**SAT Physics Practice Paper 31**

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or completions. Select the one that is best in each case and then fill in the corresponding oval on the answer sheet.

Q1. An astronaut standing on the surface of the moon (mass = M, radius = R) holds a feather (mass = m) in one hand and a hammer (mass = 100m) in the other hand, both at the same height above the surface. If he releases them simultaneously, what is the acceleration of the hammer?

(A) $\dfrac{mv^2}{r}$

(B) $\dfrac{GM}{R^2}$

(C) $\dfrac{GMm}{R^2}$

(D) $100\,\dfrac{GM}{R^2}$

(E) $100\,\dfrac{GMm}{R^2}$

Q2.

Satellite #2
Satellite #1
$2r$
E
r
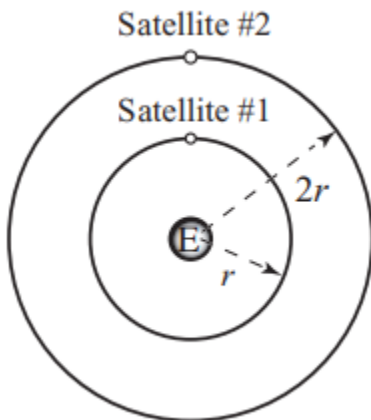
Two satellites orbit the earth. Their orbits are circular, and each satellite travels at a constant speed. If the mass of Satellite #2 is twice the mass of Satellite #1, which satellite's speed is greater?

(A) Satellite #1, by a factor of $\sqrt{2}$
(B) Satellite #1, by a factor of 2
(C) Satellite #2, by a factor of $\sqrt{2}$
(D) Satellite #2, by a factor of 2
(E) Neither; the satellites' speeds are the same.

For Questions 3-5 refer to the collision of two blocks on a frictionless table. Before the collision, the block of mass m is at rest.

8 m/s

| 4 kg | m |

v

| 4 kg | m | 6 m/s

just before
collision

just after
collision
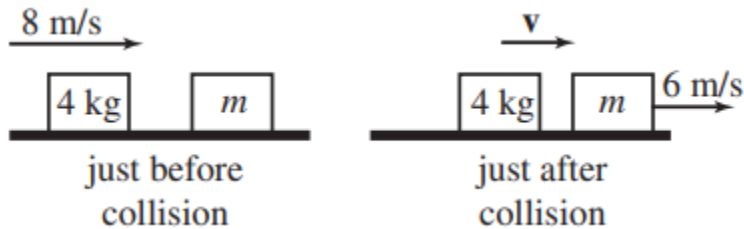
**Q3. What is the total momentum of the blocks just AFTER the collision?**
(A) 12 kg-m/s
(B) 16 kg-m/s
(C) 18 kg-m/s
(D) 24 kg-m/s
(E) 32 kg-m/s

**Q4. If the collision were elastic, what is the total kinetic energy of the blocks just AFTER the collision?**
(A) 16 J
(B) 32 J
(C) 64 J
(D) 128 J
(E) 256 J

Q5. If the blocks had instead stuck together after the collision, with what speed would they move if m = 12 kg ?
(A) 2.0 m/s
(B) 2.7 m/s
(C) 3.2 m/s
(D) 4.0 m/s
(E) 4.6 m/s

+Q   +q

fixed in
position

Q6.
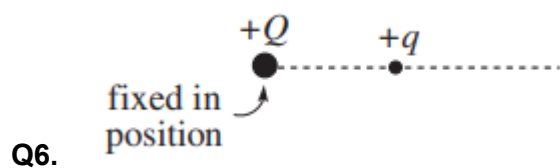
The figure above shows two positively charged particles. The +Q charge is fixed in position, and the +q charge is brought close to +Q and released from rest. Which of the following graphs best depicts the acceleration (a) of the +q charge as a function of its distance (r) from +Q ?

(A)

(D)

(B)

(E)

(C)
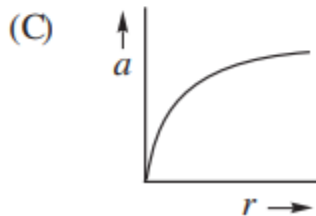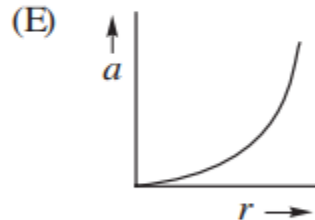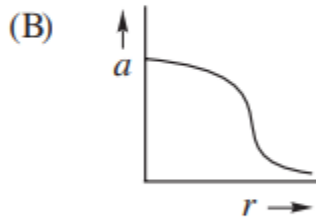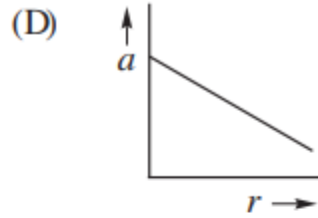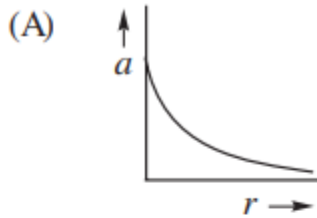
Q7. Two particles have unequal charges; one is +q and the other is –2q. The strength of the electrostatic force between these two stationary particles is equal to F. What happens to F if the distance between the particles is halved?
(A) It decreases by a factor of 4.
(B) It decreases by a factor of 2.
(C) It remains the same.
(D) It increases by a factor of 2.
(E) It increases by a factor of 4.

