# GRADE 12 PHYSICS (40S)

## Midterm Practice Examination

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## Midterm Practice Examination

***Instructions***

The midterm examination will be weighted as follows

| | |
|---|---|
| Modules 1–5 | 100% |

The format of the examination will be as follows:

| | |
|---|---|
| Part A: Multiple Choice | 21 x 1 = 21 marks |
| Part B: Fill-in-the-Blanks | 14 x 0.5 = 7 marks |
| Part C: Short Explanation Questions | 4 x 4 = 16 marks |
| Part D: Problems | 8 x 7 = 56 marks |

## Grade 12 Physics
## Midterm Practice Examination

**Part A: Multiple Choice**

Write the letter of the choice that best completes each statement.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1. | | | 11. | | | 21. | | | | |
| 2. | | | 12. | | | | | | | |
| 3. | | | 13. | | | | | | | |
| 4. | | | 14. | | | | | | | |
| 5. | | | 15. | | | | | | | |
| 6. | | | 16. | | | | | | | |
| 7. | | | 17. | | | | | | | |
| 8. | | | 18. | | | | | | | |
| 9. | | | 19. | | | | | | | |
| 10. | | | 20. | | | | | | | |

**Part B: Fill-in-the-Blanks**

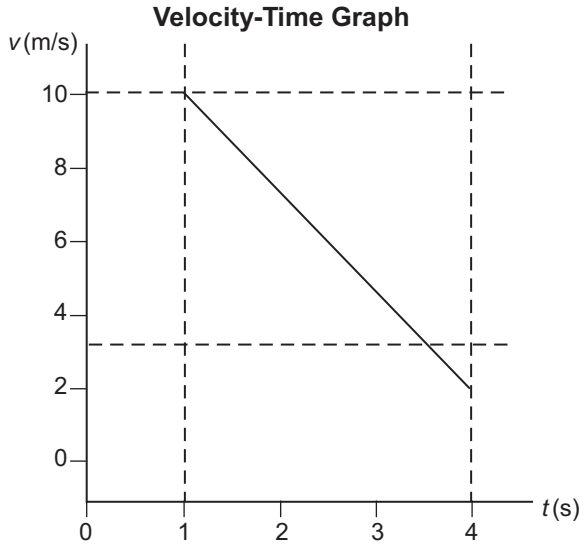
Write the word that best completes each statement in the space provided below.

| | | | |
|---|---|---|---|
| 1. | | 8. | |
| 2. | | 9. | |
| 3. | | 10. | |
| 4. | | 11. | |
| 5. | | 12. | |
| 6. | | 13. | |
| 7. | | 14. | |

## Part A: Multiple Choice (21 x 1 = 21 Marks)

**Enter the letter of the choice that best answers the question on the answer sheet provided. Please print the letters of your answers clearly.**

1. Consider the following velocity-time graph




The acceleration of the object is

a) –2.7 ms/s$^2$

b) –2.5 ms/s$^2$

c) 2.5 ms/s$^2$

d) 2.7 ms/s$^2$

2. A river is flowing from west to east at a speed of 10.0 km/h. A boat's speed in the water is 20.0 km/h. If the boat is pointing straight north, and is blown off course, the new speed of the boat relative to the shore would be

a) 10.0 km/h

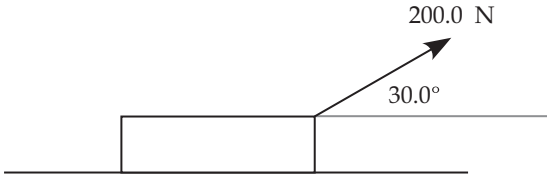
b) 17.3 km/h

c) 22.4 km/h

d) 30 km/h

3. If a mass on a horizontal surface is pushed down at an angle (similar to pushing down on a shopping cart), then the normal force will
   a) increase and the force of gravity will not change
   b) not change and the force of gravity will increase
   c) not change and the force of gravity will also not change
   d) increase and the force of gravity will also increase

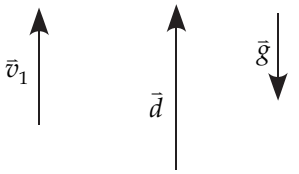
4. An object is pulled along a horizontal surface by a force that is directed up and to the right. The mass of the object is 50.0 kg. The applied force is 200.0 N directed at an angle of 30.0° above the horizontal. The magnitude force of friction is 60.0 N.



