PHYSICS C

MECHANICS: SAMPLE EXAM 1

Time – 45 minutes

35 Questions

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.

Questions 1 - 4

An object moves according to the equation $x = vt + ke^{bt}$, where k, v, and b are constants, x represents distance in meters, t represents time in seconds, and e is the base of the natural logarithmns.

1. The units of b must be

   (A) sec
   (B) sec^{-1}
   (C) sec^2
   (D) logarthmic
   (E) nonexistent; b is a pure number

2. The initial velocity (at t = 0) is

   (A) 0
   (B) v
   (C) k
   (D) v + kb
   (E) k + v

3. The acceleration at $t = \frac{1}{b}$ sec is closest to

   (A) 0
   (B) $\frac{v}{b}$
   (C) kb^2
   (D) k
   (E) $2.72kb^2$

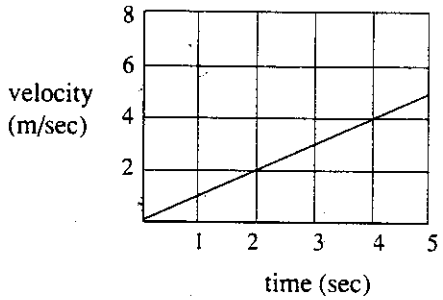
4. The units of k must be

   (A) meters
   (B) meters/sec
   (C) sec
   (D) sec/meter
   (E) nonexistent; k is a pure number

5. An object has kinetic energy 10 J and momentum 10 kg-m/s. What is its mass?

   (A) 5 grams
   (B) 100 grams
   (C) 500 grams
   (D) 5,000 grams
   (E) 10,000 grams

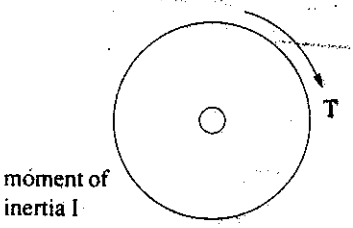
6. The graph below depicts the motion of an object of mass 2 kg. The net force on the object during the time from 0-4 seconds is



   (A) 0
   (B) 1 N
   (C) 2 N
   (D) 8 N
   (E) 12 N

Questions 7 and 8

An object of moment of inertia I is initially at rest when torque T begins to act on it as shown below.



7. After t seconds, the angular velocity of the object is

(A) TIt

(B) $\frac{TI}{t}$

(C) $\frac{Tt}{I}$

(D) $\frac{I}{t}$

(E) $\frac{I}{T}$

8. After t seconds, the kinetic energy of the object is

(A) $\frac{I^2}{2T}$

(B) Tt

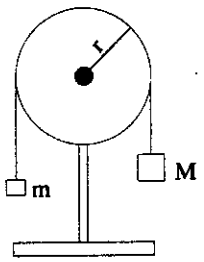
(C) $\frac{Tt}{2}$

(D) $\frac{(Tt)^2}{2I}$

(E) $\frac{I}{2t}$

Questions 9 - 12

Refer to the Atwood machine in the diagram below. The radius of the pulley is r and mass M is initially at height h. The system is initially at rest and is then released at time t = 0. Assume M>>m.



9. Assuming the pulley to be massless and frictionless, what is the kinetic energy of the system at the instant mass M hits the floor?

(A) 0
(B) (M – m) gh
(C) (M + m) gh
(D) Mgh
(E) mgh

10. What will the acceleration of the system be as M falls?

(A) $\frac{(M+m)g}{M-m}$

(B) $\frac{(M-m)g}{M+m}$

(C) g

(D) $\frac{Mg}{m}$

(E) $\frac{mg}{M}$

11. The angular acceleration of the pulley while M is falling is

(A) $\frac{(M+m)g}{(M-m)r}$

(B) $\frac{(M-m)g}{(M+m)r}$

(C) $\frac{mg}{r}$

(D) $\frac{Mgr}{m}$

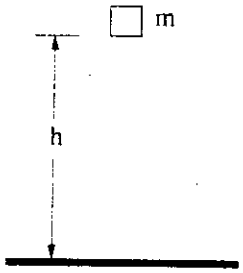
(E) $\frac{mgr^2}{M}$

12. If the pulley actually had some mass, the total kinetic energy of the system when M hits the floor would be

I. greater than with a massless pulley
II. less than with a massless pulley
III. the same as with a massless pulley

(A) I only
(B) II only
(C) III only
(D) either I or II
(E) neither I, II, nor III

13. An object of mass m is dropped from height h, as shown below. The kinetic energy of the object when it hits the ground is K. The work done by air resistance while the object drops is



(A) mgh
(B) K
(C) K + mg
(D) mgh – K
(E) always zero

Questions 14 - 16

Object A moves at speed v and collides with object B, initially at rest. Both objects have the same mass. Assume the surface on which the objects move to be frictionless. Refer to diagram below.

