Module 5 Advanced Mechanics
HSC Style questions
15 marks

2009

1 A fast-moving space probe passes close to a planet.

During its journey, how does the gravitational field of the planet affect the speed and direction of the probe?

	Speed	*Direction*
(A)	Remains constant	Remains constant
(B)	Remains constant	Changes
(C)	Changes	Changes
(D)	Changes	Remains constant

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}

3 A satellite is moved from a geostationary orbit to a higher orbit.

Which statement about the orbit change is correct?

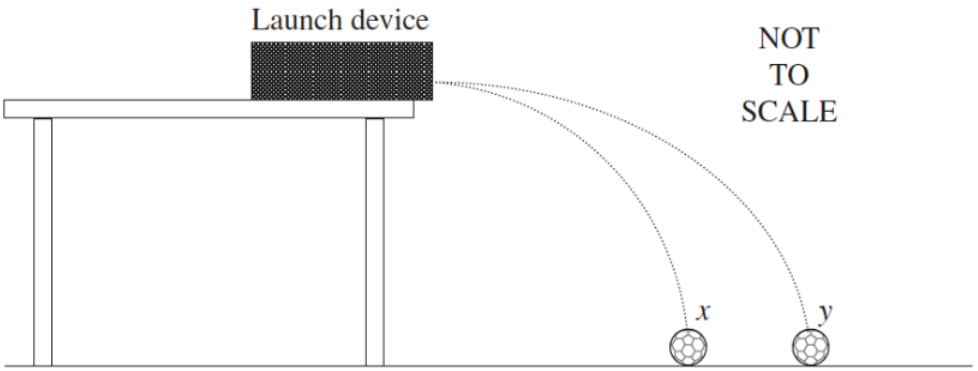
(A) During the move the gravitational potential energy decreases.

(B) The change in gravitational potential energy is independent of the mass of the satellite.

(C) The work done is the difference between the gravitational potential energy of the higher orbit and that of the geostationary orbit.

(D) The work done is the energy required to move the satellite, which is in the gravitational field, from a very large distance away, to the higher orbit.

4 A device launches two identical balls (x and y) simultaneously in a horizontal direction from the same height. The results are shown.



Which statement correctly describes what happens?

(A) x hits the ground before y as it is closer to the launch site.

(B) y hits the ground before x as it has a higher launch velocity.

(C) x and y hit the ground simultaneously with the same velocity.

(D) x and y hit the ground simultaneously with different velocities.

5 During a lunar eclipse, Earth moves between the Sun and the Moon.

What happens to the force exerted by the Sun on the Moon?

(A) It increases.

(B) It decreases.

(C) It remains unchanged.

(D) It depends on the closeness of Earth to the Moon.

2010

1 The International Space Station orbits Earth at an altitude of approximately 330 km. Another satellite, Meteosat, is in geostationary orbit at an altitude of 36 000 km.

Which of the following correctly compares the orbital velocity and orbital period of these satellites?

	International Space Station	*Meteosat*
(A)	Greater orbital velocity	Shorter orbital period
(B)	Lesser orbital velocity	Shorter orbital period
(C)	Greater orbital velocity	Longer orbital period
(D)	Lesser orbital velocity	Longer orbital period

2 Which of the following best describes Galileo's analysis of projectile motion?

(A) A projectile launched with a great enough velocity would escape Earth's gravity.

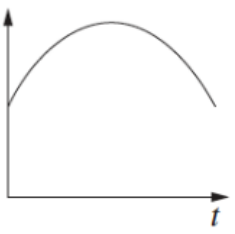
(B) A projectile would travel in a straight line until it ran out of momentum, then it would fall.

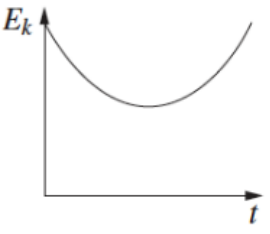
(C) A projectile launched from the equator towards the east with a great enough velocity would orbit Earth.

