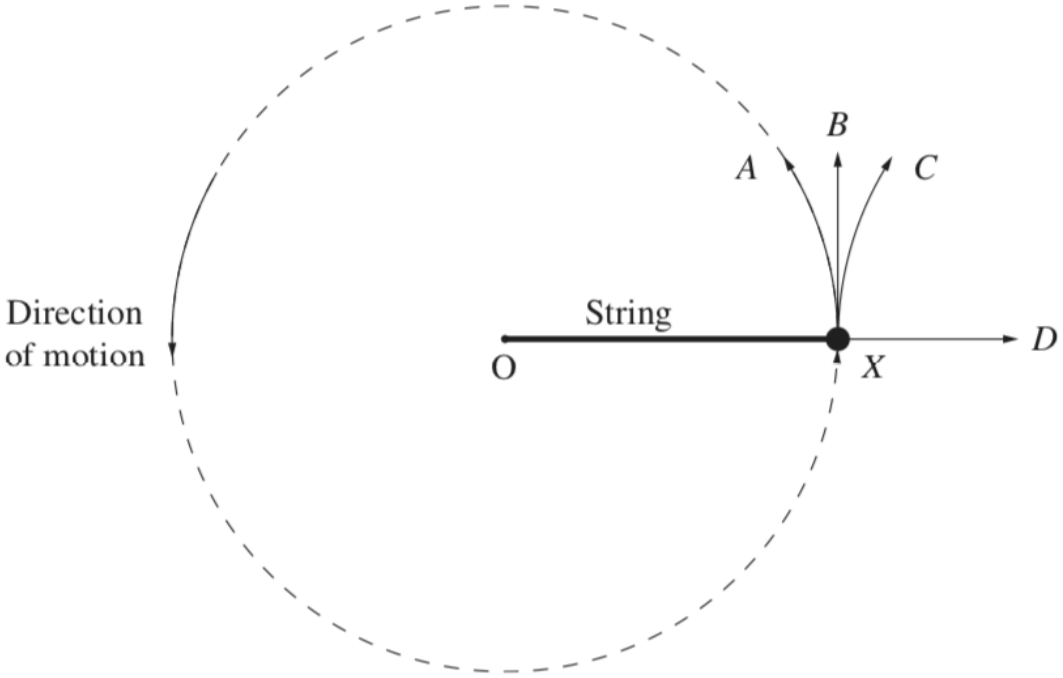
(B) Opposite direction to the gravitational force

(C) Same direction as the tangential velocity

(D) Opposite direction to the tangential velocity

2006:

2 A mass attached to a length of string is moving in a circular path around a central point, O, on a flat, horizontal, frictionless table. This is depicted in the diagram below. The string breaks as the mass passes point *X*.



Which line best depicts the subsequent path of the mass?

(A) Line *A*

(B) Line *B*

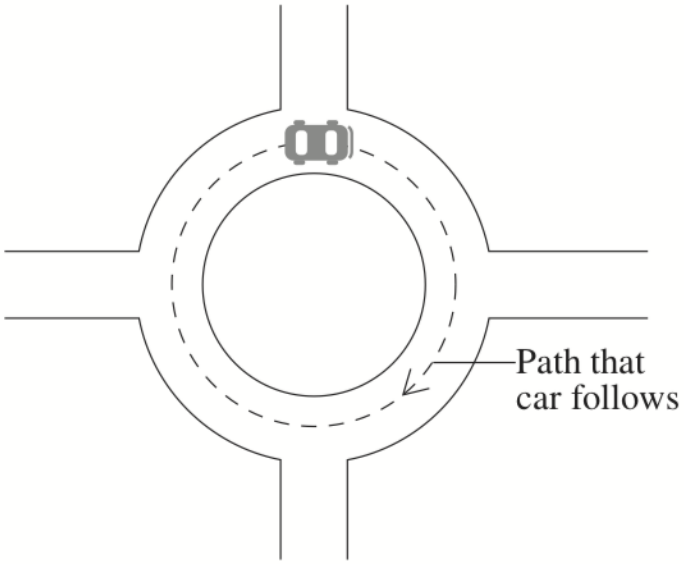
(C) Line *C*

(D) Line *D*

2004:

Question 18 (4 marks)

A car with a mass of 800 kg travels at a constant speed of 7.5 m s^{-1} on a roundabout so that it follows a circular path with a radius of 16 m. **4**



A person observing this situation makes the following statement.

> 'There is no net force acting on the car because the speed is constant and the friction between the tyres and the road balances the centripetal force acting on the car.'

Assess this statement. Support your answer with an analysis of the horizontal forces acting on the car, using the numerical data provided above.