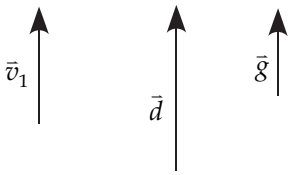

   The magnitude of the normal force is
   a) 100 N
   b) 390 N
   c) 490 N
   d) 590 N

5. A basketball is thrown straight up with a speed of 10.0 m/s. The vectors representing the initial velocity, the acceleration due to gravity, and the vertical distance travelled (height) are

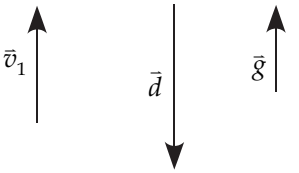
a)



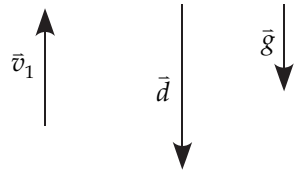

b)




c)




d)



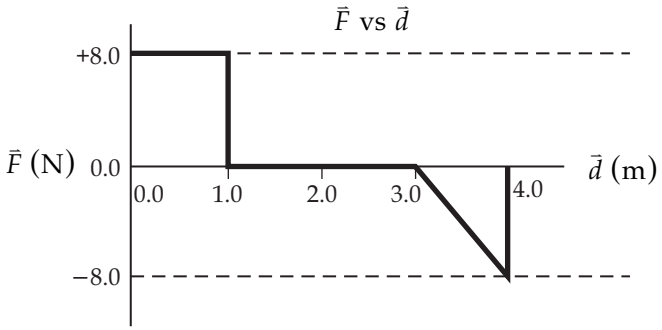

6. A ball is launched at a speed of 20.0 m/s at an angle of 40.0o above the horizontal. The maximum height reached by the ball is

   a) 0.66 m
   b) 0.78 m
   c) 8.43 m
   d) 12.0 m

7. A mass makes 20.0 revolutions in a time of 4.00 s in a circle of radius 10.0 m. The velocity of the mass is
   a) 12.6 m/s towards the centre of the circle
   b) 12.6 m/s tangent to the circle
   c) 314 m/s tangent to the circle
   d) 314 m/s towards the centre of the circle

8. When a ball is swinging in a circle at the end of a string, the hand feels a force directed away from the hand. The reason for this is that
   a) centrifugal force caused by the ball is pulling on the hand
   b) ball wants to fly out parallel to the radius of the circle
   c) centripetal force exactly balances the centrifugal force
   d) ball exerts an equal and opposite force on the hand 20

9. The force component along the displacement varies with the magnitude of the displacement, as shown on the graph.




   The work done by the force over the whole time interval is
   a) –4.0 J
   b) 0.0 J
   c) 4.0 J
   d) 12.0 J

10. A stopper is swung in a circle of radius 2.00 m with a period of 1.50 seconds. A centripetal force of 2.00 N acts on the stopper. What is the work done by the centripetal force during the time that the stopper travels once around the circle?

    a) 0 J
    b) 4.00 J
    c) 8.37 J
    d) 25.1 J

11. We can most directly derive the impulse-momentum equation from the law that states

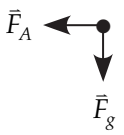
    a) when a net external force $\vec{F}$ acts on a mass $m$ the acceleration $\vec{a}$ that results is directly proportional to the net force and has a magnitude that is inversely proportional to the mass
    b) whenever one body exerts a force on a second body, the second body exerts an oppositely directed force of equal magnitude on the first body
    c) the force of gravitation between two masses is directly proportional to the product of the two masses and inversely proportional to the separation between them squared
    d) an object continues in a state of rest or in a state of motion at a constant speed along a straight line, unless compelled to change that state by a net force

12. A mass of 5.0 kg is moving at a constant speed of 10.0 m/s. A force of 200.0 N then acts on the mass for 2.0 s. The new speed of the mass is

    a) 70 m/s
    b) 80 m/s
    c) 90 m/s
    d) 410 m/s

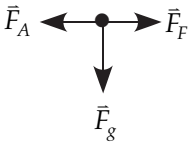
**Answer (a)**
Objective S4P-1-13

13. Which of the following free-body diagrams best represents the forces acting on an astronaut in orbit around the Earth?

