AP® Physics C
1984 Multiple Choice Questions
Mechanics

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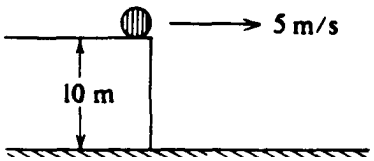
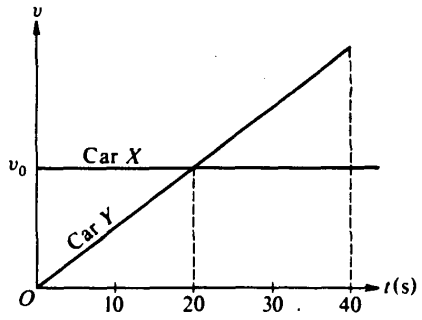
1. Torque is the rotational analogue of
   (A) kinetic energy (B) linear momentum (C) acceleration (D) force (E) mass



2. An object slides off a roof 10 meters above the ground with an initial horizontal speed of 5 meters per second as shown above. The time between the object's leaving the roof and hitting the ground is most nearly
   (A) $\frac{1}{2}$ s (B) $\frac{1}{\sqrt{2}}$ s (C) $\sqrt{2}$ s (D) 2 s (E) $5\sqrt{2}$ s

3. A simple pendulum of length *l*. whose bob has mass m, oscillates with a period T. If the bob is replaced by one of mass 4m, the period of oscillation is
   (A) $\frac{1}{4}$T (B) $\frac{1}{2}$T (C) T (D) 2T (E)4T

Questions 4-5



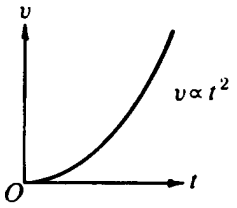
At time t = 0, car X traveling with speed v_0 passes car Y. which is just starting to move. Both cars then travel on two parallel lanes of the same straight road. The graphs of speed v versus time t for both cars are shown above.

4. Which of the following is true at time t = 20 seconds?
   (A) Car Y is behind car X. (B) Car Y is passing car X. (C) Car Y is in front of car X.
   (D) Both cars have the same acceleration. (E) Car X is accelerating fester then car Y.

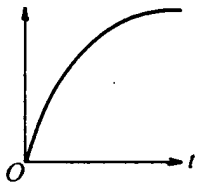
5. From time t = 0 to time t = 40 seconds, the areas under both curves are equal. Therefore, which of the following is true at time t = 40 seconds?
   (A) Car Y is behind car X. (B) Car Y is passing car X. (C) Car Y is in front of car X.
   (D) Both cars have the same acceleration. (E) Car X is accelerating faster than car Y.

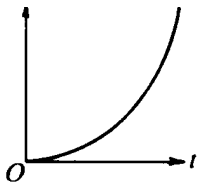
6. An ice skater is spinning about a vertical axis with arms fully extended. If the arms are pulled in closer to the body, in which of the following ways are the angular momentum and kinetic energy of the skater affected?

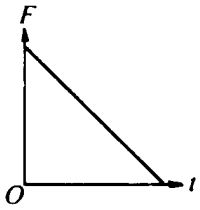
Angular Momentum	Kinetic Energy
(A) Increases	Increases
(B) Increases	Remains Constant
(C) Remains Constant	Increases
(D) Remains Constant	Remains Constant
(E) Decreases	Remains Constant

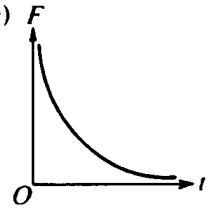


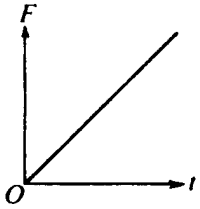
7. The parabola above is a graph of speed v as a function of time t for an object. Which of the following graphs best represents the magnitude F of the net force exerted on the object as a function of time t ?

(A)


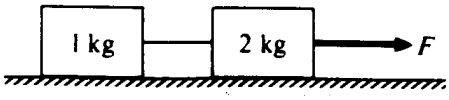
(B)


(C)


(D)


(E)


8. An object of mass m is lifted at constant velocity a vertical distance H in time T. The power supplied by the lifting force is (A) mgHT (B) mgH/T (C) mg/HT (D) mgT/H (E) zero



9. When the frictionless system shown above is accelerated by an applied force of magnitude F, the tension in the string between the blocks is (A) 2 F (B) F (C) (2/3)F (D) 0.5F (E) (1/3)F

Questions 10-12

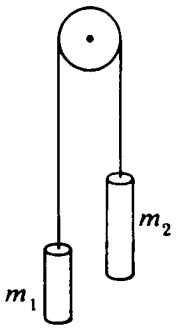
A cylinder rotates with constant angular acceleration about a fixed axis. The cylinder's moment of inertial about the axis is 4 kg m^2. At time t = 0 the cylinder is at rest. At time t = 2 seconds its angular velocity is 1 radian per second.