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2003:

2 A satellite moves in uniform circular motion around Earth.

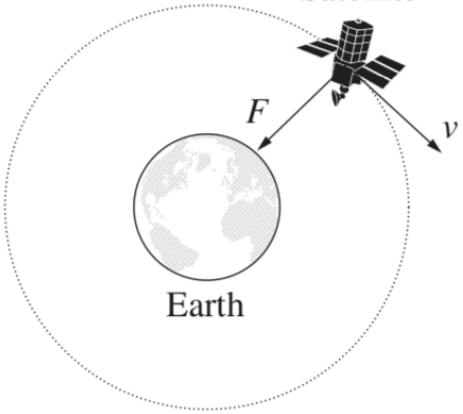
The following table shows the symbols used in the diagrams below.
These diagrams are NOT drawn to scale.

Key

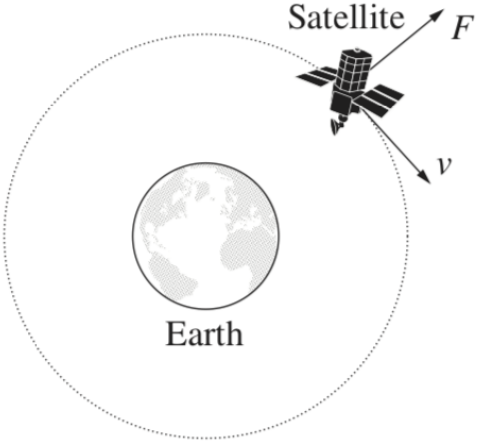
F	net force on satellite
v	velocity of satellite

Which diagram shows the direction of F and v at the position indicated?

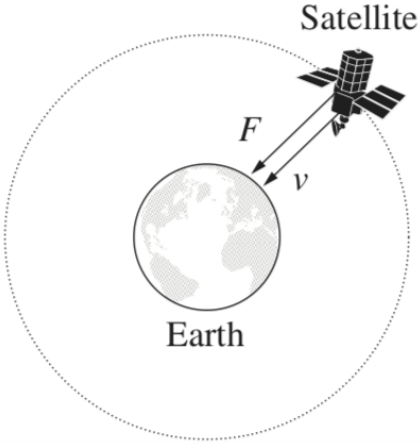
(A)



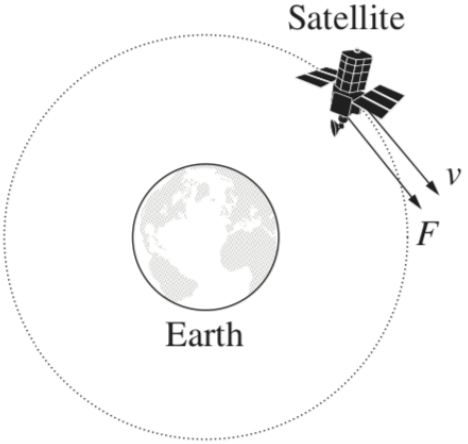
(B)



(C)



(D)

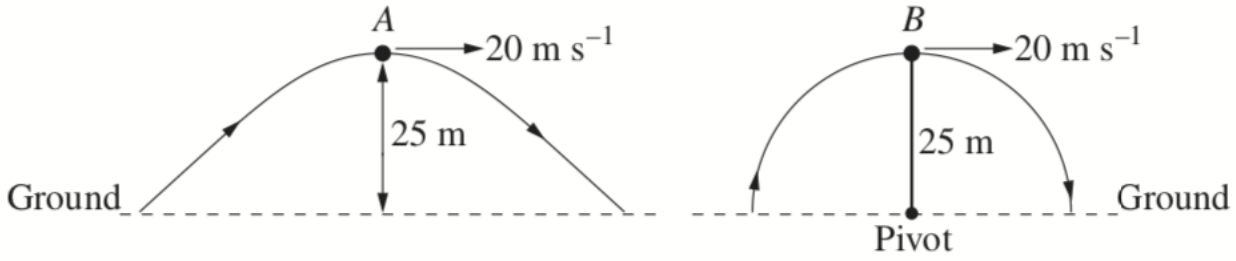


2001:

Question 18 (6 marks)

A 30 kg object, *A*, was fired from a cannon in projectile motion. When the projectile was at its maximum height of 25 m, its speed was 20 m s^{-1}.

An identical object, *B*, was attached to a mechanical arm and moved at a constant speed of 20 m s^{-1} in a vertical half-circle. The length of the arm was 25 m.



Ignore air resistance.

(a) Calculate the force acting on object *A* at its maximum height. **1**

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(b) Calculate the time it would take object *A* to reach the ground from its position of maximum height. **2**

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(c) Describe and compare the vertical forces acting on objects *A* and *B* at their maximum heights. **3**

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