14. If the collision is inelastic, the speed of object A after the collision is

(A) 0

(B) $\frac{v}{4}$

(C) $\frac{v}{2}$

(D) v

(E) 2v

15. If the collision is perfectly elastic, the speed of object B after the collision is

(A) 0

(B) $\frac{v}{2}$

(C) v

(D) 2v

(E) 4v

16. If the collision is perfectly elastic, the speed of object A after the collision is

(A) 0

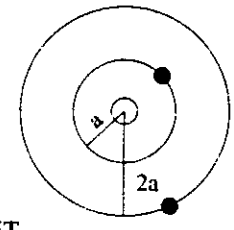
(B) $\frac{v}{4}$

(C) $\frac{v}{2}$

(D) v

(E) 2v

17. Two moons move about a planet in circular orbits, as shown below. The inner moon has orbital radius a and orbital period T. The outer moon has orbital radius 2a. The orbital period of the outer moon is



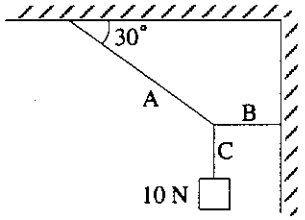
(A) 0.5T
(B) 1.0T
(C) 1.4T
(D) 2.0T
(E) 2.8T

18. The period of a pendulum can be increased by

I. increasing the mass at the end
II. increasing the length of the pendulum
III. placing it in a downwardly accelerating elevator

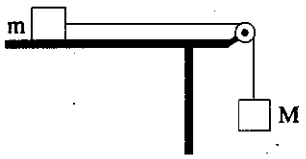
(A) I only
(B) II only
(C) III only
(D) I and II
(E) II and III

19. A 10 N weight hangs from a system of chords as diagrammed below. The tension in chord B is most nearly



(A) 0
(B) 6 N
(C) 10 N
(D) 17 N
(E) 20 N

Questions 20 - 22
The massless pulley and the tabletop in the diagram below are both frictionless. The masses of the blocks pictured are m and M, respectively.



20. The acceleration of the system is

(A) Mg
(B) mg
(C) (M – m)g
(D) $\frac{Mg}{M+m}$
(E) $\frac{Mg}{M-m}$

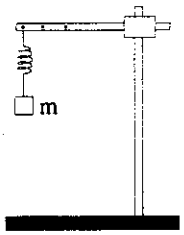
21. The tension in the chord is

(A) 0
(B) Mg
(C) Mmg
(D) $\frac{mMg}{M+m}$
(E) $\frac{mMg}{M-m}$

22. If m were zero, the acceleration of the system would be

(A) 0
(B) Mg
(C) $\frac{g}{2}$
(D) g
(E) 2g

Questions 23 and 24
A mass m is hung from a spring of spring constant k as shown below.



23. The displacement of the spring from its unstretched equilibrium position is

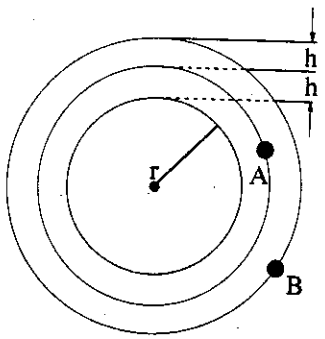
(A) 0
(B) $\frac{mg}{k}$
(C) $\frac{k}{mg}$
(D) $\frac{kg}{m}$
(E) gkm

24. The mass is set into simple harmonic motion by stretching the spring a distance A downward and then releasing it. Thefrequency of the simple harmonic motion will be most nearly

(A) $\sqrt{\frac{mg}{A}}$
(B) $\sqrt{\frac{k}{m}}$
(C) $6.28\sqrt{\frac{m}{k}}$
(D) $6.28\sqrt{\frac{k}{m}}$
(E) $0.16\sqrt{\frac{k}{m}}$

Questions 25 - 27

Two identical satellites orbit a planet of radius r as shown below. Satellite A is at altitude h above the surface of the planet and experiences centripetal force F. The kinetic energy of satellite A is K. Satellite B orbits at altitude 2h. Assume both orbits are circular. Assume r >> h.



