Miami-Dade College – Wolfson Campus

PHY1025 – Fall 2014

Exam III

Name: Key

SECTION I – MULTIPLE CHOICE (1.5 points each)

Directions: Read each question carefully and write your responses on the space provided after each number.

1) A If the net work done on an object is negative, then the object's kinetic energy

A) decreases. B) is zero.

C) remains the same. D) increases.

2) A An object is released from rest a height *h* above the ground. A second object with four times the mass of the first if released from the same height. The potential energy of the second object compared to the first is

A) four times as much. B) twice as much.

C) one-fourth as much. D) one-half as much.

3) B A ball drops some distance and gains 30 J of kinetic energy. Do not ignore air resistance. How much gravitational potential energy did the ball lose?

A) less than 30 J

B) more than 30 J

C) exactly 30 J

D) cannot be determined from the information given

4) A To accelerate your car at a constant acceleration, the car's engine must

A) develop ever-increasing power. B) maintain a constant turning speed.

C) develop ever-decreasing power. D) maintain a constant power output.

5) E A girl throws a stone from a bridge. Consider the following ways she might throw the stone. The speed of the stone as it leaves her hand is the same in each case, and air resistance is negligible.

Case A: Thrown straight up.

Case B: Thrown straight down.

Case C: Thrown out at an angle of 45° above horizontal.

Case D: Thrown straight out horizontally.

In which case will the speed of the stone be greatest when it hits the water below?

A) Case A

B) Case B

C) Case C

D) Case D

E) The speed will be the same in all cases

6) B Block 1 and block 2 have the same mass, *m*, and are released from the top of two inclined planes of the same height making 30° and 60° angles with the horizontal direction, respectively. If the coefficient of friction is the same in both cases, which of the blocks is going faster when it reaches the bottom of its respective incline?

A) Block 2 is faster.

B) Block 1 is faster.

C) Both blocks have the same speed at the bottom.

D) We must know the actual masses of the blocks to answer.

E) There is not enough information to answer the question because we do not know the value of the coefficient of kinetic friction.

7) B Swimmers at a water park have a choice of two frictionless water slides as shown in the figure. Although both slides drop over the same height, h, slide 1 is straight while slide 2 is curved, dropping quickly at first and then leveling out. How does the speed v1 of a swimmer reaching the end of slide 1 compares with v2, the speed of a swimmer reaching the end of slide 2?

A) v1 > v2
B) v1 = v2
C) v1 < v2
D) No simple relationship exists between v1 and v2 because we do not know the curvature of slide 2.

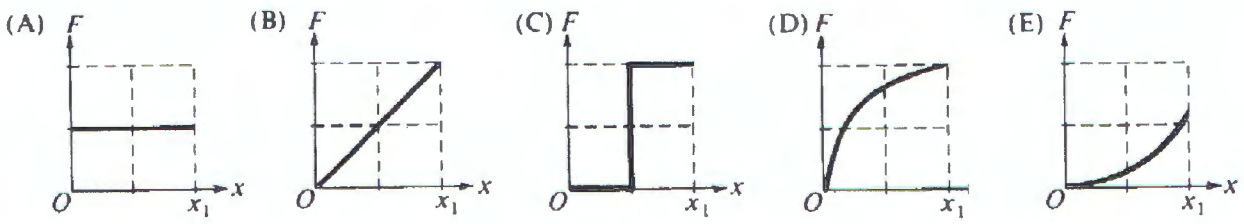
8) A A 4.0-kg mass is moving with speed 2.0 m/s. A 1.0-kg mass is moving with speed 4.0 m/s. Both objects encounter the same constant braking force, and are brought to rest. Which object travels the greater distance before stopping?

A) the 1.0-kg mass
B) the 4.0-kg mass
C) Both travel the same distance.
D) cannot be determined from the information given

9) D On a plot of Force versus position (F vs. x), what represents the work done by the force F?

A) the slope of the curve
B) the length of the curve
C) the product of the maximum force times the maximum x
D) the area under the curve

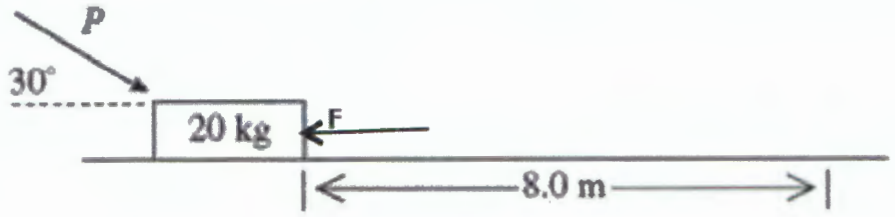
10) D The following graphs represent the net force F on an object as a function of displacement x.



