Academic Services

Academic Upgrading

Study guide for placement into Physics 20 (PHYS 181)

Updated: March 2020

Important Information about this Study Guide and the Placement Exam

This study guide is designed to prepare students for the Academic Upgrading Physics 10 Placement test. It assesses grade 10 physics content that students will need to know to be successful in Physics 20 (PHYS 181). An answer key is included at the end of this guide.

It is recommended that you review and practice the material in the study guide before taking the placement test.

You should ensure that you have access to the appropriate formula sheet and writing materials when you are taking the placement test.

You can take your placement test online through https://www.sait.ca/programs-and-courses/full-time-studies/academic-upgrading

It is designed for upgrading placement purposes only. **This exam may not be used for admission to any SAIT program; that is, this is not a SAIT admission exam. In addition, the results cannot be used at any other educational institution.**

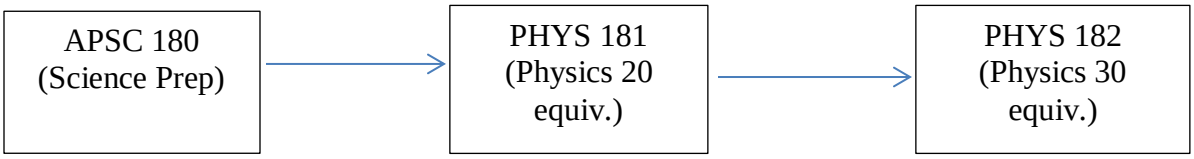
The time allotted for the test to place into Physics 20 is 45 minutes. It consists of 13 questions and covers the physics material from Science 10. A mark of 60% is required to pass and allows entrance into PHYS 181.

Note: PHYS 181 is equivalent to Physics 20.

PHYS 181 is accepted as an admission requirement at other post-secondary institutions in Alberta, but you should always check with the post-secondary institution you are interested in attending (if it is not SAIT) to confirm it will accept the course.

Students who have successfully taken APSC 180 (grade 10 Science) at SAIT **are not required** to take the placement test for PHYS 181.

SAIT Academic Upgrading Course Sequence



Introduction: Physics 10 Study Guide

- Review the practice exercises. You may use the formulas provided on the formula sheet at the end of the guide.
- Check your answers with the answer key provided at the end of this guide.
- You may choose to utilize a Science 10 Study Guide from the Calgary Public Library or bookstore for extra review. Make sure you focus on the physics chapters from such guides.
- You will be given a formula sheet during the exam.
- You will need and are required to bring a scientific calculator for the test (graphing calculators are not permitted).

Multiple Choice

Use the following information to answer questions 1 and 2:

A nervous papa bear is expecting the birth of his first baby cub. He paces 10.0 m north in 5.0 s, then 16 m south in 5.0 s, and then 14 m north in 4.0 s.

1. The average speed of the bear is:

    a) 0.57 m/s
    b) 1.1 m/s
    c) 2.9 m/s
    d) 4.0 m/s

2. The average velocity of the bear is:

    a) 0.57 m/s [N]
    b) 1.1 m/s [N]
    c) 2.9 m/s [N]
    d) 4.0 m/s [N]

3. Another nervous papa bear paces at 1.0 m/s north for 3.0 s, then at 1.6 m/s south for 5.0 s, and then at 1.4 m/s north for 4.0 s. The average speed of this bear is:

    a) 1.3 m/s
    b) 1.4 m/s
    c) 4.0 m/s
    d) 8.0 m/s

4. Which one of the following is true?
    a) The units for acceleration are m^2/s^2.
    b) Acceleration is a change in speed over time.
    c) The slope of a speed-time graph gives the velocity.
    d) A positive slope on a distance-time graph means that the object is accelerating.

Use the following information to answer questions 5 and 6.

A car changes its velocity from 8.00 m/s [E] to 4.00 m/s [E] in 2.10 s.

