Name: _____Answer Key_____ Date: _____

Honors Physics Test #4 Review

Forces

1. Read Chapter 4

2. Terms to know: force, net force, weight, mass, inertia, normal force, applied force, free-body diagram, kinetic friction, static friction, coefficient of friction, terminal velocity

3. State each of Newton's laws of motion in order.

4. What is the difference between mass and weight? Be able to calculate each.
   Mass is how much matter you take up, weight is (m x g), or your gravitational force
5. Be able to identify the net force acting on an object and calculate with the formula $a = F_{net} / m$.

6. What is the normal force? Is it always the same as the weight of an object?
   Supportive force, same as weight on flat surface, not on inclines
7. Be able to draw and label a free-body diagram.

8. What is the difference between the acceleration of gravity and the force of gravity?
   Force due to g is your weight – how attracted you are to the Earth.
   Acceleration due to g is the rate at which Earth pulls you down towards it
9. Be able to draw the free-body diagram for an object on an inclined plane, and calculate the magnitude of the forces acting on it.

10. How does the motion of an elevator change the reading of a scale inside it?
    Accelerate upwards = heavier, accelerate downwards = lighter, constant v = no change
11. What is the difference between the force of friction and the coefficient of friction?
    Force of friction = force needed to overcome friction, coefficient = how rough surface is
12. What factors influence the force of friction? Which do not?
    Normal force, coefficient of friction, mass, incline
13. What factors influence the coefficient of friction? Which do not?
    Texture of surface, wet or dry, affect it
14. Be able to calculate the force of friction from
    a) a free body diagram, and
    b) using the coefficient of friction.

15. What are the four fundamental forces? Strong nuclear, weak nuclear, gravity, electromagnetic.
    Which are short-range forces? Strong, weak, EM Long range? Gravity Strongest? Strong nuclear
    Weakest? Gravity

16. Explain how Newton's laws of motion apply to a hovercraft.

17. What happens when a falling body reaches its terminal velocity? Why does it reach a terminal velocity? The object no longer accelerates because force of air resistance balances with weight. It still continues to fall, but at a constant rate.
18. Be able to calculate for gravitational force, normal force, frictional force, and coefficient of friction for an object on an inclined plane.

Directions: Read each question carefully and record your answers in the space provided. Be sure to show all work! Answers should be in significant figures. You will be graded on proper use of the GUESS method. These will be the same directions on the test. Practice the GUESS method now.

19. A 35 kilogram mass weighs 85 newtons on planet Trophtron. What is the acceleration due to gravity on this planet?

$$g = \frac{F_g}{m} = \frac{-85N}{35kg} = 2.4\,{}^{m}/_{s^2} \text{ down}$$

Need negative in substitution and down with answer

20. A net force of 15. Newtons accelerates an object at a rate of 6.5 m/s^2.
    a. What is the mass of the object?

$$m = \frac{F_{net}}{a} = \frac{+15N}{+6.5\,\frac{m}{s^2}} = 2.3kg$$

    b. What force would be needed to accelerate the object at a rate of 2.7 m/s^2?

$$F_{net} = ma = 2.3kg(+2.7\,\tfrac{m}{s^2}) = +6.2N$$

Direction is unclear. so use + or forward

21. A 1.5 kilogram lab cart is accelerated uniformly from rest to a speed of 3.5 m/s in 1.2 seconds. What is the magnitude of the force producing this acceleration?

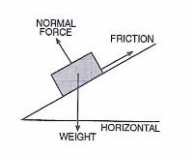
$$a = \frac{\Delta v}{t} = \frac{3.5\,\frac{m}{s} - 0\,\frac{m}{s}}{1.2s} = +2.9\,\tfrac{m}{s^2}$$

$$F_{net} = ma = 1.5kg(+2.9\,\tfrac{m}{s^2}) = 4.4N$$

"Magnitude of …" means no direction on final answer

22. Three forces act on a 7.0 kilogram box at rest on an inclined plane of 35° as shown in the diagram below. Determine the box's
    a. weight

$$F_g = mg = 7.0kg(-9.81\,\tfrac{m}{s^2}) = 69N \text{ down}$$



    b. normal force

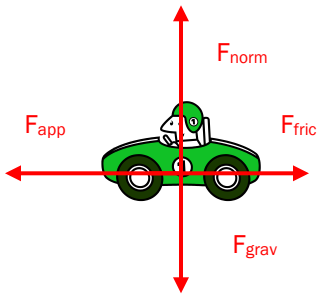
$$F_{norm} = -F_{grav\,\perp} = -F_{grav}\cos\theta = -(-69N)\cos(35°) = +57N = 57\text{ N out of hill}$$

