Name-Surname :
Number :
Department :
Signature :

FİZ 137 PHYSICS I
MIDTERM I
18.11.2011

1. The duration of the exam is 100 minutes.
2. There are 30 questions with equal weight in this exam.
3. This question booklet is type "**M**" booklet. Check to see that all pages are type "**M**".
4. Use the appropriate box **in the answer sheet**.
5. Five wrong answers nullify a correct answer.
6. If need be, use the back page of the booklet for calculation.
7. Please fill in identity information both the booklet and answer sheet.
8. It is not allowed to use calculator.

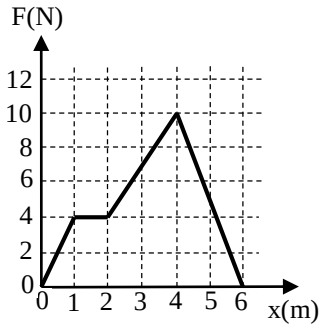
GIVENS

The acceleration of gravity: $g = 10\ m/s^2$
$\sin 45^\circ = \cos 45^\circ = 0.7$
$\sin 37^\circ = \cos 53^\circ = 0.6$
$\tan 37^\circ = 0.75$
$\sin 53^\circ = \cos 37^\circ = 0.8$
$\sin 30^\circ = \cos 60^\circ = -\cos 120^\circ = 0.5$
$\sin 60^\circ = \cos 30^\circ = 0.87$
$\cos 180^\circ = -1$
$\pi = 3$
$\sqrt{2} = 1.4$
$\sqrt{3} = 1.7$

Metric Prefixes

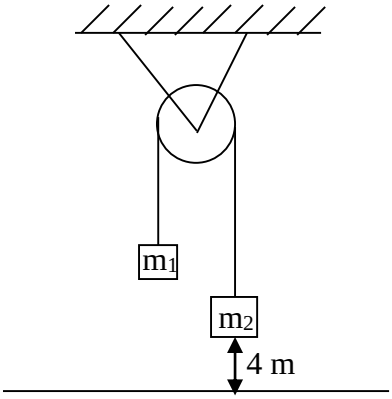
Number	Prefix	Abbr.
10^9	giga	G
10^6	mega	M
10^3	kilo	k
10^{-2}	centi	c
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p

1. A position dependent force acting on an object moving along x-axis is given in the figure. What is the work done (in J) on the object by this force between x = 0 m and x = 6 m?



A) 30 B) 40 C) 50
D) 60 E) 70

2. An Atwood machine with masses m_1 = 2 kg and m_2 = 3 kg, is initially at rest and m_2 is at a distance 4 m from the ground. After the system is released, what is the speed (in m/s) of m_2 just before hitting the ground?

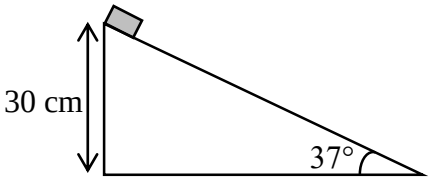


A) 5 B) 4 C) 3
D) 2 E) 1

3. A 30 kg object is bouncing on an elastic horizontal surface. During a certain time interval after it leaves the surface, its kinetic energy decreases from 390 J to 210 J. How high (in m) does it rise during this interval? (Neglect the air resistance.)

A) 2.0 B) 1.8 C) 1.2 D) 0.6 E) 0.3

4. A block of mass 500 g starts to slide down from the top of an inclined plane of height 30 cm and slope 37° without initial velocity. If the coefficient of kinetic friction between the block and incline is 0.3, find the work (in J) done by the frictional force along the inclined plane.

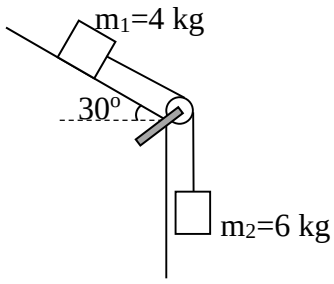


A) – 0.3 B) – 0.6 C) – 1.2 D) – 1.6 E) – 2.1

5. A stone is thrown from top of a building at an angle of 30^o above the horizontal with an initial speed of 20 m/s. If the height of the building is 40 m, what is the time of flight (in s) of the stone?