25. The force experienced by satellite B is approximately

(A) F (r + 2h)
(B) F (1 – h/r)²
(C) $\frac{F}{4}$
(D) $\frac{F}{2}$
(E) 2F

26. The kinetic energy of satellite B is most nearly

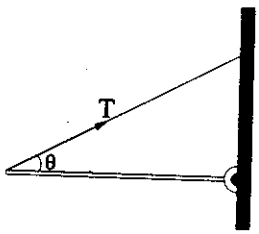
(A) $\frac{(r+h)K}{(r+2h)}$
(B) $\frac{(r+2h)K}{(r+h)}$
(C) $\frac{K}{4}$
(D) $\frac{K}{2}$
(E) 2K

27. If the mass of each satellite is m, the angular momentum of satellite A is most nearly

(A) $\frac{K}{m}$
(B) mKr
(C) $(r+h)\sqrt{2Km}$
(D) $r\sqrt{\frac{K}{m}}$
(E) $\sqrt{\frac{m}{K}}$

Questions 28 and 29

A boom of mass m, length L, and moment of inertia I is mounted horizontally on a frictionless pivot. It is suspended by a massless string set at angle θ to the horizontal and fixed to the far end of the boom. Refer to the diagram below.



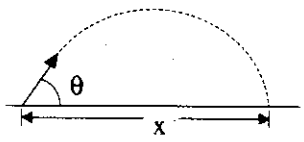
28. The tension in the string is

(A) mg cos θ
(B) mgL
(C) 0.5 mg cos θ
(D) 0.5 mg csc θ
(E) mg sec θ

29. If the string is cut, the initial angular acceleration of the boom will be

(A) $\frac{2g}{L}$
(B) $\frac{mgL}{2I}$
(C) $\frac{mgL}{I}$
(D) $g\sqrt{\frac{m}{I}}$
(E) IgL

30. As shown below, a cannon fires a shell at angle θ to the horizontal with initial velocity v. Assume that the shell travels as a projectile over flat terrain with no air resistance. The horizontal distance x covered by the shell before it hits the earth is most nearly equal to



(A) $\frac{2v^2}{g}\sin\theta$

(B) $\frac{2v^2}{g}$

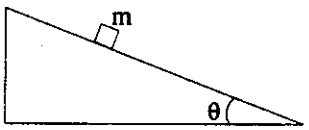
(C) $\frac{v^2}{g}\sin 2\theta$

(D) $\frac{v^2}{g}\cos\theta$

(E) vg

Questions 31 and 32

A block of mass m slides at a constant speed down an inclined plane of slope angle θ as shown below.



31. The coefficient of sliding friction between the block and the plane must be

(A) 0
(B) 1
(C) $mg\sin\theta$
(D) $mg\cos\theta$
(E) $\tan\theta$

32. If the coefficient of sliding friction were made equal to 0, the acceleration of the block would become

(A) 0
(B) $g\sin\theta$
(C) $g\cos\theta$
(D) $g\tan\theta$
(E) g

33. A ball of mass m drops a distance h with no air resistance. The power exerted on the ball by gravity in this process is

(A) $mg\sqrt{\frac{hg}{2}}$

(B) $mh\sqrt{2gh}$

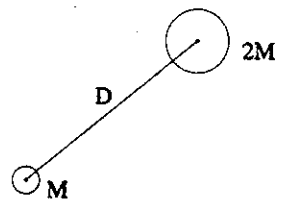
(C) mgh

(D) $mgh\sqrt{2g}$

(E) $\sqrt{\frac{mgh}{2}}$

Questions 34 and 35

A molecule is made up of an atom of mass M connected to another atom of mass 2M at a distance D, as shown below. Assume the atoms to be point masses.



34. How far from the first atom (of mass M) is the center of mass of the molecule?

(A) $\frac{D}{3}$

(B) $\frac{D}{2}$

(C) $\frac{2D}{3}$

(D) 2MD

(E) D

35. The moment of inertia of the molecule about its center of mass is most nearly

(A) $0.3MD^2$
(B) $0.5MD^2$
(C) $0.7MD^2$
(D) MD^2
(E) $2MD^2$

Name Key Date

AP Physics

Part 1 Answer Sheet Exam # SE #1

Place the best answer to each question in the space provided.

1. B	19. D		
2. D	20. D		
3. E	21. D		
4. A	22. D		
5. D	23. B		
6. C	24. E		
7. C	25. B		
8. D	26. A		
9. B	27. C		
10. B	28. D		
11. B	29. B		
12. C	30. C		
13. D	31. E		
14. C	32. B		
15. C	33. A		
16. A	34. C		
17. E	35. C		
18. E			

Number correct _____ x 1 = _____

Number left blank _____ x 1 = _____

Number incorrect _____ x -.25 = _____

Score (out of 35) _____

Grade _____ AP Score _____