RESTRICTED

CANARY G.W. JR.
GROUP IV 43-H FLIGHT SQDN

# ACADEMIC DEPARTMENT
# ARMY AIR FORCES PREFLIGHT SCHOOL (*PILOT*)

SAN ANTONIO AVIATION CADET CENTER

SAN ANTONIO, TEXAS

# PHYSICS

# WORK BOOK

12-15-42-mi
2373

PHYSICS

PREFACE

I. OBJECTIVES: The fundamental objectives of this course are (1) to give you an understanding of the more important natural laws and scientific principles upon which the construction and operation of aircraft and aircraft instruments are based, and (2) to acquaint you with the fundamental principles and terminology of meteorology.

II. SCOPE: Beginning with a review of the Units of Measurement this course includes a study of the principles of moving bodies, work and power, and energy and friction as a basis for an understanding of the construction and operation of aircraft. Also included is a study of the properties of gases and liquids, at rest and in motion, and an application of these characteristics of gases to a study of the atmosphere and its changing conditions.

III. USE OF THIS PUBLICATION: This publication contains a series of question and problem sheets (called Q-sheets) and, at the end, some supplementary material for your reference. On each Q-sheet space has been provided for you to enter the correct solution or answer for each problem or question. This publication is yours to keep and use for reference; therefore, you should work out each problem on the Q-sheet in such a manner that you can refer back to it in future stages of your training and understand the solution which you have entered.

The material in the Q-sheets has been carefully prepared to aid you in obtaining a complete understanding of the subject matter for each lecture period. Certain Q-sheets will be assigned by the instructor for your completion, following each lecture. You should complete all the assignments in this book for each lecture only after you have completed the textbook assignment for that lecture. The best way to insure that you will be successful in this course is to complete all assignments.

12-14-42-mi
2339

# INDEX

12-15-42-mi. PRACTICE EXERCISES PHYSICS FORM Q-1
2196

I. COMPLETION SECTION:

A. Fill in each blank space with the one word or term which will make that statement true and complete.

Physics is considered an exact science because most of the general truths and laws on which it is based can be expressed in terms of quantitative or mathematical relationships.

The need for having absolutely permanent basis for weights and measures resulted in the establishment of the metric system by the French Government in 1793. The English system of measures is often called the F.P.S. system because it involves the use of the Feet, Pound and Second as units of measurement. The most commonly used unit of length in the metric system is the centimeter which is one-hundredth of a meter. Density is defined as the mass of a body per unit of its volume. Acceleration is the change in velocity per unit of time. Acceleration is the rate of decrease or increase in velocity. Ft./sec./sec. is one way of expressing acceleration.

B. 1. If $d = \frac{m}{v}$, give formula for finding m. $m = DV$

2. If $V = \frac{d}{t}$, give formula for finding t. $T = \frac{D}{V}$

3. If $a = \frac{v}{t}$, give formula for finding v. $V = Ta$

II. PROBLEM: A train, traveling at the rate of 45 mi./hr., accelerates to a stop in 10 seconds. What was its acceleration in

(a) mi./hr./sec.? (a) 4.5
(b) mi./min./sec.? (b) .075
(c) mi./sec./sec.? (c) .00125
(d) ft./sec./sec.? (d) 6.6

12-15-42-mi
2197

PRACTICE EXERCISES

PHYSICS FORM Q-2

1. a. 2.5 meters = 250 cm.
   b. 10 cm. = 3.40 in.
   c. 26 in. = _____ cm.
   d. .4 m. = _____ in.
   e. 3.3 lb. = _____ kg.
   f. 8 km. = 5 mi.
   g. 3 kg. = _____ g.
   h. 454 g. = _____ kg.
   i. 907 g. = _____ lb.
   j. 4617 mg. = _____ g.

2. What is the surface area in $cm.^2$ of a rectangle 15 cm. by 18 cm.?

   Ans. 270 $cm^2$

3. a. What is the area in $cm.^2$ of a rectangle 5 in. long and 4 in. wide?

   Ans. 129 $cm^2$

   b. How many liters will a five-quart can hold?

   Ans. 6.285

   c. 453 $cm.^3$ = _____ liters

   d. 4.5 liters = _____ $cm.^3$

4. If a liter of tallow weighs 812 grams, what is the density of tallow?

   Ans. _____ $g./cm.^3$

5. The density of iron is 7.8 $g./cm.^3$. What will be the weight in kg. of a block of iron 400 cm. long, 25 cm. wide, and 10 cm. thick?

   Ans. _____

12-15-42-mi
2198

PRACTICE EXERCISES

PHYSICS FORM Q-3

1. A falling body at the end of the third second of fall, has a velocity of 96 ft./sec. What is the acceleration of the body?