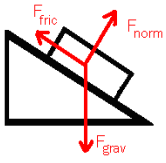
MEMORIZE these equations!

    c. frictional force

$$F_{fric} = -F_{grav\,||} = -F_{grav}\sin\theta = -(-69N)\sin(35°) = +40.N = 40.\text{ N uphill}$$

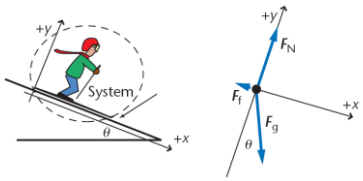
23. Construct a free body diagram, showing ALL of the forces acting on the object, for the following situations: [Neglect air resistance]
    a. A car steps on the gas and accelerates to the left.
    b. A book is sliding down an incline.
    c. A football is rising through the air after being punted.





24. A 62 kg person on skis is going down a hill sloped at 37^0. The coefficient of kinetic friction between the skies and the snow is 0.15.

a. Draw a free body diagram showing all of the forces acting on the skier.



b. Calculate the components of the weight force parallel and perpendicular to the plane.

i. parallel

MEMORIZE these equations!

$$F_{g\parallel} = F_g \sin\theta = mg\sin\theta = (62kg)(-9.81\tfrac{m}{s^2})\sin(37°) = 370\ N \text{ downhill}$$

ii. perpendicular

$$F_{g\perp} = F_g \cos\theta = mg\sin\theta = (62kg)(-9.81\tfrac{m}{s^2})\cos(37°) = 490N \text{ into hill}$$

c. Calculate the frictional force between the skier and the snow.

$$F_f = \mu_k F_N = (0.15)(^+490N) = 74N \text{ uphill}$$

d. Determine the net force acting on the skier.

s.f based on least decimal when adding

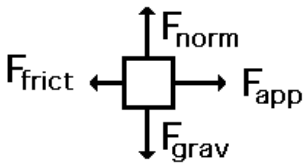
$$F_{net} = F_{g\parallel} + F_f = -370N + 74N = -296N = 3.0\times10^2 N \text{ downhill}$$

e. Determine the acceleration of the skier.

$$a = \frac{F_{net}}{m} = \frac{-3.0\times10^2 N}{62kg} = 4.8\tfrac{m}{s^2} \text{ downhill}$$

25. A rightward force of 25 N is applied to a 4.5 kg object to move it across a rough surface with a rightward acceleration of 2.5 m/s^2.

a. Construct a free body diagram of the situation.



b. Determine the gravitational force (aka the weight)

$$F_{grav} = mg = 4.5kg\ (-9.81\tfrac{m}{s^2}) = -44\ N = 44\ N \text{ down}$$

c. Determine the normal force

$$F_{norm} = -F_{grav} = +44N = 44\ N \text{ up}$$

d. Determine the net force acting on the object.

$$F_{net} = ma = 4.5kg\ (^+2.5\tfrac{m}{s^2}) = +11\ N = 11\ N \text{ right}$$

e. Determine the frictional force

$$F_{net} = F_{applied} + F_{fric}$$
$$F_{fric} = F_{net} - F_{applied} = (^{+}11N) - (^{+}25N) = -14N = 14N \text{ left}$$

f. Determine the coefficient of friction between object and the surface.

$$\mu = \frac{F_{fric}}{F_{norm}} = \frac{14N}{44N} = 0.32$$

Directions: Fill in the blanks with the best word that answers the question or completes the sentence.

26. The direction of the force of sliding friction is always ____opposite____ to that of velocity.

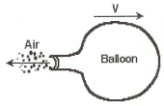
27. The SI unit of force is _____kg•m/s^2 (Newtons)_____.

28. The force of gravity acting on an object is called the object's _____weight_____.

29. The amount of material in an object is called the object's _____mass_____.

30. If it takes a force of 200 newtons to move a wagon up a frictionless hill at constant speed, the force needed to let the wagon roll downhill at constant speed is _____200 N_____.

31. As shown in the diagram below, an inflated balloon released from rest moves horizontally with velocity v.



The velocity of the balloon is most likely caused by

Newton's Third Law

(A) centripetal forces
(B) rolling force
(C) action - reaction
(D) gravitational attraction

32. What is the magnitude of the net force acting on a 2000. kilogram car as it accelerates from rest to a speed of 15 meters per second in 5.0 seconds?