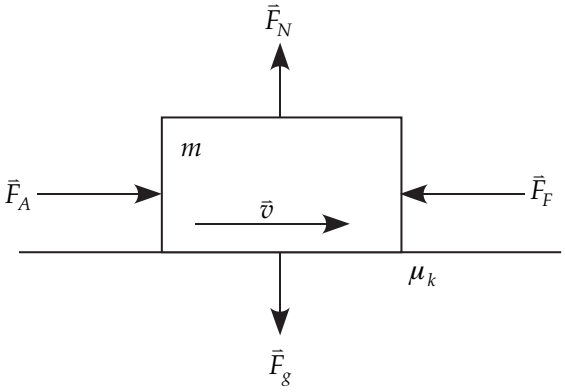
a) 


b) 


c) 


d) 


14. Study the force system diagram pictured below and select the factor that would ***not*** influence the amount of kinetic friction.




a) object's mass, $m$
b) coefficient of kinetic friction, $\mu_k$
c) normal force, $\vec{F}_N$
d) applied force, $\vec{F}_A$

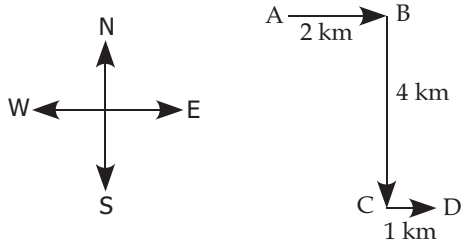
15. A person lifts a pail of water of mass 1.50 kg from the ground to a deck 1.00 m above the ground. How much work was done by gravitational force on the pail of water?

a) –14.7 J
b) +1.50 J
c) –1.50 J
d) +0.153 J

16. In which case is positive work done?
    a) An eastward force is applied to an eastward moving soccer ball that is already moving at a constant velocity to increase its speed in that direction.
    b) A cart is moving at a constant velocity of 10 m/s [W] when a 0.5 N [E] force is applied.
    c) Earth applies a force on the Moon as the Moon travels one complete rotation in orbit around Earth.
    d) The work done by air resistance as a baseball is thrown horizontally towards the catcher.

17. A 15-kg load of groceries is lifted up from the first floor to the fifth floor of an apartment building. Each floor is 5.00 m high. The potential energy of the groceries with respect to the second floor is
    a) $3.68 \times 10^3$ J
    b) $2.94 \times 10^3$ J
    c) $7.5 \times 10^1$ J
    d) $2.20 \times 10^3$ J

18. The diagram below shows the first three legs of a trip: A to B, B to C, and C to D. If a person returns from point D to point A, what is the displacement for this fourth and final leg?




    a) 7 km [37° W of N]
    b) 5 km [37° W of N]
    c) 5 km [37° E of S]
    d) 7 km [37° E of S]

19. The speed of an object moving with uniform circular motion of radius 15.0 m with a frequency of 4.00 Hz is which of the following?

    a) 3.75 m/s

    b) 23.6 m/s

    c) 60.0 m/s

    d) 377 m/s

20. A pilot flies to a destination due north from the departure point. During the flight there is a wind blowing from the west. What direction must the pilot point the plane during the flight?

    a) due east

    b) east of north

    c) due north

    d) west of north

21. An object is moving at 2.50 m/s [E]. At a time 3.00 seconds later the object is travelling at 1.50 m/s [E]. What was the displacement during this 3.00 second time interval?

    a) 6.00 m [E]

    b) 7.50 m [E]

    c) 4.50 m [E]

    d) 0.500 m [E]

## Part B: Fill-in-the-Blanks (14 x 0.5 = 7 Marks)

**Fill in the blanks with one of the choices in the word bank. The terms in the word bank may be used once, more than once, or not at all.**

**Write your answers in the space provided on the answer sheet.**

| | | | |
|---|---|---|---|
| acceleration | into | normal force | static |
| centripetal | joule | out of | two times |
| four times | kinetic | potential | uniform |
| impulse | larger | range | velocity |
| inertia | normal | smaller | watt |