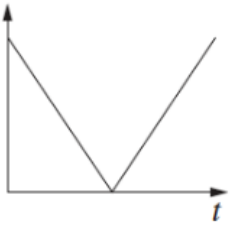
(D) A projectile would travel in a parabolic path because it has constant horizontal velocity and constant vertical acceleration.

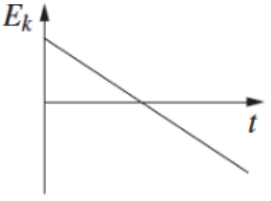
4 A ball was thrown upward at an angle of 45°. It landed at the same height as thrown.

Which graph best represents the kinetic energy of the ball during its time of flight?

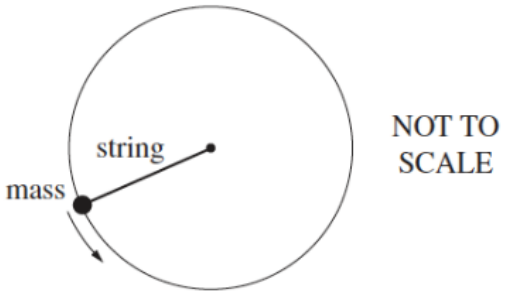
(A) 

(B) 

(C) 

(D) 

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.



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

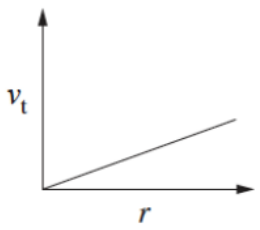
(C) 10 N

(D) 20 N

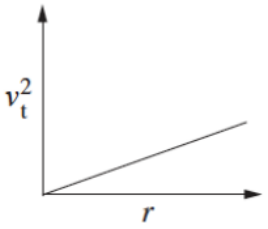
12 The terminal velocity (v_t) of a spherical object in Earth's atmosphere is proportional to the square root of its radius (r).

Which graph correctly shows this relationship?

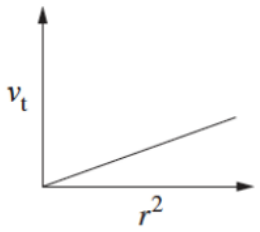
(A)



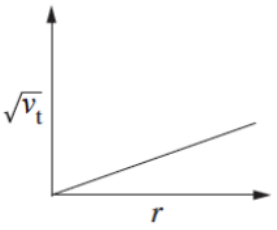
(B)



(C)

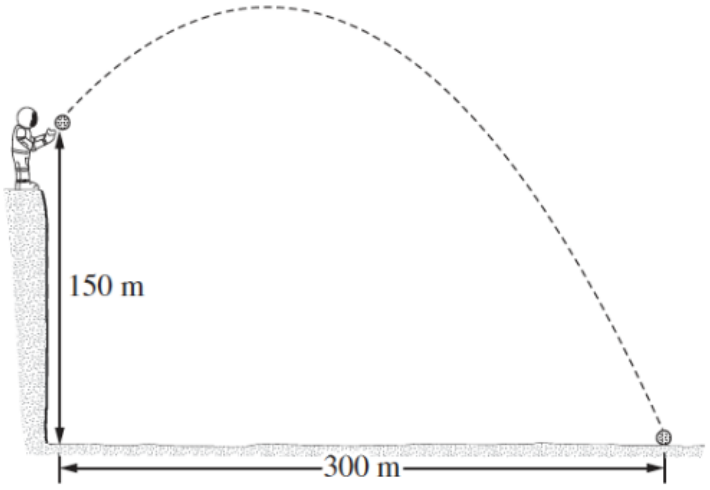


(D)



Question 22 (5 marks)

An astronaut on the Moon throws a stone from the top of a cliff. The stone hits the ground below 21.0 seconds later. The acceleration due to gravity on the moon is 1.6 ms^{-2}.



(a) Calculate the horizontal component of the stone's initial velocity. Show your working. **1**

(b) Calculate the vertical component of the stone's initial velocity. Show your working. **2**

(c) On the diagram, sketch the path that the stone would follow if the acceleration due to gravity was higher. The initial velocity is the same. **2**