10. What is the angular acceleration of the cylinder between t = 0 and t = 2 seconds?
(A) 0.5 radian/s² (B) 1 radian/s² (C) 2 radian/s² (D) 4 radian/s² (E) 5 radian/s²

11. What is the angular momentum of the cylinder at time t = 2 seconds?
(A) 1 kgm m²/s (B) 2 kgm m²/s (C) 3 kgm m²/s (D) 4 kgm m²/s
(E) It cannot be determined without knowing the radius of the cylinder.

12. What is the kinetic energy of the cylinder at time t = 2 seconds?
(A) 1 J (B) 2 J (C) 3 J (D) 4 J (E) cannot be determined without knowing the radius of the cylinder

Questions 13-14

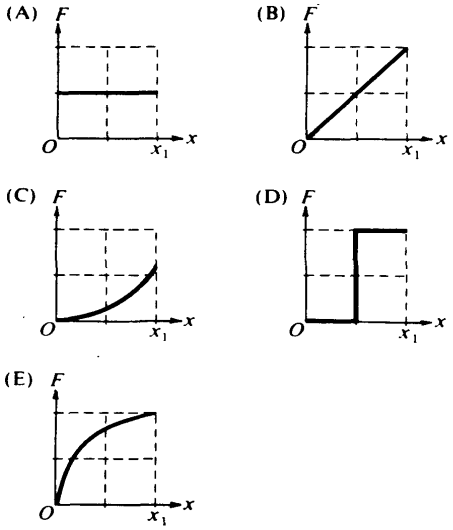


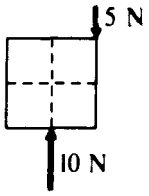
A system consists of two objects having masses m_1 and m_2 ($m_1 < m_2$). The objects are connected by a massless string, hung over a pulley as shown above, and then released.

13. When the speed of each object is v, the magnitude of the total linear momentum of the system is
(A) $(m_1 + m_2)\,v$ (B) $(m_2 - m_1)\,v$ (C) $\frac{1}{2}(m_1+m_2)v$ (D) $\frac{1}{2}(m_2 - m_1)v$ (E) m_2v

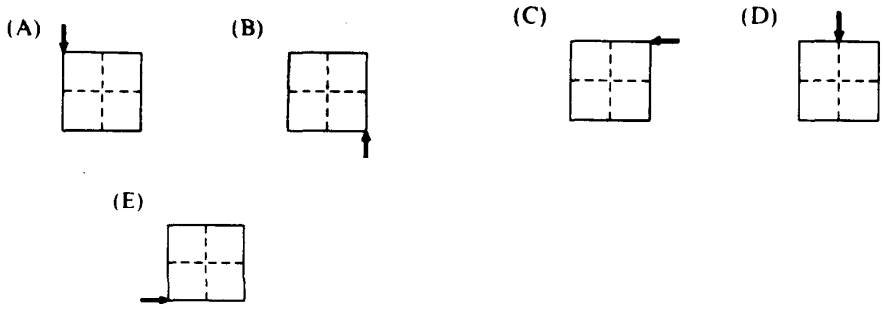
14. When the object of mass m_2 has descended a distance h, the potential energy of the system has decreased by
(A) $(m_2 - m_1)gh$ (B) m_2gh (C) $(m_1 + m_2)gh$ (D) $\frac{1}{2}(m_1 + m_2)gh$ (E) 0

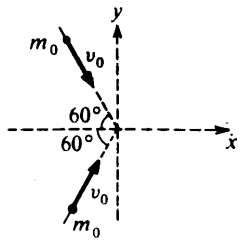
15. The following graphs, all drawn to the same scale, represent the net force F as a function of displacement x for an object that moves along a straight line. Which graph represents the force that will cause the greatest change in the kinetic energy of the object from $x = 0$ to $x = x_1$?





16. A square piece of plywood on a horizontal tabletop is subjected to the two horizontal forces shown above right. Where should a third force of magnitude 5 newtons be applied to put the piece of plywood into equilibrium?