1. The force required to keep an object moving with uniform circular motion is called the _____ force. (Outcome S4P-1-19)
2. In uniform circular motion, if the velocity doubles, the acceleration of the object must change to be _____ as great as the original acceleration. (Outcome S4P-1-24)
3. The _____ force is always perpendicular to the surface supporting an object. (Outcome S4P-1-5)
4. The force of friction exerted on an object just before it begins to slide across a surface is called _____ friction. (Outcome S4P-1-7)
5. In projectile motion, the _____ refers to the horizontal distance the object travels. (Outcome S4P-1-18)
6. The tendency of an object to resist changes in its motion is called _____. (Outcome S4P-1-9)
7. The area beneath a force-time graph represents _____. (Outcome S4P-1-11)
8. The word that best describes the motion of an object with a net force of 0 N acting on it is _____. (Outcome S4P-1-8)
9. The amount of friction acting on an object that is sliding across the surface of a level table depends on the coefficient of kinetic friction and the _____. (Outcome S4P-1-7)
10. The unit newton · metre is equivalent to the _____. (Outcome S4P-1-25)

11. The area beneath the force-extension graph of a spring represents _____ energy. (Outcome S4P-1-32)

12. If negative work is done on an object, kinetic energy is transferred _____ the object. (Outcome S4P-1-27)

13. The work-energy theorem relates work done to changes in _____ energy. (Outcome S4P-1-29)

14. If an object is pulled across a horizontal surface with a force that acts at 20° up from the horizontal, the magnitude of the normal force will be _____ than the force of gravity. (Outcome S4P-1-5)

## Part C: Short Explanation Questions (4 x 4 = 16 Marks)

**Answer any four (4) of the following questions. Be sure to indicate clearly which four questions are to be marked. Use proper English in your explanations.**

**Outcome S4P-1-2**

1. Using sketches of the appropriate graph, derive the kinematics formula $\vec{d} = \vec{v}_1 t + \frac{1}{2}\vec{a}\Delta t^2$.

**Outcome S4P-1-27, S4P-1-28**

2. The speed of a gymnast revolving around a horizontal bar is greatest at the bottom and least at the top. Explain using the law of conservation of energy.

**Outcome S4P-1-19**

3. An object is travelling in a straight line with velocity $\vec{v}$. Describe the motion of the object that would result if only

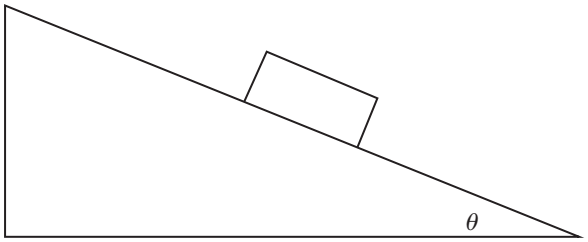
   a) an acceleration parallel to the original velocity acts on the object

**Outcome S4P-1-32**

4. Derive the equation for the potential energy of a spring $\left(PE_S = \frac{1}{2}kx^2\right)$ using Hooke's law and a force-displacement graph.

**Outcome S4P-1-5**

5. Draw a free-body diagram for an object of mass m resting on an inclined plane, as given in the diagram below. Label clearly the force of gravity and its components, the normal force, and the force of friction. Write an expression for the magnitude of the components of the force of gravity parallel to the surface and perpendicular to the surface.



**Outcome S4P-1-14**

6. Relate the impulse-momentum equation to the following real-life situations:
   a) hitting a baseball as far as possible

## Part D: Problems (8 x 7 = 56 Marks)

**Answer any eight (8) problems. Please show your work. Number your answers clearly.**

**Outcomes S4P-0-2a, S4P-0-2f, S4P-0-2h, S4P-1-2, S4P-1-3**

1. An airplane flies with an airspeed of 225 km/h heading due west. At the altitude at which the plane is flying, the wind is blowing at 105 km/h heading due south.
   a) What is the velocity of the plane as observed by someone standing on the ground?
   *Answer: (4 marks)*

b) How far off course would the plane, while it is heading due west, be blown by the wind during 1.50 h of flying?

*Answer: (1 mark)*

The wind pushes the plane south. The velocity of the wind is constant at 105 km/h [S] for 1.50 hours.

Using the equation $\vec{v} = \frac{\vec{d}}{\Delta t}$ rearranged to give $\vec{d} = \vec{v}\Delta t$, the plane is pushed off course by $\vec{d} = (105 \text{ km/s [S]})(1.50 \text{ h}) = 158 \text{ km [S]}$.

c) What heading must a plane take in order to reach its destination, which is due west of a starting point?