Q8. A simple harmonic oscillator has a frequency of 2.5 Hz and an amplitude of 0.05 m. What is the period of the oscillations?
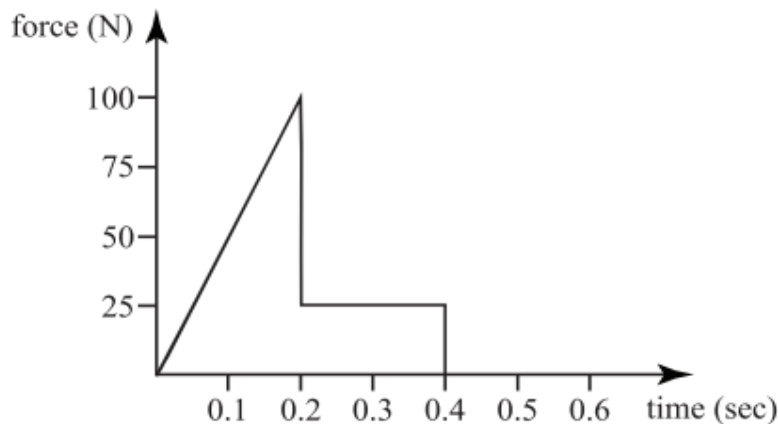(A) 0.4 sec
(B) 0.2 sec
(C) 8 sec
(D) 20 sec
(E) 50 sec

Q9. A beam of monochromatic light entering a glass window pane from the air will experience a change in
(A) frequency and wavelength
(B) frequency and speed
(C) speed and wavelength
(D) speed only
(E) wavelength only

Q10. If the total resistance in the circuit is 10 R/3 , the amount of current that passes through resistor a is what constant times V/R ?
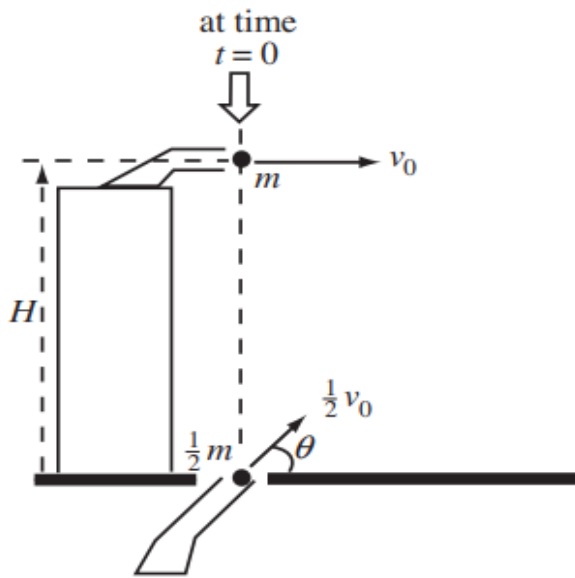(A) 1/20
(B) 1/10
(C) 3/10
(D) 10/9
(E) 10/3

Q11.

The total force acting on an object as a function of time is given in the graph above. What is the magnitude of the change in momentum of the object between t = 0 and t = 0.4 sec?
(A) 2 kg-m/sec
(B) 5 kg-m/sec
(C) 10 kg-m/sec
(D) 12 kg-m/sec
(E) 15 kg-m/sec

For questions 12-14 refer to the diagram.

at time
$t = 0$

v_0

m

H

$\frac{1}{2}v_0$

$\frac{1}{2}m$

θ

Two cannons shoot cannonballs simultaneously. The cannon embedded in the ground shoots a cannonball whose mass is half that of the cannonball shot by the elevated cannon. Also, the initial speed of the cannonball projected from ground level is half the initial speed of the cannonball shot horizontally from the elevated position. Air resistance is negligible and can be ignored. Each cannonball is in motion for more than 2 seconds before striking the level ground.

Q12. Let a1 denote the acceleration of the cannonball of mass m one second after launch, and let a2 denote the acceleration of the cannonball of mass m/2 one second after launch. Which of the following statements is true?

(A) $a_1 = 4a_2$
(B) $a_1 = 2a_2$
(C) $a_1 = a_2$
(D) $a_2 = 2a_1$
(E) $a_2 = 4a_1$

Q13. If the cannonball projected from ground level is in flight for a total time of T, what horizontal distance does it travel?

(A) $\dfrac{1}{2}v_0T$

(B) v_0T

(C) $\dfrac{1}{2}v_0T\sin\theta_0$

(D) $\dfrac{1}{2}v_0T\cos\theta_0$

(E) $v_0T\cos\theta_0$

Q14. For the cannonball of mass m, which of the following quantities decreases as the cannonball falls to the ground?
(A) Kinetic energy
(B) Potential energy
(C) Momentum
(D) Speed
(E) Mass

Q15. Which of the following statements is true concerning phase changes?
(A) When a liquid freezes, it releases thermal energy into its immediate environment.
(B) When a solid melts, it releases thermal energy into its immediate environment.
(C) For most substances, the latent heat of fusion is greater than the latent heat of vaporization.
(D) As a solid melts, its temperature increases.
(E) As a liquid freezes, its temperature decreases.