Which graph represents the force that will cause the greatest change in kinetic energy of the object from $x=0$ to $x=x_1$?

SECTION II – FREE-RESPONSE

Directions: Read each question carefully and write your responses on the space provided after each question. You must show your work to receive credit.



1. Two forces F = 2 N and P = 20 N act on a box of mass m = 20 kg which can move 8 meters along a rough horizontal surface. See figure above. The coefficient of friction between the box and the floor is μ = 0.01. The box is initially a rest. **For each of the following questions you must justify your answer or show all the calculations.**

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A) Determine the work done on the box by the force of gravity.

(2) $W_g = 0$ $F_g \perp d$

B) Determine the work done on the box by the normal force.

(2) $W_{F_N} = 0$ $F_N \perp d$

C) Determine the work done on the box by the force of friction

$W_f = f \cdot d \cdot \cos(180°) = -\mu F_N d$

$F_N - mg - P\sin 30° = 0$

$F_N = mg + P\sin 30°$

$F_N = 200 + 10$

$= 210\ N$

$W_f = -\mu(mg + P\sin(30°))d$

(6) $= -0.01(200 + 10)(8)$

$= -16.8\ J$

D) Determine the work done on the box by the force P.

$W_p = P \cdot d \cdot \cos(30°)$

(4) $= 20(8)(\cos(30°) = 20(8)\sqrt{3}/2 =$

$= 138.6\ J$

E) Determine the work done on the box by the force F

$$W_F = F \cdot d \cdot \cos(180^\circ)$$

(3) $$= 2(8)(-1) = \boxed{-16\,J}$$

F) Determine the net work.

$$W_{Net} = \Sigma W_i = 0 + 0 + 138.6 - 16.8 - 16$$

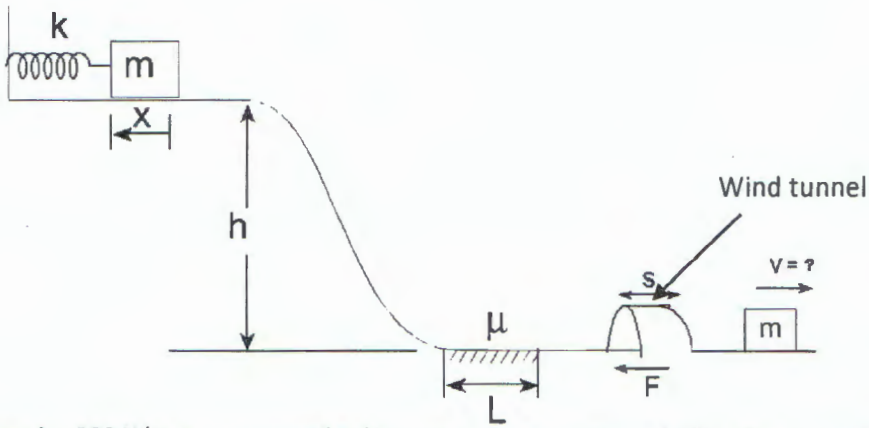
(2) $$= 105.8\,J$$

G) Determine the velocity of the box at the end of the 8 meters.

$$W_{NET} = \Delta KE$$

(5) $$105.8 = \frac{1}{2}(20)(v^2) - \frac{1}{2}(20)(0)^2$$

$$v = \sqrt{10.58} = \boxed{3.25\ m/s}$$



(10)

2. A spring of constant k = 200 N/m is compressed a distance x = 2m and released. The 10-kg block skids down the inclined of height h = 12 m. All surfaces are frictionless except for a portion of length L = 2m which has a coefficient of friction μ = 0.1. The wind tunnel exerts a constant backward force F = 4N for a length S = 2m.

A) Determine the work done on the block by the wind tunnel.

(4) $W_F = 4(2)\cdot\cos(180^\circ) = -8\,J$

B) Determine the work done on the block by the force of friction.