17. Two particles of equal mass m_o, moving with equal speeds v_O along paths inclined at 60° to the x-axis as shown above, collide and stick together. Their velocity after the collision has magnitude

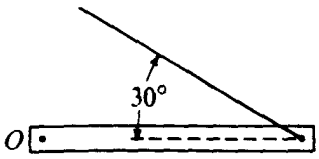
(A) $\frac{v_0}{4}$ (B) $\frac{v_0}{2}$ (C) $\frac{\sqrt{2}v_0}{2}$ (D) $\frac{\sqrt{3}v_0}{2}$ (E) v_o

18. Which of the following is true for a system consisting of a mass oscillating on the end of an ideal spring?
(A) The kinetic and potential energies are equal at all times.
(B) The kinetic and potential energies are both constant.
(C) The maximum potential energy is achieved when the mass passes through its equilibrium position.
(D) The maximum kinetic energy and maximum potential energy are equal, but occur at different times.
(E) The maximum kinetic energy occurs at maximum displacement of the mass from its equilibrium position.

19. A particle is moving in a circle of radius 2 meters according to the relation $\theta = 3t^2 + 2t$, where θ is measured in radians and t in seconds. The speed of the particle at t = 4 seconds is
(A) 13 m/s (B) 16m/s (C) 26m/s (D) 52 m/ s (E) 338 m/ s

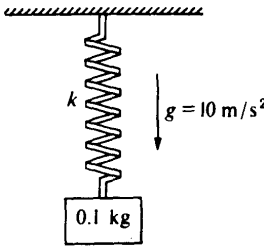
20. The mass of Planet X is one-tenth that of the Earth, and its diameter is one-half that of the Earth. The acceleration due to gravity at the surface of Planet X is most nearly
(A) $2m/s^2$ (B) $4m/s^2$ (C) $5m/s^2$ (D) $7 m/s^2$ (E) $10 m/s^2$

21. A person pushes a box across a horizontal surface at a constant speed of 0.5 meter per second. The box has a mass of 40 kilograms, and the coefficient of sliding friction is 0.25. The power supplied to the box by the person is (A) 0.2 W (B) 5 W (C) 50 W (D) 100 W (E) 200 W



22. A uniform rigid bar of weight W is supported in a horizontal orientation as shown above by a rope that makes a 30° angle with the horizontal. The force exerted on the bar at point O, where it is pivoted, is best represented by a vector whose direction is which of the following?

(A)  (B)  (C)  (D)  (E) 



Questions 23-24

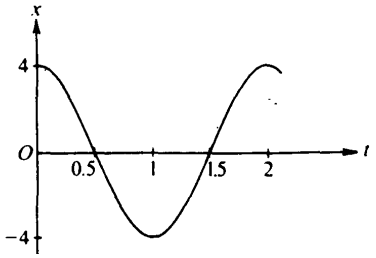
A 0. l -kilogram block is attached to an initially unstretched spring of force constant k = 40 newtons per meter as shown above. The block is released from rest at time t = 0.

23. What is the amplitude of the resulting simple harmonic motion of the block?

(A) $\frac{1}{40}$ m (B) $\frac{1}{20}m$ (C) $\frac{1}{4}m$ (D) $\frac{1}{2}m$ (E) $1m$

24. At what time after release will the block first return to its initial position?

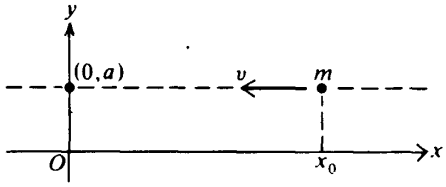
(A) $\frac{\pi}{40}s$ (B) $\frac{\pi}{20}s$ (C) $\frac{\pi}{10}s$ (D) $\frac{\pi}{5}s$ (E) $\frac{\pi}{4}s$



25. A particle moves in simple harmonic motion represented by the graph above. Which of the following represents the velocity of the particle as a function of time?

(A) v(t) = 4 cos πt (B) v(t)= πCosπt

(C) v(t) = $-\pi^2\cos\pi t$ (D) v(t) =-4 sinπt (E) v(t) = - 4πsinπt



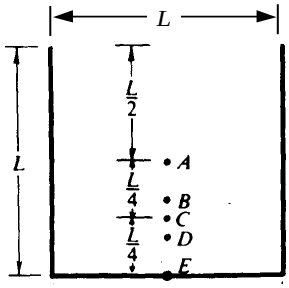
26. A particle of mass m moves with a constant speed v along the dashed line y = a. When the x-coordinate of the particle is x_o, the magnitude of the angular momentum of the particle with respect to the origin of the system is

(A) zero (B) mva (C) mvx_o (D) $mv\sqrt{x^2+a^2}$ (E) $\frac{mva}{\sqrt{x^2+a^2}}$

