Ver. 2 MP3 2nd Exam

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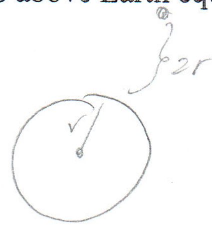
1. The approximate value of g at an altitude above Earth equal to one Earth diameter is:
   A) 9.8 m/s^2
   B) 4.9 m/s^2
   C) 2.5 m/s^2
   D) 1.9 m/s^2
   E) 1.1 m/s^2



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

$g \to \frac{1}{9} g$

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 $x = -x_m$

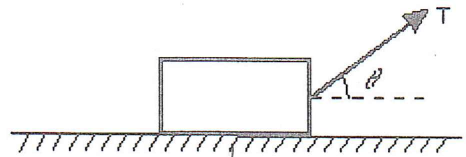
0.75 T

0 0

0.5 T

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

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:



mg

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

$mg - T\sin\theta$

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) $2R$

$KE + PE = 0$

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

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

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

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

$\rightarrow G\frac{Mm}{4R} - G\frac{Mm}{R} = \frac{-3G\,Mm}{4R}$

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

$-\frac{Mm}{R}$

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

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

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

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 $1/\sqrt{t}$

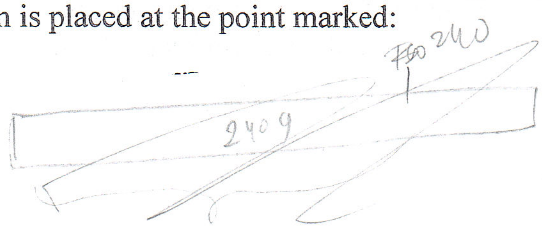
$\cancel{F \cdot d} = \cancel{KE}$

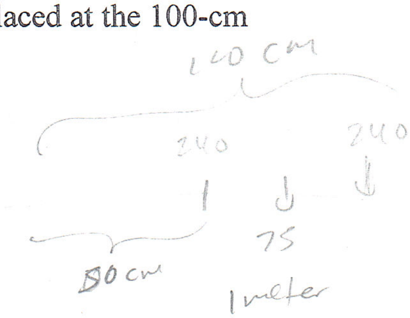
$ma \downarrow \frac{x}{t^2}$

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

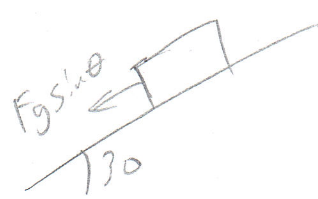
17. Which of the following is a scalar quantity?
A) Speed
B) Velocity
C) Displacement
D) Acceleration
E) None of these

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

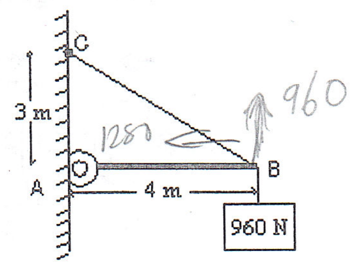
$L = I\omega$
$\downarrow$
$\frac{1}{2}I \quad \omega = \uparrow 2\omega$

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
$\cancel{W = \int F\,ds = -kx}$
$W = \frac{1}{2}Kx^2$

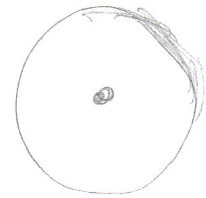
25. A 960-N block is suspended as shown. The beam AB is weightless and is hinged to the wall at A. The tension force of the cable BC has magnitude:



= 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



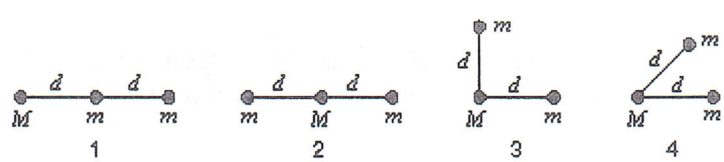
V=const

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/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

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

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

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

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

$F = ma$

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

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