5. The acceleration of the car is:
   a) $-1.90\ m/s^2$ [E]
   b) $1.90\ m/s^2$ [E]
   c) $-5.71\ m/s^2$ [E]
   d) $5.71\ m/s^2$ [E]

6. The acceleration of the car in the example above is:

   a) positive because it is speeding up in a positive direction
   b) negative because it is slowing down in a positive direction.
   c) positive because it is slowing down in a negative direction.
   d) negative because it is speeding up in a negative direction.

7. The unit of work described in fundamental units is:

   a) $kg \cdot m/s$
   b) $kg \cdot m/s^2$
   c) $kg \cdot m^2/s$
   d) $kg \cdot m^2/s^2$

8. A student pushes a box a horizontal distance of 8.70 m with a horizontal force of 55.0 N. The work done by the student in pushing the box is:

   a) 0.158 J
   b) 6.32 J
   c) 63.7 J
   d) 479 J

Use the following information to answer questions 9, 10, and 11:

On a camping trip, the following scenario occurs:

I **A camper rubs a match on a gritty surface igniting a match.**
II **The match is then used to ignite a pile of wood kindling, creating a bonfire.**
III **While standing by the bonfire, the camper senses that the part of his body facing the fire is warm while his backside remains cool.**
IV **Another group of campers across the lake spots the bonfire.**

9. Which of the above describes a conversion of mechanical energy to heat?

a) I
b) II
c) III
d) IV

10. Which of the above describes a conversion of chemical energy to heat?

a) I
b) II
c) III
d) IV

11. Which of the above describes a conversion of heat to radiant energy?

a) I
b) II
c) III
d) IV

12. Technologically "useful" energy refers to:

a) energy needed to do work
b) useful thermal energy input
c) total mechanical energy input
d) input energy of a cogeneration process

13. A 2.00-kg object is thrown 3.00 m/s horizontally at 1.50 m above the ground. The total mechanical energy of the ball is:

a) 9.00 J
b) 20.4 J
c) 29.4 J
d) 38.4 J

Use the following information to answer questions 14 and 15:

I A carpenter applies a force on the handle of a claw hammer to pull a nail from a board and the handle moves a certain distance.
II The nail comes out of the board a certain distance.
III When the carpenter then touches the nail, she senses that the nail is hot.

14. Which of the situations stated above can best be described by the first law of thermodynamics?

a) I and II
b) I and III
c) II and III
d) III only

15. Which of the situations stated above can best be described by the second law of thermodynamics?

a) I and II
b) I and III
c) II and III
d) III only

16. The type of energy stored in the bonds of chemical compounds is:

a) elastic energy
b) potential energy
c) electromagnetic energy
d) gravitational potential energy

Numerical Response

17. A girl lifts her 30.0-kg knapsack a vertical distance of 0.500 m. Then she carries it 10.0 m across the park to the water fountain. What is the value of the work done by the girl?

Use the following information to answer questions 18, 19, and 20:

An archer uses a force of 60.0 N to draw back the string of his bow through a distance of 0.330 m. He then fires a 300.0-g arrow straight up into the air.

18. What is the value of the work done by the archer?

19. What is the maximum speed of the arrow at the instant it leaves the bow?

20. What is the maximum height reached by the arrow in its flight into the air? (Record your answer to three significant digits.)