   A) 5 B) 2 C) 4 D) 6 E) 8

6. A block of mass m_1 = 4 kg on a frictionless inclined plane of angle 30^o is connected by a cord over a massless, frictionless pulley to a second block of mass m_2 = 6 kg as shown in the figure. The system is released from rest, what is the magnitude of the acceleration (in m/s^2) of the system?

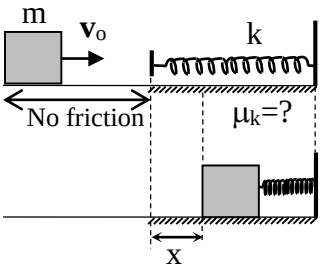


   A) 5 B) 6 C) 7 D) 8
   E) 9

7. The velocity of a particle moving in the xy plane is given by the equation $\mathbf{v} = (6\,t - 4\,t^2)\mathbf{i} + 8\mathbf{j}$ (m/s). What is its acceleration (in m/s^2) at t = 3 s?

   A) – 10 **i** B) – 30 **i** C) 30 **i** D) 18 **i** E) – 18 **i**

8. A block of mass m = 4 kg slides with a constant speed v_o = 10 m/s on a frictionless surface. It then collides head on with a spring (k = 2400 N/m) over a horizontal floor with friction. The block momentarily stops after compressing the spring by x = 40 cm. What is the coefficient of kinetic friction between the block and floor?



   A) 0.5 B) 0.4 C) 0.3 D) 0.2 E) 0.1

9. A car travels on a straight road for 80 km at 30 km/h. It then continues in the same direction for another 80 km at 60 km/h. What is the average velocity (in km/h) during this 160 km trip?

A) 33 B) 35 C) 37 D) 40 E) 45

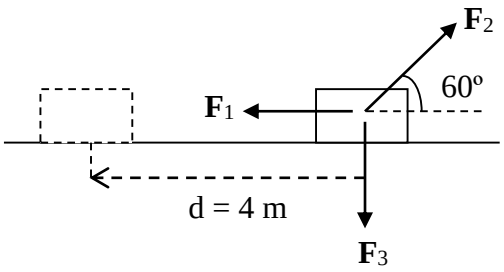
10. Vectors **a** and **b** are given by **a** = 2**i** – **j** and **b** = 3**i** + 5**j**. What is the value of (**a** – **b**) · **a**?

A) – 33 B) – 27 C) 0 D) 2 E) 4

11. A ball is thrown horizontally from the top of a building with a height of 27 m. It hits the ground with a speed that is 4 times its initial speed. What is the initial speed (in m/s) of the ball?

A) 6 B) 8 C) 10 D) 12 E) 14

12. Figure shows three forces applied to a block that moves leftward by 4 m on a frictionless floor. If F_1 = 10 N, F_2 = 5 N and F_3 = 4 N, what is the net work (in J) done on the block?



A) 66 B) 46 C) 30 D) 14 E) 16

13. A 2 kg object, which has an initial speed of 100 m/s, is fired at an angle of 37° above the horizontal. What is the change in its potential energy (in kJ) by the time it reaches to the top of its trajectory? (Ignore the air resistance.)

A) 1.0 B) 3.0 C) 4.5 D) 3.6 E) 1.5

14. A 200 g block is placed on a frictionless horizontal table and is attached to a spring with a spring constant of 5 N/m. The block is stretched by 10 cm from the relaxed position and released. Find the instantaneous velocity (in m/s) of the block as it is passing at 6 cm?