(3) $W_f = -\mu mgd = -(0.1)(10)(10)(2) = -20\,J$

C) Determine the final speed of the block upon exiting the wind tunnel.

$\Delta E_M = W_{NC}$

$ME_i = \frac{1}{2}kx^2 + mgh = \frac{1}{2}(200)(2)^2 + (10)(10)(12)$

$= 400 + 1200 = 1600\,J$

(9) $ME_F = \frac{1}{2}(m)v^2 = \frac{1}{2}(10)(v^2) = 5v^2$

$W_{NC} = W_f + W_F = -28\,J$

$5v^2 - 1600 = -28$

$v^2 = \frac{1572}{5} = 314.4$

$v = \sqrt{314.4} = 17.7\ m/s$

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SECTION I – MULTIPLE CHOICE

Directions: Read each question carefully write your response on the space provided.

1) A You slam on the brakes of your car in a panic, and skid a certain distance on a straight, level road. If you had been traveling twice as fast, what distance would the car have skidded, under the same conditions?

A) It would have skidded 4 times farther.
B) It would have skidded 1.4 times farther.
C) It would have skidded twice as far.
D) It is impossible to tell from the information given.

2) D Is it possible for a system to have negative potential energy?

A) Yes, as long as the total energy is positive.
B) No, because this would have no physical meaning.
C) No, because the kinetic energy of a system must equal its potential energy.
D) Yes, since the choice of the zero of potential energy is arbitrary.

3) B A ball falls from the top of a building, through the air (air friction is present), to the ground below. How does the kinetic energy (K) just before striking the ground compare to the potential energy (U) at the top of the building?

A) K is greater than U. B) K is less than U.
C) K is equal to U. D) It is impossible to tell.

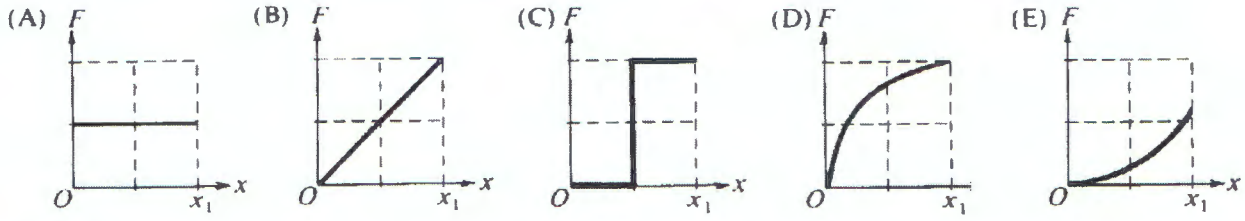
4) D Compared to yesterday, you did 3 times the work in one-third the time. To do so, your power output must have been

A) one-third of yesterday's power output. B) 3 times yesterday's power output.
C) the same as yesterday's power output. D) 9 times yesterday's power output.

5) A Swimmers at a water park have a choice of two frictionless water slides as shown in the figure. Although both slides drop over the same height, h, slide 1 is straight while slide 2 is curved, dropping quickly at first and then leveling out. How does the speed v_1 of a swimmer reaching the end of slide 1 compares with v_2, the speed of a swimmer reaching the end of slide 2?

A) $v_1 = v_2$
B) $v_1 > v_2$
C) $v_1 < v_2$
D) No simple relationship exists between v_1 and v_2 because we do not know the curvature of slide 2.

6) E The following graphs represent the net force F on an object as a function of displacement x.



Which graph represents the force that will cause the smallest change in kinetic energy of the object from $x=0$ to $x=x_1$?

7) C If you push twice as hard against a stationary brick wall, the amount of work you do

A) is cut in half. B) doubles.
C) remains constant at zero. D) remains constant but non-zero.

8) D The area under the curve, on a Force versus position (F vs. x) graph, represents

A) kinetic energy. B) potential energy.
C) power. D) work.

9) D If the net work done on an object is positive, then the object's kinetic energy

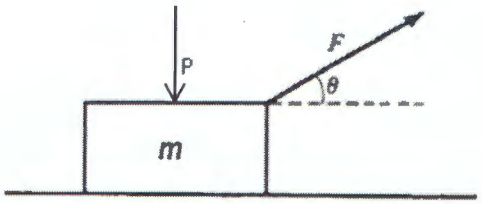
A) decreases. B) is zero.
C) remains the same. D) increases.

