Ver. 2 MP3 2nd Exam

Name: Qiu, Zeqin Date: 12/20/11 Period: 1&2

1. The approximate value of g at an altitude above Earth equal to one Earth diameter is:
   A) 9.8 m/s^2
   B) 4.9 m/s^2
   C) 2.5 m/s^2
   D) 1.9 m/s^2
   E) 1.1 m/s^2

$2r$ $r \to 3r$ $g \to \frac{1}{9}g$ $g \propto \frac{1}{r^2}$

2. The period of a simple pendulum is 1 s on Earth. When brought to a planet where g is one-tenth that on Earth, its period becomes:
   A) 1 s
   B) $1/\sqrt{10}$ s
   C) 1/10 s
   D) $\sqrt{10}$ s
   E) 10 s

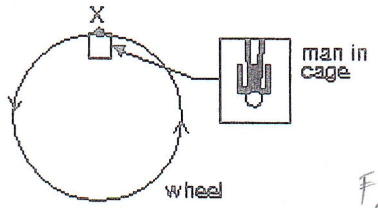
$T \propto \sqrt{\frac{L}{g}}$ $g \to \frac{1}{10}$

3. A particle moves back and forth along the x axis from $x = -x_m$ to $x = +x_m$, in simple harmonic motion with period T. At time $t = 0$ it is at $x = +x_m$. When $t = 0.75T$:
   A) it is at $x = 0$ and is traveling toward $x = +x_m$
   B) it is at $x = 0$ and is traveling toward $x = -x_m$
   C) it is at $x = +x_m$ and is at rest
   D) it is between $x = 0$ and $x = +x_m$ and is traveling toward $x = -x_m$
   E) it is between $x = 0$ and $x = -x_m$ and is traveling toward $x = -x_m$

0.75T 0.5T

4. In simple harmonic motion, the restoring force must be proportional to the:
   A) amplitude
   B) frequency
   C) velocity
   D) displacement
   E) displacement squared

5. A giant wheel, 40 m in diameter, is fitted with a cage and platform on which a man can stand. The wheel rotates at such a speed that when the cage is at X (as shown) the force exerted by the man on the platform is equal to his weight. The speed of the man is:



$F_c = 2mg = \frac{mv^2}{r}$

$\sqrt{2gr} = v$

$= 28 \text{ m/s}$

A) 14 m/s
B) 20 m/s
C) 28 m/s
D) 80 m/s
E) 120 m/s

6. An object of mass m and another object of mass $2m$ are each forced to move along a circle of radius 1.0 m at a constant speed of 1.0 m/s. The magnitudes of their accelerations are:
A) equal
B) in the ratio of $\sqrt{2}$: 1
C) in the ratio of 2 : 1
D) in the ratio of 4 : 1
E) zero

$a_c = \frac{v^2}{r}$ no mass fac

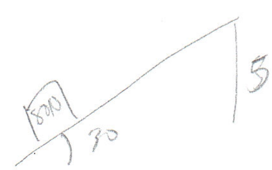
7. At time $t = 0$ a 2-kg particle has a velocity in m/s of (4 m/s)$\hat{i}$ – (3 m/s)$\hat{j}$. At $t = 3$ s its velocity is (2 m/s)$\hat{i}$ + (3 m/s)$\hat{j}$. During this time the work done on it was:
A) 4 J
B) –4 J
C) –12 J
D) –40 J
E) (4 J)$\hat{i}$ + (36 J)$\hat{j}$

$W = \Delta KE = \sqrt{2^2+3^2} - \sqrt{4^2+3^2}$

$\cancel{\sqrt{13} - 5}$ $13 - 25$

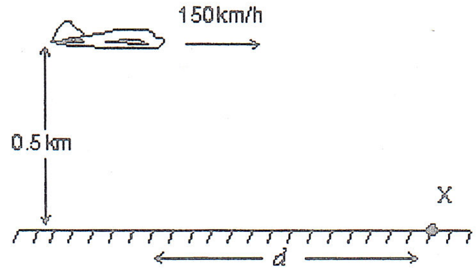
8. A man pushes an 80-N crate a distance of 5.0 m upward along a frictionless slope that makes an angle of 30° with the horizontal. The force he exerts is parallel to the slope. If the speed of the crate is constant, then the work done by the man is:
A) –200 J
B) 61 J
C) 140 J
D) 200 J
E) 260 J

$W = F \cdot d$



$80 \cdot 5 \sin 30$

12. The airplane shown is in level flight at an altitude of 0.50 km and a speed of 150 km/h. At what distance d should it release a heavy bomb to hit the target X? Take $g = 10\ m/s^2$.