A) 0.4 B) 0.5 C) 0.3 D) 0.1 E) 0.2

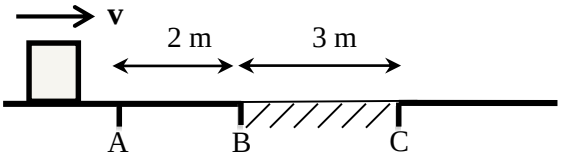
15. A particle moves with a constant speed on a circular path of radius 0.4 m. If the particle completes 5 revolutions each second, find its acceleration (in m/s^2).

A) 585 B) 440 C) 360 D) 235 E) 120

16. Position dependence of a force acting on a particle is given as $\mathbf{F} = 3x^2\,\mathbf{i} + y\,\mathbf{j}$ (N). Find the work (in J) done on the particle by the force while it is moving from point A (−2m;1m) to point B (3m; 3m).

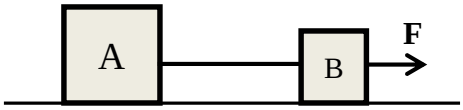
A) 31 B) 35 C) 39 D) 41 E) 45

17. The block shown in the figure moves on a horizontal plane. There is friction only between the points B and C. If the speed of the block at point A is 3 m/s, what is the coefficient of kinetic friction to stop the block at point C?



A) 0.35 B) 0.30 C) 0.25 D) 0.20 E) 0.15

18. Two blocks A and B with the masses of 6 kg and 4 kg, respectively, are connected by a rope and lie on a frictionless surface. If force of 10 N acts on block B, calculate the magnitude of force (in N) acting on block A.

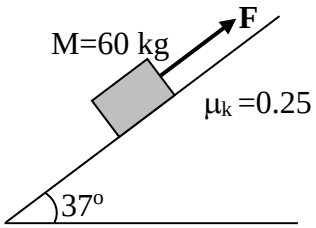


A) 4 B) 6 C) 10 D) 8 E) 12

19. A 4 kg object accelerates uniformly from rest to a speed of 30 m/s in 6 s. What is the instantaneous power (in W) delivered to the object 2 s after it starts?

A) 100 B) 120 C) 180 D) 200 E) 240

20. A block of mass M = 60 kg is moved upward on a plane inclined at angle 37° to the horizontal. The coefficient of kinetic friction between the block and the inclined plane is μ_k = 0.25. What must be the magnitude of the force **F** (in N) which is parallel to the plane to move the block with a constant velocity?

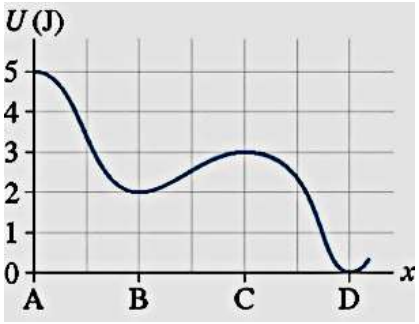


A) 120 B) 240 C) 300 D) 360 E) 480

21. A 300 kg lift starts its upward motion at a constant acceleration of 2 m/s^2. What is the tension (in kN) in the rope carrying it?

A) 3.6 B) 1.8 C) 2.4 D) 2.8 E) 1.1

22. The potential energy vs. position of a 2 kg object is given in the figure. If the velocity of the object is 3 m/s at position D, what is its velocity (in m/s) at the position C?



A) $\sqrt{3}$ B) $\sqrt{6}$ C) $\sqrt{2}$
D) $2\sqrt{2}$ E) $2\sqrt{3}$

23. The position of an object is given by $x(t) = t^2 + 2/t$, where x is in m and t is in s. What is its average acceleration (in m/s^2) from t = 1 s to t = 2 s?

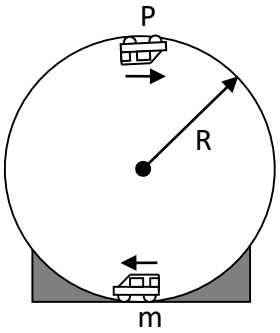
A) 1.0 B) 1.5 C) 2.0 D) 2.5 E) 3.5

24. An object is rotated on a horizontal circle of radius 5 m. What is the period (in s) of this motion if the centripetal acceleration has a magnitude of 80 m/s^2?