Use the following information to answer questions 21 and 22:

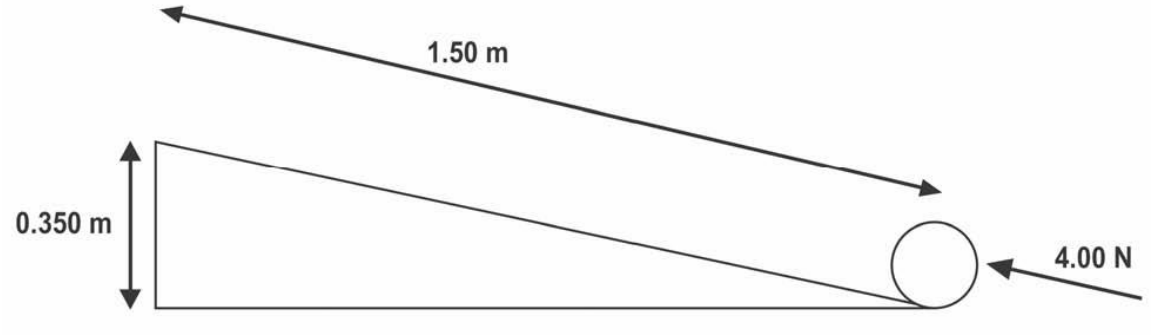
A worker applies a force of 5.50×10^2 N in sliding a block of wood 15.0 m along a surface. The work output is determined to be 5.00×10^3 J.

21. Calculate the efficiency of the worker.

22. If the percent efficiency is 35.0%, what work input would be required to do the same work output?

Written Response

23. A student rolls a 1.25-kg ball up a 1.50 m inclined plane with a vertical height of 0.350 m, as shown below. The uniform force exerted by the student to roll the ball up the inclined plane is 4.00 N along the incline. The time taken to roll the ball a distance of 1.50 m is 3.30 s.



a) Calculate the work input, the work output (hint: if it falls off the edge, for example), and the percent efficiency in rolling the ball up the inclined plane.

b) Explain why there is a difference in the work input and the work output.

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c) Calculate the average speed of the ball up the incline.

d) Calculate the gravitational potential energy of the ball at the top of the incline.

e) Suppose the ball drops over the edge of the inclined plane. Calculate the maximum speed of the ball just before it hits the ground below.

f) Describe the assumption that was made in determining the maximum speed of the ball.

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24. a) State the first law of thermodynamics. Describe one situation in the technology where this law can be applied.

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b) State the second law of thermodynamics. Describe one situation in the technology where the second law can be applied.

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c) Identify one place in the technology where percent efficiency of an energy transfer or transformation will be a low value.

_____

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_____

Answers

Multiple Choice

1. c
2. a
3. a
4. b
5. a
6. b
7. d
8. d
9. a
10. b
11. c
12. a
13. d
14. a
15. d
16. b

Numerical Response

17. 147 J
18. 19.8 J
19. 11.5 m/s
20. 6.74 m
21. 60.6%
22. 1.43×10^{4} J

Written Response

23. a) $W_{input} = 6.00$ J
    $W_{output} = 4.29$ J
    percent efficiency = 71.5%
    b) Some energy is lost as heat from friction.
    c) 0.455 m/s
    d) 4.29 J
    e) 2.62 m/s
    f) All the potential energy is converted to kinetic energy.

24. a) First law of thermodynamics: The total energy (including heat) put into a system and its surroundings remains constant. All the energy put into the CD player's system is converted to useful energy output plus heat.
    b) Second law of thermodynamics: Heat flows naturally from hot to cold objects and in the process can be made to do work. The heat generated in the CD player flows from the CD to your hand, which is cooler.
    c) The percent efficiency of an energy transfer would be low when electrical energy is converted to mechanical energy in the CD player because moving parts are involved. These will produce friction and thus lose energy as heat.

Physics 10 Placement Exam

Formula Sheet

Note: use 9.81 m/s^2 for the acceleration due to gravity.

$$v = \frac{d}{t}$$

$$a = \frac{v_f - v_i}{t}$$

$$F_{net} = ma$$

$$W = Fd$$

$$d = v_i t + \frac{1}{2} a t^2$$

$$d = \left(\frac{v_i + v_f}{2} \right) t$$

$$E_p = mgh$$

$$E_k = \frac{1}{2} m v^2$$

$$\% \text{ efficiency } = \frac{W_{out}}{W_{in}} x100\%$$