(A) 60,000. N (B) 6,000. N (C) 30,000. N (D) 20,000. N

Two steps - solve for *a* first

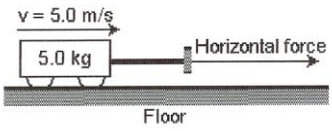
$$a = \frac{\Delta v}{t} = \frac{15\,\frac{m}{s}}{5.0s} = 3.0\,\frac{m}{s^2}$$
$$F_{net} = ma = (2000.kg)(3.0\,\frac{m}{s^2})$$

33. A 60. kilogram astronaut weighs 96 newtons on the surface of the Moon. The acceleration due to gravity on the Moon is

(A) 1.6 m/s^2 (B) 9.8 m/s^2 (C) 0.0 m/s^2 (D) 4.9 m/s^2

$$g = \frac{F_g}{m} = \frac{96N}{60.kg}$$

34. A horizontal force is used to pull a 5.0 kg cart at a constant speed of 5.0 meters per second across the floor as shown in the diagram below.



Constant speed – forces balance
forward force = backward force

If the force of friction between the cart and the floor is 10. newtons, the magnitude of the horizontal force along the handle of the cart is

(A) 10. N (B) 25 N (C) 50. N (D) 5.0 N

35. Two forces are applied to a 2.0 kg block on a frictionless, horizontal surface, as shown in the diagram below. Determine the acceleration of the block.

Two steps - solve for F_{net} first

$F_{net} = F_1 + F_2 = (^-2.0N) + (^+8.0N) = 6.0N$ right

$a = \frac{F_{net}}{m} = \frac{^+6.0N}{2.0kg}$

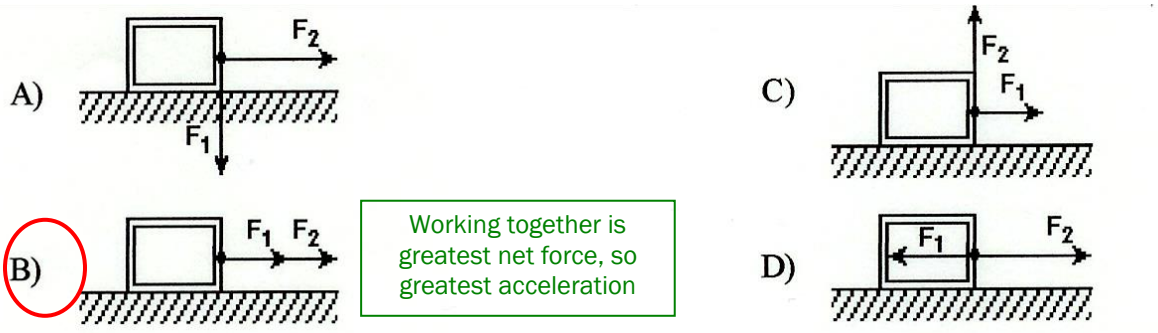
(A) 5.0 m/s^2 to the left
(B) 3.0 m/s^2 to the left
(C) 5.0 m/s^2 to the right
(D) 3.0 m/s^2 to the right

36. A 3.0 kg mass weighs 15 newtons at a given point in the Earth's gravitational field. What is the magnitude of the acceleration due to gravity at this point?

(A) 9.8 m/s^2 (B) 5.0 m/s^2 (C) 45 m/s^2 (D) 0.20 m/s^2

$g = \frac{F_g}{m} = \frac{15N}{3.0kg}$

37. A 150. Newton force, F1 and a 200. Newton force, F2 are applied simultaneously to the same point on a large crate resting on a frictionless, horizontal surface. Which diagram shows the forces positioned to give the crates the *greatest* acceleration?



Working together is greatest net force, so greatest acceleration

38. A 100. kg box rests on the bed of a truck that is accelerating at 2.0 m/s^2. What is the magnitude of the force of friction on the box as it moves with the truck without slipping?

(A) 200. N (B) 1,000. N (C) 0.0 N (D) 500. N

Without slipping = forces balance

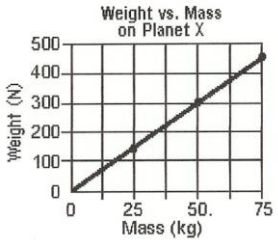
$F_f = -F_A = ma = (100.kg)(2.0\frac{m}{s^2})$

39. Which combination of fundamental units can be used to express the weight of an object?

(A) kilogram/second
(B) kilogram*meter/second^2
(C) kilogram*meter
(D) kilogram*meter/second