$150 \frac{km}{h} = 41.666\ m/s$

$\times 10$

$= 416.6$

A) 150 m
B) 295 m
C) 417 m
D) 2550 m
E) 15,000 m

$500 = \frac{1}{2} a t^2$

$\sqrt{100} = t$

$t = 10$

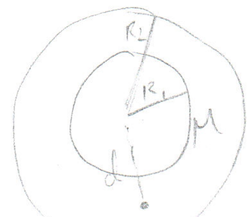
$d = V_i t + \frac{1}{2} a t^2$

$= 150 \cdot 10$

150000×10

13. A spherical shell has inner radius R_1, outer radius R_2, and mass M, distributed uniformly throughout the shell. The magnitude of the gravitational force exerted on the shell by a point mass particle of m a distance d from the center, outside the inner radius, is:

A) 0
B) GMm / R_1^2
C) GMm/d^2
D) $GMm / \left(R_2^2 - d^2\right)$
E) $GMm/(R_1 - d)^2$



$F = mg$

$g \cdot 4\pi R^2 = 4\pi G M_{enc}$

$m g = \frac{mG}{R^2}$

$M_{enc} =$

14. The escape velocity at the surface of Earth is approximately 8 km/s. What is the mass, in units of Earth's mass, of a planet with twice the radius of Earth for which the escape speed is twice that for Earth?

A) 2
B) 4
C) 8
D) 1/2
E) 1/4

$V = \sqrt{\frac{2GM}{R}}$

$V^2 = \frac{2GM}{R}$

$\frac{V^2 R}{2G} = M$

$R \to 2R$

$V \to 2V$

$M = 8M$

37. Venus has a mass of about 0.0558 times the mass of Earth and a diameter of about 0.381 times the diameter of Earth. The acceleration of a body falling near the surface of Venus is about:

A) 0.21 m/s^2
B) 1.4 m/s^2
C) 2.8 m/s^2
D) 3.8 m/s^2
E) 25 m/s^2

$a = G\frac{M}{r^2} \rightarrow G\frac{0.0558M}{(0.381)^2 r^2}$

$= 0.3844g = 3.8\,m/s^2$

38. In simple harmonic motion, the magnitude of the acceleration is:

A) constant
B) proportional to the displacement
C) inversely proportional to the displacement
D) greatest when the velocity is greatest
E) never greater than *g*

39. A man pushes an 80-N crate a distance of 5.0 m upward along a frictionless slope that makes an angle of 30° with the horizontal. His force is parallel to the slope. If the speed of the crate decreases at a rate of 1.5 m/s^2, then the work done by the man is:

A) –200 J
B) 61 J
C) 140 J
D) 200 J
E) 260 J

~~W = ΔKE~~ $W = F \cdot d$

$F = ma$

$F = \frac{80 \cdot 1.5}{9.81}$ $\frac{80 \cdot 1.5}{9.81}$ ·5

40. A certain spring elongates 9 mm when it is suspended vertically and a block of mass *M* is hung on it. The natural frequency of this mass-spring system is:

A) is 0.088 rad/s
B) is 33 rad/s
C) is 200 rad/s
D) is 1140 rad/s
E) cannot be computed unless the value of *M* is given

$W = 2\pi f$

$\sqrt{\frac{k}{M}} = 2\pi f$

41. In the formula $F = Gm_1m_2/r^2$, the quantity G:

A) depends on the local value of *g*
B) is used only when the Earth is one of the two masses
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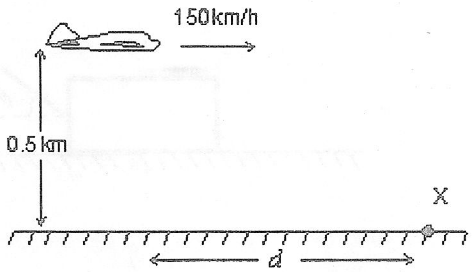

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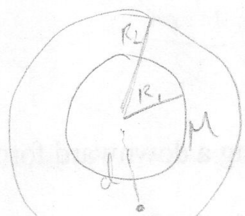

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$R \to 2R$

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23. A man, holding a weight in each hand, stands at the center of a horizontal frictionless rotating turntable. The effect of the weights is to double the rotational inertia of the system. As he is rotating, the man opens his hands and drops the two weights. They fall outside the turntable. Then:

A) his angular velocity doubles
B) his angular velocity remains about the same
C) his angular velocity is halved
D) the direction of his angular momentum vector changes
E) his rotational kinetic energy increases

$L = I\omega$

$\frac{1}{2}I$ $\quad \omega = \uparrow 2\omega$

24. An ideal spring is hung vertically from the ceiling. When a 2.0-kg mass hangs at rest from it the spring is extended 6.0 cm from its relaxed length. A downward external force is now applied to the mass to extend the spring an additional 10 cm. While the spring is being extended by the force, the work done by the spring is:

A) –3.6 J
B) –3.3 J
C) -3.4×10^{-5} J
D) 3.3 J
E) 3.6 J

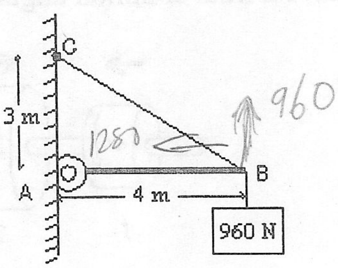
$2 \times 9.81 = k \cdot 0.06$

$k = 327$

2 kg

$W = \frac{1}{2}kx^2$

25. A 960-N block is suspended as shown. The beam AB is weightless and is hinged to the wall at A. The tension force of the cable BC has magnitude:



$= 1600$

A) 720 N
B) 1200 N
C) 1280 N
D) 1600 N
E) none of these

29. If a satellite moves above the Earth's atmosphere in a circular orbit with constant speed, then:
    A) its acceleration and velocity are in the same direction
    B) the net force on it is zero
    C) its velocity is constant
    D) it will fall back to Earth when its fuel is used up
    E) its acceleration is toward the Earth

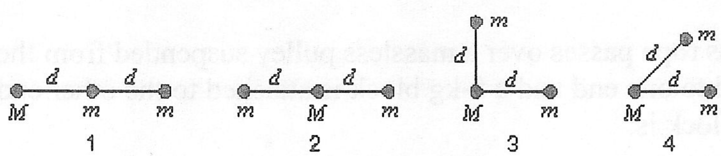
$V = const$

30. Suppose you have a pendulum clock which keeps correct time on Earth (acceleration due to gravity = 9.8 m/s^2). Without changing the clock, you take it to the Moon (acceleration due to gravity = 1.6 m/s^2). For every hour interval (on Earth) the Moon clock will record:
    A) (9.8/1.6) h
    B) 1 h
    C) $\sqrt{9.8/1.6}$ h
    D) (1.6/9.8) h
    E) $\sqrt{1.6/9.8}$ h

$T \propto \sqrt{\frac{L}{g}}$

31. The mass of an object:
    A) is slightly different at different locations on the Earth
    B) is a vector
    C) is independent of the acceleration due to gravity
    D) is the same for all objects of the same size and shape
    E) can be measured directly and accurately on a spring scale

32. Three particles, two with mass m and one mass M, might be arranged in any of the four configurations known below. Rank the configurations according to the magnitude of the gravitational force on M, least to greatest.



    A) 1, 2, 3, 4
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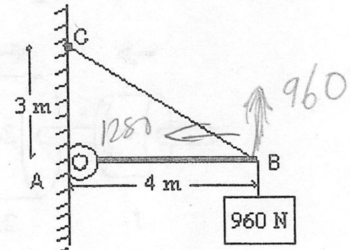

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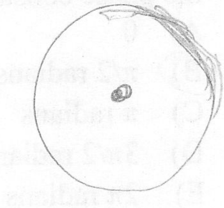

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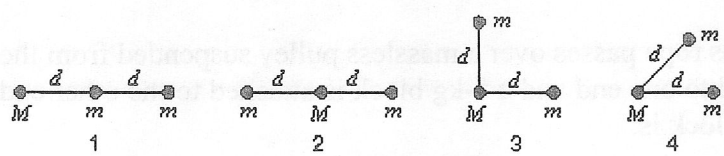

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50. A hoop rolls with constant velocity and without sliding along level ground. Its rotation kinetic energy is:

A) half its translational kinetic energy
B) the same as its translational kinetic energy
C) twice its translational kinetic energy
D) four times its translational kinetic energy
E) one-third its translational kinetic energy

$KE = \frac{1}{2} m v^2$

$\omega = V/R$

$KE_R = \frac{1}{2} I \omega^2$

$= \frac{1}{2} M \cancel{R}^2 \cdot \frac{V^2}{\cancel{R^2}}$

$= \frac{1}{2} M V^2$

42. A watt per hour is a unit of:
A) energy
B) power
C) force
D) acceleration
E) none of these

~~E = Pt~~

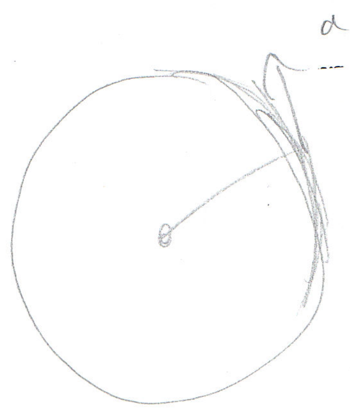
$P = \frac{E}{t} \rightsquigarrow \frac{J}{s} \rightsquigarrow \frac{kg\,\frac{m^2}{s^2}}{s^2} \rightarrow kg\,\frac{m^2}{s^3}$

43. In planetary motion the line from the star to the planet sweeps out equal areas in equal times. This is a direct consequence of:
A) the conservation of energy
B) the conservation of momentum
C) the conservation of angular momentum
D) the conservation of mass
E) none of the above