10) D Two stones, one of mass m and the other of mass $2m$, are thrown directly upward with the same velocity at the same time from ground level and feel no air resistance. Which statement about these stones is true?

A) The heavier stone will go twice as high as the lighter one because it initially had twice as much kinetic energy.
B) The lighter stone will reach its maximum height sooner than the heavier one.
C) Both stones will reach the same height because they initially had the same amount of kinetic energy.
D) At its highest point, the heavier stone will have twice as much gravitational potential energy as the lighter one because it is twice as heavy.
E) At their highest point, both stones will have the same gravitational potential energy because they reach the same height.

SECTION II – FREE-RESPONSE

Directions: Read each question carefully and write your responses on the space provided after each question. You must show your work to receive credit.



1. Two forces F = 50 N (θ =37°) and P = 10 N act on a box of mass m = 20 kg which can move 10 meters along a rough horizontal surface. See figure above. The coefficient of friction between the box and the floor is μ = 0.1. The box is initially a rest. **For each of the following questions you must justify your answer or show all the calculations.**

   A) Determine the work done on the box by the force of gravity.

(2) 0

   B) Determine the work done on the box by the normal force.

(2) 0

   C) Determine the work done on the box by the force P.

(2) 0

   D) Determine the work done on the box by the force of friction

(4) $W_f = -(0.1)(200+10)(10) = -210\ J$

E) Determine the work done on the box by the force F

$$W = (\cancel{20})(\cancel{10})(4/\cancel{x}) = 400\text{J}$$

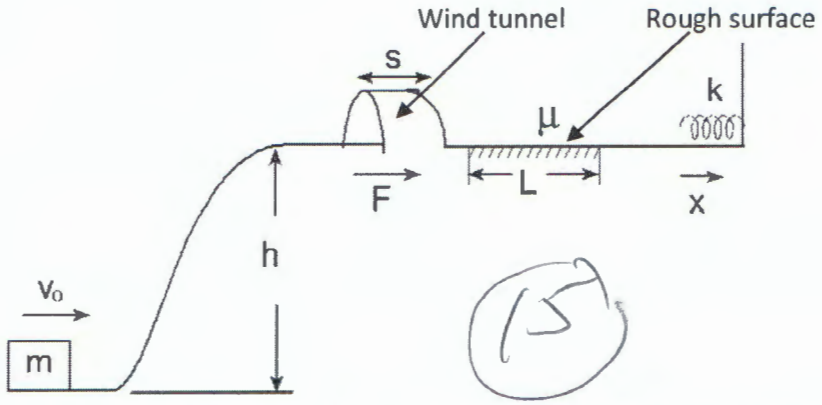
F) Determine the net work.

$$W_{NET} = 400 - 210 = 190\text{J}$$

G) Determine the velocity of the box at the end of the 10 meters.

$$190 = \frac{1}{2}(\cancel{10})(v^2$$

$$v = \sqrt{19} = 4.36\text{ m/s}$$



(15)

The diagram above (not drawn to scale) shows a block of mass m = 4 kg moving to the right with an initial speed of v_0 = 20m/s. The height of the inclined is h = 4.5m. The wind tunnel exerts a forward constant force $F = 2X^2$ for a length S = 1.5 m. All surfaces are smooth except for a rough surface (μ = 0.2) of length L = 2.5m located between the tunnel and the spring. The block is stopped by a spring of force constant k=20 N/m.

A) Determine the work done on the block by the force of friction.

$$W_f = -\mu mgd = (0.2)(4)(10)(2.5) = -20\,J$$

(4)

B) Determine the work done on the block by the wind tunnel.

$$W_{WT} = \int F\,dx = \int_0^{1.5} 2x^2\,dx = \frac{2}{3}(1.5)^3 = 2.25\,J$$

(4)

C) Determine the compression of the spring X.

$$\frac{1}{2}mv^2 = E_i$$

$$\frac{1}{2}(4)(20)^2 = E_i = 800\,J$$

$$E_f = \frac{1}{2}kx^2 + mgh = \frac{1}{2}(20)(x^2) + 40(4.5)$$

(7)

$$= 10x^2 + 180$$

$$10x^2 + 180 - 800 = -20 + 2.25$$

$$x = \sqrt{\frac{602.25}{10}} = \sqrt{60.225} = 7.8\,m$$