$F_g = mg$

40. The graph below shows the weight of three objects on planet X as a function of their mass



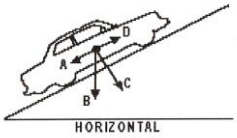
Slope of line or pick a point ON line

$g = \frac{F_g}{m} = \frac{300.N}{50.kg}$

The acceleration due to gravity of planet X is approximately

(A) 9.8 m/s^2 (B) 50.0 m/s^2 (C) 6.0 m/s^2 (D) 0.17 m/s^2

41. The diagram below represents a car resting on a hill



Weight is always straight down

Which vector best represents the weight of the car

(A) C (B) D (C) B (D) A

42. A student weighing 500. newtons stands on a spring scale in an elevator. If the scale reads 520. newtons, the elevator must be

(A) accelerating downward (C) moving downward at constant speed
(B) accelerating upward (D) moving upward at constant speed

Heavier reading means more support from floor – pushing up into feet

43. A tennis ball is hit with a tennis racket. Compared to the magnitude of the force of the racket on the ball, the magnitude of the force of the ball on the racket is

(A) larger (B) the same (C) smaller

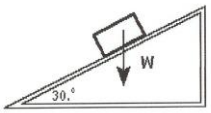
Newton's Third Law

44. Equilibrium exists in a system where three forces are acting concurrently on an object. If the system included a 5.0 newton force due north and a 2.0 newton force due south, the third force must be

Equilibrium = forces balance so need 3.0 N south to add to 2.0 N south to balance 5.0 N north

(A) 7.0 N south (B) 7.0 N north (C) 3.0 N south (D) 3.0 N north

45. In the diagram below, the weight of a box on a plane inclined at 30.0° is represented by the vector W. What is the amount of weight parallel to the incline?



$F_{g\parallel} = F_g \sin\theta = W \sin(30.°)$

(A) 1.5W (B) 0.50W (C) 0.87W (D) W

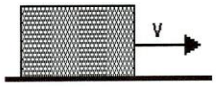
46. The weight of an apple is closest to

(A) 10^{-2} N (B) 10^{0} N (C) 10^{4} N (D) 10^{2} N

$m = \frac{F_g}{g} = \frac{1N}{9.81\frac{m}{s^2}} = 0.1kg$

$1kg = 2.2lbs$

47. A box decelerates as it moves to the right along a horizontal surface, as shown in the diagram below



Friction always opposes motion

Which vector *best* represents the force of friction on the box?

(A) ← (B) → (C) ↑ (D) ↓

Answers:
19. 2.4 m/s² down
20. a. 2.3 kg
b. +6.2 N
21. 4.4 N
22. a. 69 N down
b. 57 N out of hill
c. 40. N up
23. See sheet in classroom
24. a. See sheet in classroom
b. $F_{g//}$ = 370 N downhill
$F_{g\perp}$ = 490 N into hill
c. 74 N uphill
d. 3.0x10² N downhill
e. 4.8 m/s² downhill
25. a. See sheet in classroom
b. 44 N down
c. 44 N up
d. 11 N right
e. 14 N left
f. 0.32
26. opposite
27. Newton
28. weight
29. mass
30. 200 N
31. C
32. B
33. A
34. A
35. D
36. B
37. B
38. A
39. B
40. C
41. C
42. B
43. B
44. C
45. B
46. B
47. A

Name _____Answer Key_____ Date _____

Honors Physics SAT Review #4

SAT Review: Forces

Unless otherwise noted, use g = 10 m/s² and neglect air resistance for all questions.

PART A

Directions – For each group of questions below, there is a set of five letter choices, followed by numbered questions. For each question select the one choice in the set that best answers the question. You may use a lettered choice once, more than once, or not at all in each set. Do not use a calculator or table of reference.

Questions 1 – 3 relate to the following equations or physical principles that might be used to solve certain problems.

(A) Newton's first law
(B) Newton's second law
(C) Newton's third law
(D) Newton's law of universal gravitation
(E) Conservation of Linear Momentum

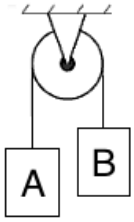
1. A jar remains at rest on a table when a piece of paper is pulled out from under it. A
2. Two teams pull against each other on a rope that is stretched across a stream. One team pulls with 1,000 N of force. What is the tension in the rope? C
3. A stone of mass 1 kg and weight 10 N fall through the air. The air resistance acting on the stone is 2N. What is the acceleration of the stone? B

PART B

Directions – Each of the questions or incomplete statements below is followed by five answer choices. Select the choice that best answers the question or completes the statement. Do not use a calculator or any tables of reference.

4. A force of 20 N is needed to overcome a frictional force of 5 N and accelerate a 3 kg mass across a floor. What is the acceleration of the mass?