44. An object at the surface of Earth (at a distance R from the center of Earth) weighs 90 N. Its weight at a distance $3R$ from the center of Earth is:
A) 10 N
B) 30 N
C) 90 N
D) 270 N
E) 810 N

$F_g \propto \frac{1}{R^2}$

45. For a wheel spinning on an axis through its center, the ratio of the radial acceleration of a point on the rim to the radial acceleration of a point halfway between the center and the rim is:
A) 1
B) 2
C) 1/2
D) 4
E) 1/4



$a_c = \frac{\cancel{m}v^2}{R}$

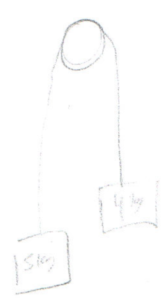
33. The displacement of a mass oscillating on a spring is given by $x(t) = x_m\cos(\omega t + \phi)$. If the initial displacement is zero and the initial velocity is in the negative x direction, then the phase constant ϕ is:
A) 0
B) $\pi/2$ radians
C) π radians
D) $3\pi/2$ radians
E) 2π radians

$x(0) = 0 = x_m\cos(\overset{0}{\omega t} + \phi)$
$v(0) = -x_m \omega \underset{\sin}{\cancel{\cos}}(\omega t + \phi)$

34. A lead block is suspended from your hand by a string. The reaction to the force of gravity on the block is the force exerted by the:
A) string on the block
B) block on the string
C) string on the hand
D) hand on the string
E) block on the Earth

35. An artificial Earth satellite is moved from a circular orbit with radius R to a circular orbit with radius $2R$. During this move:
A) the gravitational force does positive work, the kinetic energy of the satellite increases, and the potential energy of the Earth-satellite system increases
B) the gravitational force does positive work, the kinetic energy of the satellite increases, and the potential energy of the Earth-satellite system decreases
C) the gravitational force does positive work, the kinetic energy of the satellite decreases, and the potential energy of the Earth-satellite system increases
D) the gravitational force does negative work, the kinetic energy of the satellite system increases, and the potential energy of the Earth-satellite system decreases
E) the gravitational force does negative work, the kinetic energy of the satellite decreases, and the potential energy of the Earth-satellite system increases

36. A massless rope passes over a massless pulley suspended from the ceiling. A 4-kg block is attached to one end and a 5-kg block is attached to the other end. The acceleration of the 5-kg block is:
A) $g/4$
B) $5g/9$
C) $4g/9$
D) $g/5$
E) $g/9$



$a = F/M$
$\frac{g}{9} = \frac{5 \cdot 9.81}{5} + F_T \qquad -\frac{g}{9} = F_T - 9.81$

26. Three physical pendulums, with masses m_1, $m_2 = 2m_1$, and $m_3 = 3m_1$, have the same shape and size and are suspended at the same point. Rank them according to their periods, from shortest to longest.

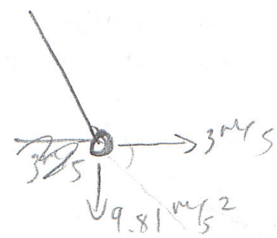
A) 1, 2, 3
B) 3, 2, 1
C) 2, 3, 1
D) 2, 1, 3
E) All the above are the same

$\omega = \sqrt{\frac{g}{m}} = 2\pi f \quad T =$

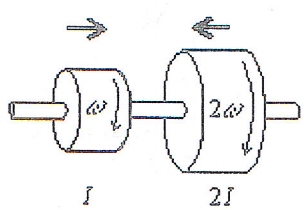
$T = 2\pi \sqrt{\frac{m}{g}}$

27. A car moves horizontally with a constant acceleration of 3 m/s². A ball is suspended by a string from the ceiling of the car; the ball does not swing, being at rest with respect to the car. What angle does the string make with the vertical?

A) 17°
B) 35°
C) 52°
D) 73°
E) Cannot be found without knowing the length of the string



28. Two disks are mounted on low-friction bearings on a common shaft. The first disc has rotational inertia I and is spinning with angular velocity ω. The second disc has rotational inertia $2I$ and is spinning in the same direction as the first disc with angular velocity 2ω as shown. The two disks are slowly forced toward each other along the shaft until they couple and have a final common angular velocity of:



A) $5\omega/3$
B) $\omega\sqrt{3}$
C) $\omega\sqrt{7/3}$
D) ω
E) 3ω

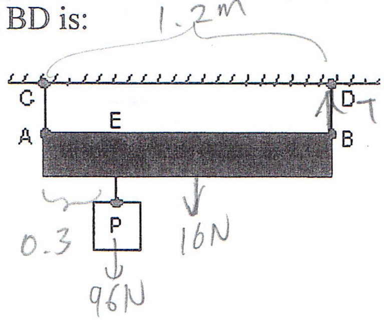
$L = I\omega$

$I\omega + 4I\omega$

$= 5I\omega / 3I$

$\omega = \frac{5}{3}\omega$

20. A uniform rod AB is 1.2 m long and weighs 16 N. It is suspended by strings AC and BD as shown. A block P weighing 96 N is attached at E, 0.30 m from A. The magnitude of the tension force in the string BD is:



A) 8.0 N
B) 24 N
C) 32 N
D) 48 N
E) 80 N

$\sum T = -96 \cdot 0.3 - 16 \cdot 0.6 + F_T \cdot 1.2$

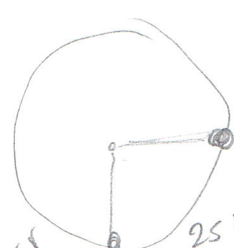
$F_T = 32$

21. A pulley with radius R and rotational inertia I is free to rotate on a horizontal fixed axis through its center. A string passes over the pulley. A block of mass m_1 is attached to one end and a block of mass m_2, is attached to the other. At one time the block with mass m_1 is moving downward with speed v. If the string does not slip on the pulley, the magnitude of the total angular momentum, about the pulley center, of the blocks and pulley, considered as a system, is given by:

A) $(m_1 - m_2)vR + Iv/R$
B) $(m_1 + m_2)vR + Iv/R$
C) $(m_1 - m_2)vR - Iv/R$
D) $(m_1 + m_2)vR - Iv/R$
E) none of the above

22. A girl jogs around a horizontally circle with a constant speed. She travels one fourth of a revolution, a distance of 25 m along the circumference of the circle, in 5.0 s. The magnitude of her acceleration is:

A) 0.31 m/s²
B) 1.3 m/s²
C) 1.6 m/s²
D) 3.9 m/s²
E) 6.3 m/s²

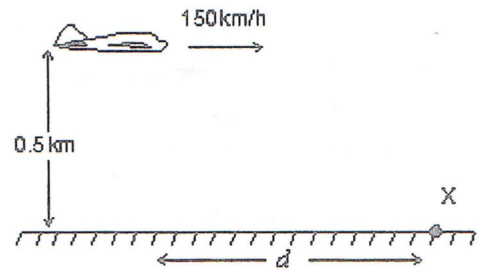


$25m \times 4 = 2\pi r$

$R = 50/\pi$

$a = \frac{V^2}{R}$

12. The airplane shown is in level flight at an altitude of 0.50 km and a speed of 150 km/h. At what distance d should it release a heavy bomb to hit the target X? Take $g = 10\ \text{m/s}^2$.



$150 \frac{km}{h} = 41.666\ m/s$

$\times 10$

$= 416.6$

A) 150 m
B) 295 m
C) 417 m
D) 2550 m
E) 15,000 m

$500 = \frac{1}{2} a t^2$

$\sqrt{100} = t$

$t = 10$

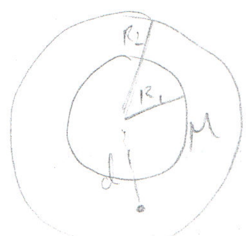
~~$d = v_i t + \frac{1}{2} a t^2$~~

~~$= 150 \times 10$~~

150000×10

13. A spherical shell has inner radius R_1, outer radius R_2, and mass M, distributed uniformly throughout the shell. The magnitude of the gravitational force exerted on the shell by a point mass particle of m a distance d from the center, outside the inner radius, is:

A) 0
B) GMm / R_1^2
C) GMm/d^2
D) $GMm / \left(R_2^2 - d^2\right)$
E) $GMm/(R_1 - d)^2$



$F = mg$

$g \cdot 4\pi R^2 = 4\pi G M_{enc}$

$mg = \frac{mG}{R^2}$

14. The escape velocity at the surface of Earth is approximately 8 km/s. What is the mass, in units of Earth's mass, of a planet with twice the radius of Earth for which the escape speed is twice that for Earth?

A) 2
B) 4
C) 8
D) 1/2
E) 1/4

M_{enc}

$V = \sqrt{\frac{2GM}{R}}$

$V^2 = \frac{2GM}{R}$

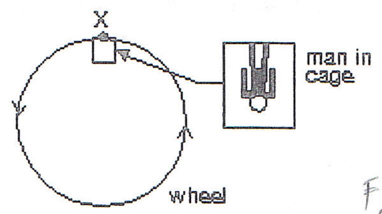
$\frac{V^2 R}{2G} = M$

$R \to 2R$

$V \to 2V$

$M = 8M$

5. A giant wheel, 40 m in diameter, is fitted with a cage and platform on which a man can stand. The wheel rotates at such a speed that when the cage is at X (as shown) the force exerted by the man on the platform is equal to his weight. The speed of the man is:



$F_c = 2\cancel{m}g = \frac{\cancel{m}v^2}{r}$

$\sqrt{2gr} = v$

$= 28$ m/s

A) 14 m/s
B) 20 m/s
C) 28 m/s
D) 80 m/s
E) 120 m/s

6. An object of mass m and another object of mass $2m$ are each forced to move along a circle of radius 1.0 m at a constant speed of 1.0 m/s. The magnitudes of their accelerations are:

A) equal
B) in the ratio of $\sqrt{2}$: 1
C) in the ratio of 2 : 1
D) in the ratio of 4 : 1
E) zero

$a_c = \frac{v^2}{r}$ no mass here

7. At time $t = 0$ a 2-kg particle has a velocity in m/s of $(4\text{ m/s})\hat{\imath} - (3\text{ m/s})\hat{\jmath}$. At $t = 3$ s its velocity is $(2\text{ m/s})\hat{\imath} + (3\text{ m/s})\hat{\jmath}$. During this time the work done on it was:

A) 4 J
B) −4 J
C) −12 J
D) −40 J
E) $(4\text{ J})\hat{\imath} + (36\text{ J})\hat{\jmath}$

$W = \Delta KE = \sqrt{2^2+3^2} - \sqrt{4^2+3^2}$

$\sqrt{13}$ ~~5~~ 13−25

8. A man pushes an 80-N crate a distance of 5.0 m upward along a frictionless slope that makes an angle of 30° with the horizontal. The force he exerts is parallel to the slope. If the speed of the crate is constant, then the work done by the man is:

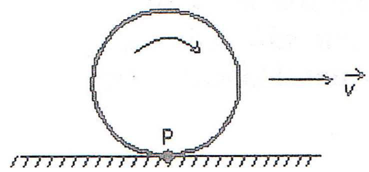
A) −200 J
B) 61 J
C) 140 J
D) 200 J
E) 260 J

W = F·d

80 · 5 sin 30

80 30 5

46. A wheel rolls without slipping along a horizontal road as shown. The velocity of the center of the wheel is represented by →. Point P is painted on the rim of the wheel. The instantaneous velocity of point P is:



A) →
B) ←
C) ↑
D) ↗
E) zero

47. A uniform disk has radius R and mass M. When it is spinning with angular velocity ω about an axis through its center and perpendicular to its face its angular momentum is $I\omega$. When it is spinning with the same angle velocity about a parallel axis a distance h away its angular momentum is:

A) $I\omega$
B) $(I + Mh^2)\omega$
C) $(I - Mh^2)\omega$
D) $(I + MR^2)\omega$
E) $(I - MR^2)\omega$

48. Ten seconds after an electric fan is turned on, the fan rotates at 300 rev/min. Its average angular acceleration is:

A) 3.14 rad/s²
B) 30 rad/s²
C) 30 rev/s²
D) 50 rev/min²
E) 1800 rev/s²

$300 \frac{rev}{min}$

0 10

49. A wheel initially has an angular velocity of 18 rad/s but it is slowing at a rate of 2.0 rad/s². By the time it stops it will have turned through:

A) 81 rad
B) 160 rad
C) 245 rad
D) 330 rad
E) 410 rad

$\theta = \omega_i t + \frac{1}{2}\alpha t^2$

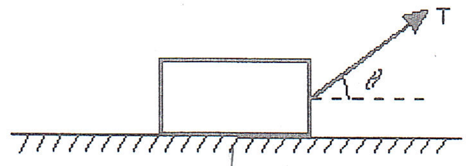
$18(9) + \frac{1}{2}(-2)(9)^2$

$\omega_f = \omega_i + \alpha t$

$0 = 18 - 2t$

$t = 9\ s$

9. A block of mass *m* is pulled along a rough horizontal floor by an applied force $\vec{T}$ as shown. The vertical component of the force exerted on the block by the floor is:



A) mg
B) $mg - T\cos\theta$
C) $mg + T\cos\theta$
D) $mg - T\sin\theta$
E) $mg + T\sin\theta$

mg

$mg - T\sin\theta$

10. A projectile is fired straight upward from Earth's surface with a speed that is half the escape speed. If *R* is the radius of Earth, the highest altitude reached, measured from the surface, is:
A) $R/4$
B) $R/3$
C) $R/2$
D) R
E) $2R$

KE + PE = 0

$\cancel{v = \sqrt{\frac{2GM}{R}}}$

$\frac{1}{2}\cancel{m}v^2 = G\frac{M\cancel{m}}{R}$

$\frac{1}{2}mv^2 \to \frac{1}{8}mv^2 = G\frac{Mm}{4R}$

11. A book rests on a table, exerting a downward force on the table. The reaction to this force is:
A) the force of the Earth on the book
B) the force of the table on the book
C) the force of the Earth on the table
D) the force of the book on the Earth
E) the inertia of the book