2. A motorcycle starts from rest and accelerates at +3.50 $m/s^2$ for a distance of 175 m. It then slows down with an acceleration of –1.50 $m/s^2$ until the velocity is +10.0 m/s.

   a) What is the length of time the motorcyclist takes to travel +175m?

   b) What is the velocity at the end of the time interval determined in part (a)?

c) Determine the displacement of the motorcycle while it is slowing down during the second part of its journey.

**Outcomes S4P-1-4, S4P-0-2h**

3. What mass, M, can be supported at P so that the forces are in equilibrium at P?

**Outcome S4P-1-24**

4. A bicyclist and his bicycle have a mass of 85.4 kg. The cyclist is travelling around a circular track of radius 75.0 m at a constant speed of 7.96 m/s.

   a) Calculate the period of this motion.

   b) Calculate the acceleration of the cyclist.

c) Calculate the force necessary to keep the cyclist moving around the track.

d) Calculate the frequency of this motion.

**Outcomes S4P-1-13, S4P-0-2h**

5. A car of mass 1250 kg is travelling at 20.0 m/s [W]. At an icy intersection, the car collides with a truck of mass 2450 kg travelling at 15.0 m/s [S]. The collision lasts 0.250 seconds. After the collision, the two vehicles slide along together.

   a) What is the total momentum of the system of the car and the truck before the collision?

b) What is the velocity of the car after the collision?

**Outcomes S4P-1-8, S4P-0-2h**

6. A crate of mass 80.0 kg is pulled across a level concrete floor at a constant acceleration of 0.895 $m/s^2$. A force of 305 N acting 35.0° above the horizontal is used to move the crate.

   a) Calculate the normal force acting on the crate.

b) Calculate the force of kinetic friction acting on the crate.

c) Calculate the coefficient of kinetic friction.

**Outcome S4P-1-15**

7. A stone of mass 75.0 g is thrown upwards at 23.2 m/s from the height of a railing of a bridge that is 63.8 m above the surface of the water.

   a) Calculate the velocity of the stone as it strikes the water's surface.

b) How long after the stone is thrown is the stone 10.0 m above the surface of the water?

c) Where is the stone 3.50 seconds after being thrown?

**Outcomes S4P-1-18, S4P-0-2h**

8. A golfball is struck leaving the tee at a velocity of 45.0 m/s 47.9° from the horizontal. The ball travels over a level fairway towards a green where the hole is located 204 m from the tee.

   a) Calculate the vertical and horizontal components of the ball's velocity.

   b) Determine the time the ball is in the air.

c) If the ball is heading in the right direction, will it be possible for the golfer to score a hole in one?

**Outcomes S4P-1-24, S4P-1-8**

9. A satellite orbits the earth in a nearly circular orbit of radius $7.88 \times 10^6$ m with a period of 115 minutes. The satellite has a mass 238 kg.

   a) Calculate the speed of the satellite in m/s.

   b) Calculate the centripetal force acting on the satellite.

   c) If the weight of the satellite supplies the centripetal force, calculate the gravitational field strength at this distance from earth.

**Outcome S4P-1-33**

10. A skier of mass 82.4 kg starts his run from rest. The skier drops 155 m vertically while skiing 795 m down the slope. The skier arrives at the bottom of the slope moving at 10.0 m/s.

    a) Determine the change in the gravitational potential energy of the skier.

b) Determine the work done by friction.
*Answer: (3 marks)*

c) Determine the average force of friction that acted on the skier.

**Outcome S4P-1-33**

11. A dry ice puck, which slides along with no friction, has a mass of 2.30 kg and is sliding along a level horizontal surface at 2.25 m/s. The puck hits a spring bumper, which is compressed 20.0 cm, before the puck comes to rest.

    a) Determine the force constant of this spring.

b) How much is the spring compressed when the puck is sliding at 1.75 m/s towards the bumper?

c) If the dry ice puck was initially moving at 2.25 m/s towards the spring and the spring is compressed only 10.0 cm, calculate the speed of the puck at that moment.

**Outcomes S4P-1-5, S4P-1-7, S4P-1-8**

12. A child is sitting in a wagon on a hill, which has an incline of 14.0° from the horizontal. The mass of the child and wagon is 42.0 kg. The coefficient of kinetic friction is 0.125. The wagon begins to move.

    a) Calculate the normal force acting on the wagon.

b) Calculate the force of kinetic friction.

c) Calculate the distance the child and his wagon will move during the first 15.0 s of his trip.

# NOTES