27. A uniform stick has length L. The moment of inertia about the center of the stick is I_o. A particle of mass M is attached to one end of the stick. The moment of inertia of the combined system about the center of the stick is

(A) $I_0 + \frac{1}{4}ML^2$ (B) $I_0 + \frac{1}{2}ML^2$ (C) $I_0 + \frac{1}{2}ML^2$ (D) $I_0 + ML^2$ (E) $I_0 + \frac{5}{4}ML^2$

28. A body moving in the positive x direction passes the origin at time t = 0. Between t = 0 and t = 1 second, the body has a constant speed of 24 meters per second. At t = 1 second, the body is given a constant acceleration of 6 meters per second squared in the negative x direction. The position x of the body at t = 11 seconds is
(A) +99 m (B) +36 m (C) -36 m (D) -75 m (E) -99 m



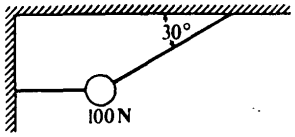
29. The center of mass of a uniform wire, bent in the shape shown above, is located closest to point
(A) A (B) B (C) C (D) D (E) E

View of Track from Above

30. A racing car is moving around the circular track of radius 300 meters shown above. At the instant when the car's velocity is directed due east, its acceleration is directed due south and has a magnitude of 3 meters per second squared. When viewed from above, the car is moving
(A) clockwise at 30 m/s (B) clockwise at 10 m/ s (C) counterclockwise at 30 m/s
(D) counterclockwise at 10 m/s (E) with constant velocity

31. Mass M_1 is moving with speed v toward stationary mass M_2. The speed of the center of mass of the system is

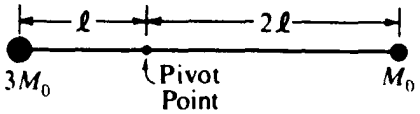
(A) $\frac{M_1}{M_2}v$ (B) $\left(1+\frac{M_1}{M_2}\right)v$ (C) $\left(1+\frac{M_2}{M_1}\right)v$ (D) $\left(1+\frac{M_1}{M_2}\right)v$ (E) $\left(\frac{M_1}{M_1+M_2}\right)v$



32. A 100-newton weight is suspended by two cords as shown in the figure above. The tension in t slanted cord is
(A) 50 N (B) 100 N (C) 150 N (D) 200 N (E) 250 N

33. If a particle moves in such a way that its position x is described as a function of time t by $x = t^{3/2}$, then its kinetic energy is proportional to
(A) t^2 (B) $t^{3/2}$ (C) t (D) $t^{1/2}$ (E) t° (i.e., kinetic energy is constant)

34. From the top of a 70-meter-high building, a l-kilogram ball is thrown directly downward with an initial speed of 10 meters per second. If the ball reaches the ground with a speed of 30 meters per second, the energy lost to friction is most nearly (A) 0J (B) 100 J (C) 300 J (D) 400 J (E) 700 J



35. A light rigid rod with masses attached to its ends is pivoted about a horizontal axis as shown above. When released from rest in a horizontal orientation, the rod begins to rotate with an angular acceleration of magnitude

(A) $\frac{g}{7l}$ (B) $\frac{g}{5l}$ (C) $\frac{g}{4l}$ (D) $\frac{5g}{7l}$ (E) $\frac{g}{l}$

Answers - 1984 Multiple Choice - C

Mechanics	% answering correctly	E & M	% answering correctly
1. D	89	36. C	72
2. C	75	37. E	60
3. C	46	38. D	43
4. A	85	39. A	82
5. B	84	40. B	37
6. C	54	41. B	51
7. E	81	42. C	42
8. B	82	43. D	52
9. E	62	44. B	62
10. A	74	45. E	22
11. D	75	46. D	36
12. B	72	47. D	68
13. B	55	48. E	87
14. A	73	49. B	62
15. E	77	50. E	73
16. A	97	51. D	69
17. B	44	52. A	70
18. D	91	53. A	48
19. D	47	54. A	75
20. B	57	55. E	90
21. C	51	56. E	59
22. B	53	57. A	54
23. A	46	58. A	58
24. C	27	59. B	58
25. E	47	60. B	76
26. B	27	61. C	36
27. A	56	62. B	66
28. C	51	63. A	31
29. B	35	64. E	58
30. A	56	65. E	35
31. E	57	66. B	43
32. D	68	67. A	22
33. C	61	68. C	32
34. C	65	69. A	50
35. A	45	70. D	39

Mechanics: 24 and above - 28% of the students. 83% of those got fives.

E & M 22 and above - 84% got fives