$\to G\frac{Mm}{4R} - G\frac{Mm}{R} = -\frac{3GMm}{4R}$

$\frac{4}{3} = R$

$v^2 = 2G\frac{M}{R}$

15. A 3-kg block, attached to a spring, executes simple harmonic motion according to $x = 2\cos(50t)$ where x is in meters and t is in seconds. The spring constant of the spring is:
A) 1 N/m
B) 100 N/m
C) 150 N/m
D) 7500 N/m
E) none of these

$w = \sqrt{\frac{K}{m}} = 50$

16. At time $t = 0$ a particle starts moving along the x axis. If its kinetic energy increases uniformly with t the net force acting on it must be:
A) constant
B) proportional to t
C) inversely proportional to t
D) proportional to $\sqrt{t}$
E) proportional to $1/\sqrt{t}$

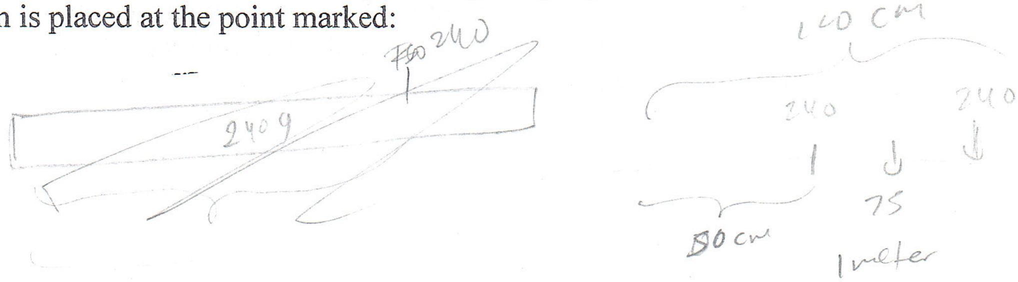
$\cancel{F \cdot d} = \cancel{KE}$

$ma \downarrow \frac{x}{t^2}$

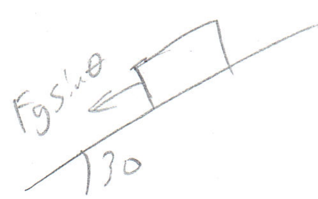
$\frac{1}{2} m v^2 \downarrow \frac{x^2}{t^2}$

17. Which of the following is a scalar quantity?
A) Speed
B) Velocity
C) Displacement
D) Acceleration
E) None of these

18. A uniform 240-g meter stick can be balanced by a 240-g weight placed at the 100-cm mark if the fulcrum is placed at the point marked:
A) 75 cm
B) 60 cm
C) 50 cm
D) 40 cm
E) 80 cm



19. A block slides down a frictionless plane that makes an angle of 30° with the horizontal. The acceleration of the block (in cm/s²) is:
A) 980
B) 566
C) 849
D) zero
E) 490



$mg \sin\theta = ma$

$g \sin\theta = a$

23. A man, holding a weight in each hand, stands at the center of a horizontal frictionless rotating turntable. The effect of the weights is to double the rotational inertia of the system. As he is rotating, the man opens his hands and drops the two weights. They fall outside the turntable. Then:

A) his angular velocity doubles
B) his angular velocity remains about the same
C) his angular velocity is halved
D) the direction of his angular momentum vector changes
E) his rotational kinetic energy increases

$L = I\omega$

$\frac{1}{2}I \quad \omega = \uparrow 2\omega$

24. An ideal spring is hung vertically from the ceiling. When a 2.0-kg mass hangs at rest from it the spring is extended 6.0 cm from its relaxed length. A downward external force is now applied to the mass to extend the spring an additional 10 cm. While the spring is being extended by the force, the work done by the spring is:

A) –3.6 J
B) –3.3 J
C) -3.4×10^{-5} J
D) 3.3 J
E) 3.6 J

$2 \times 9.81 = K \cdot 0.06$

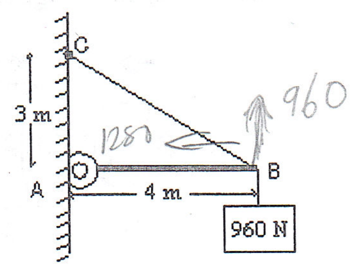
$K = 327$

2 kg

~~$W = \int F\, ds = -kx$~~

$W = \frac{1}{2}Kx^2$

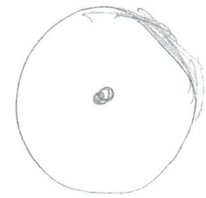
25. A 960-N block is suspended as shown. The beam AB is weightless and is hinged to the wall at A. The tension force of the cable BC has magnitude:



= 1600

A) 720 N
B) 1200 N
C) 1280 N
D) 1600 N
E) none of these

29. If a satellite moves above the Earth's atmosphere in a circular orbit with constant speed, then:
A) ~~its acceleration and velocity are in the same direction~~
B) ~~the net force on it is zero~~
C) ~~its velocity is constant~~
D) ~~it will fall back to Earth when its fuel is used up~~
E) its acceleration is toward the Earth