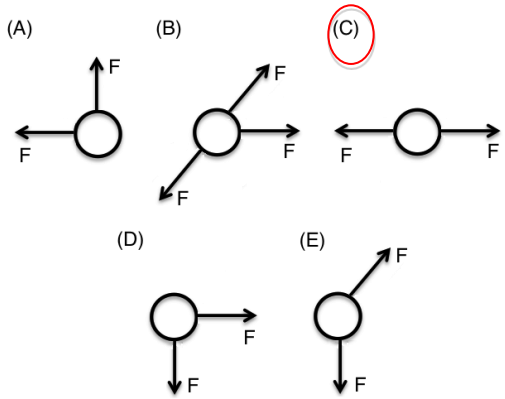
A) 4 m/s²
B) 5 m/s²
C) 7 m/s²
D) 20 m/s²
E) 60 m/s²



5. Two blocks A and B are attached to a string that passes over a pulley of negligible mass and friction as shown above. Which of the following statements is true?

A) Block A is more massive than block B.
B) Block B is more massive than block A.
C) Both blocks will move with the same constant velocity.
D) Both blocks will move with the same constant acceleration.
E) Block A must have a greater acceleration than block B.

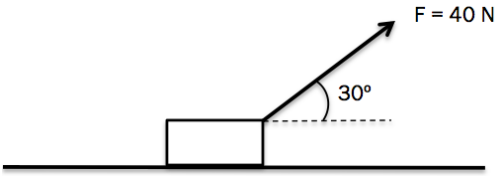
6. Each of the figures below shows the forces acting on a particle, where each force is the same magnitude. In which figure can the particle's velocity be constant?



7. The amount of force needed to keep a 0.1 kg hockey puck moving at a constant speed of 5 m/s on frictionless ice is

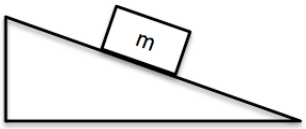
A) zero.
B) 0.1 N.
C) 0.5 N.
D) 5 N.
E) 50 N.

A force of 40 N directed at 30° from the hori-zontal acts on a block of weight 50 N and pulls it across a level floor through displacement of 10 meters. (sin 30° = 0.50, cos 30° = 0.87)

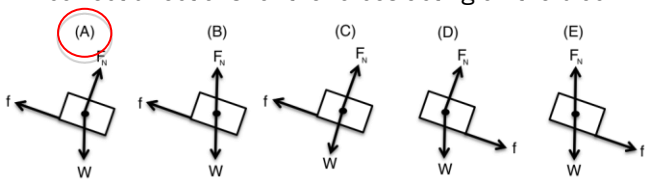


8. The normal force between the floor and the block while the block is being pulled is most nearly

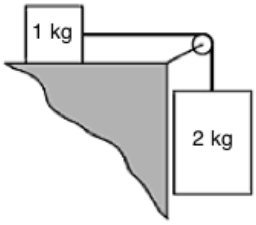
A) 50 N.
B) 44 N.
C) 30 N.
D) 25 N.
E) 5 N.



9. A block of mass *m* is at rest on a rough inclined plane. Which of the following diagrams best represents the correct directions for the forces acting on the block?



10. A 1 kg block rests on a frictionless table and is connected by a light string to another block of mass 2 kg. The string is passed over a pulley of negligible mass and friction. What is the acceleration of the masses?



A) 5 m/s^2
B) 6.7 m/s^2
C) 10 m/s^2
D) 20 m/s^2
E) 30 m/s^2

11. A ball falls freely toward earth. If the action force is the earth pulling down the ball, the reaction force is

A) the ball pulling up on the earth.
B) air resistance acting on the ball.
C) the ball striking the earth when it lands.
D) the inertia of the ball.
E) There is no reaction force in this case.

12. You are sitting on a seat facing forward on an airplane with its wings parallel to the ground. The window shades of the airplane are closed, and the vibration of the plane is negligible. When you place your class ring on the end of a necklace and hold the other end in front of you, you notice that the chain and ring hang vertically and point directly to the floor of the airplane. Which of the following could be true of the airplane?

I. The airplane is at rest.
II. The airplane is moving with constant speed.
III. The airplane is increasing its speed.
IV. The airplane is decreasing its speed.

A) I only
B) III only
C) I or II, but not III or IV
D) III or IV, but not I or II
E) IV only

Answers: 1) A, 2) C, 3) B, 4) B, 5) D, 6) C, 7) A, 8) C, 9) A, 10) B, 11) A, 12) C