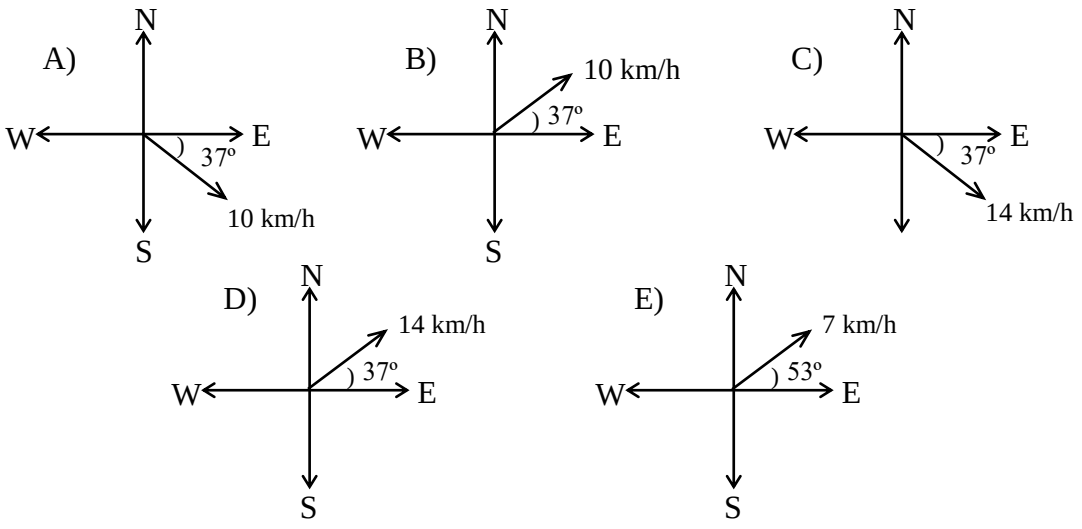
A) 0.5 B) 0.7 C) 1.5 D) 1.2 E) 1.8

25. A toy car with a mass of 0.6 kg moves in a vertical circle with radius R. The normal force at point P acting on the car is 3 N. Find the magnitude of the centripetal acceleration (in m/s^2) at the same point.

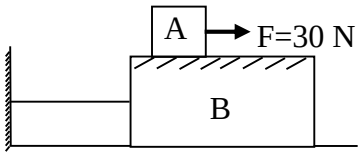
A) 24 B) 5 C) 8 D) 12 E) 15



26. Two ships A and B are 4 km apart. If A moves with a uniform velocity of 8 km/h due east and B moves with a uniform velocity of 6 km/h due south, calculate the velocity (in km/h) of A relative to B ($\mathbf{v}_{AB}$).



27. Block A, with a mass of 5 kg, rests on 20 kg block B which is connected to the wall by a massless cord. There is no friction between the block B and the floor. The coefficients of kinetic and static friction between the blocks are 0.2 and 0.4 respectively. A force F = 30 N acts on the block A, find the tension (in N) in the cord.



A) 10 B) 15 C) 20 D) 25 E) 35

28. The potential energy function of a particle is $U = (6x^2 - 3x + 1)$ J, where x is in meters. Find the conservative force (in N) acting on the particle at x = 1 m?

A) 6 **i** B) 15 **i** C) –15 **i** D) –9 **i** E) 9 **i**

29. A flat (unbanked) curve on a highway has a radius of 75 m. A car rounds the curve at a speed of 15 m/s. Find the minimum coefficient of static friction that will prevent the car from sliding?

A) 0.6 B) 0.5 C) 0.3 D) 0.1 E) 0.2

30. A toy gun shoots a projectile straight up. The maximum vertical displacement of the projectile is H when the spring of the gun is compressed an amount of x. To obtain a maximum vertical displacement of 4H, what should the compression of the spring be in terms of x?

A) 4 x B) 2 x C) $2\sqrt{2}$ x D) $\sqrt{2}$ x E) $4\sqrt{2}$ x