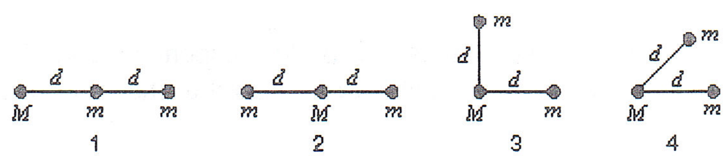
V = const

30. Suppose you have a pendulum clock which keeps correct time on Earth (acceleration due to gravity = 9.8 m/s^2). Without changing the clock, you take it to the Moon (acceleration due to gravity = 1.6 m/s^2). For every hour interval (on Earth) the Moon clock will record:
A) (9.8/1.6) h
B) 1 h
C) $\sqrt{9.8/1.6}$ h
D) (1.6/9.8) h
E) $\sqrt{1.6/9.8}$ h

$T \propto \sqrt{\frac{L}{g}}$

31. The mass of an object:
A) is slightly different at different locations on the Earth
B) is a vector
C) is independent of the acceleration due to gravity
D) is the same for all objects of the same size and shape
E) can be measured directly and accurately on a spring scale

32. Three particles, two with mass *m* and one mass *M*, might be arranged in any of the four configurations known below. Rank the configurations according to the magnitude of the gravitational force on *M*, least to greatest.



A) ~~1, 2, 3, 4~~
B) 2, 1, 3, 4
C) 2, 1, 4, 3
D) 2, 3, 4, 1
E) 2, 3, 2, 4

37. Venus has a mass of about 0.0558 times the mass of Earth and a diameter of about 0.381 times the diameter of Earth. The acceleration of a body falling near the surface of Venus is about:
   A) 0.21 m/s²
   B) 1.4 m/s²
   C) 2.8 m/s²
   D) 3.8 m/s²
   E) 25 m/s²

$a = G\frac{M}{r^2} \rightsquigarrow G\frac{0.0558M}{(0.381)^2 r^2}$

$= 0.3844\,g = 3.8\ m/s^2$

38. In simple harmonic motion, the magnitude of the acceleration is:
   A) constant
   B) proportional to the displacement
   C) inversely proportional to the displacement
   D) greatest when the velocity is greatest
   E) never greater than g

39. A man pushes an 80-N crate a distance of 5.0 m upward along a frictionless slope that makes an angle of 30° with the horizontal. His force is parallel to the slope. If the speed of the crate decreases at a rate of 1.5 m/s², then the work done by the man is:
   A) –200 J
   B) 61 J
   C) 140 J
   D) 200 J
   E) 260 J

~~$W = \Delta KE$~~ $W = F \cdot d$

$F = ma$

$F = \frac{80 \cdot 1.5}{9.81}$ $\frac{80 \cdot 1.5}{9.81}$ .5

40. A certain spring elongates 9 mm when it is suspended vertically and a block of mass M is hung on it. The natural frequency of this mass-spring system is:
   A) is 0.088 rad/s
   B) is 33 rad/s
   C) is 200 rad/s
   D) is 1140 rad/s
   E) cannot be computed unless the value of M is given

$W = 2\pi f$

$\sqrt{\frac{k}{M}} = 2\pi f$

41. In the formula $F = Gm_1m_2/r^2$, the quantity G:
   A) depends on the local value of g
   B) is used only when the Earth is one of the two masses
   C) is greatest at the surface of the Earth
   D) is a universal constant of nature
   E) is related to the Sun in the same way that g is related to the Earth

SIDE 1

RESCORE | MARK ✓ | TOTAL ONLY/BOTH SIDES

Item	Marked	Handwritten	Item	Marked	Handwritten
1	E		26	A	E
2	D		27	A	
3	A		28	A	
4	D		29	E	
5	C	B	30	C	E
6	A		31	C	
7	C		32	B	
8	D		33	B	
9	D		34	E	
10	B		35	E	
11	B		36	E	
12	C		37	D	
13	D	C	38	B	
14	C		39	B	C
15	D		40	E	B
16	B	E	41	D	
17	A		42	E	
18	A		43	C	
19	E		44	A	
20	C		45	B	
21	A	B	46	E	
22	A	C	47	B	
23	A	B	48	C	A
24	B	A	49	A	
25	D		50	B	

KEY ITEM COUNT

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USE NO. 2 PENCIL ONLY

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Fill circle completely

Erase cleanly

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SCORE	38	# CORRECT
	76	% CORRECT
RESCORE		# CORRECT
		% CORRECT
ROSTER NUMBER	6	SCORE
		RESCORE

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PERIOD 1&2 DATE 12/20/11

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