Ans. 32

2. 62.4 lb./ft.$^3$ is the density of water. How much will 5 ft.$^3$ of water weigh?

Ans. 312

3. The density of water is 1 g./cm.$^3$. What is the volume of one kilogram of water?

Ans. 1000

4. If the velocity of a baseball is 60 ft./sec., how long a time will be required for the ball to travel from center field to home plate if the distance is 200 feet?

Ans. 3.33

12-15-42-mi
2199

PRACTICE EXERCISES

PHYSICS FORM Q-4

1. Oxygen has a density of .001429 g./cm.$^3$.

   a. How much will 200 cm.$^3$ weigh?

   Ans. .2858

   b. How many liters must be taken to obtain 2.858 g.?

   Ans._____

2. A train traveled 400 miles in 12 hours. Express its average velocity in:

   a. Mi./hour

   Ans. 33.33

   b. Ft./sec.

   Ans._____

3. An airplane whose velocity is 200 mi./hr.

   a. Has what velocity in ft./sec.?
   b. Will travel how far in 5 seconds?

   a._____

   b._____

4. What is the acceleration of a body which starts from rest and attains a velocity of 240 cm./sec. over a period of one minute?

   Ans. 4 cm/sec/sec

12-15-42-mi
2200

PRACTICE EXERCISES

PHYSICS FORM Q-5

If one of the following statements is true write the word "True" in the space preceding that statement. If a statement is either partially or totally false, write the word "False" in the blank space preceding that statement.

True 1. The air is a mixture, not a compound.

True 2. Water vapor in the air produces fog, icing and clouds.

_____ 3. The highest clouds are called cirrus and are seldom found above 35,000 feet.

True 4. Weather courses for pilots are not given for the purpose of making them into accurate forecasters.

True 5. When weather information is inadequate or inaccurate, pilots should have sufficient understanding of weather principles to make correct decisions if trouble arises.

FALSE 6. A large percentage of all aircraft accidents occur as a result of ignorance concerning weather.

FALSE 7. Weather conditions are unimportant in waging war except in the Air Corps.

TRUE 8. The lapse rate in the troposphere is 2°C. per 1000 ft.

COMPLETION: Fill each blank space with the one word which makes that respective statement true and complete.

For discussion the atmosphere is usually divided into three strata, namely the TROPOSPHERE, the TROPAUSE and the STRATOSPHERE.

That branch of Physics, which deals with the atmosphere and its phenomena, is called METEOROLOGY. On any flight, it is necessary that pilots have a reasonable idea of probable WEATHER CONDITIONS to be encountered on the flight.

1. Why are experiments in meteorology more difficult than those in chemistry or biology?
2. What is the maximum amount of water vapor that may exist in the atmosphere?
3. What flying hazards are brought about by the presence of water vapor in the atmosphere?
4. Why are oxygen tanks used in high altitude flying?
5. Above what altitude are cloud formations seldom found?
6. (a) Below what altitude does 50% of the weight of the atmosphere lie? 90% of the total water content?

   (b) Is all this altitude included in the troposphere?
7. In what layer of the atmosphere is the mother of pearl cloud sometime observed?
8. What is the normal decrease of temperature for each 1000 feet of altitude in the troposphere?
9. Using the lapse rate in the troposphere, if the temperature at the earth's surface is 20°C., what would be the temperature at 17,000 feet?
10. A pilot's thermometer reading is -50°C. at 35,000 feet, and he wishes to fly at an altitude at which the temperature will be 0°C. How much altitude must he lose? (Use normal lapse rate).
11. How does an increase in altitude effect the density and pressure of the air?

12-15-42-mi
2202

PRACTICE EXERCISES

PHYSICS FORM Q-7

1. What are components?

2. Complete the statement: Any force will have an EQUAL FORCE in another direction unless the angle between the acting forces is the same.

3. When is a body in a state of equilibrium?

4. What is force?

5. Define absolute units for measuring force.

6. If a one-lb. force will give a one-lb. mass an acceleration of 32 ft./sec./sec., what force will be required to give a ten-lb. mass an acceleration of 64 ft./sec./sec.

7. TRUE-FALSE SECTION:

T a. The acceleration of a body is equal to the product of its mass and the force producing the acceleration.

T b. If two bodies of equal mass are accelerated by the application of unequal forces, the greater of the two forces will produce the greater acceleration.

T c. If two equal forces are each applied to two bodies of equal mass, the two bodies will be equally accelerated.

T d. If air resistance is neglected, any freely falling body, near sea level, will have an acceleration of 32 ft./sec./sec. or 980 cm./sec./sec.

F e. A one pound force acting on a one pound mass for one second will increase its speed by 1 ft./sec.

K f. A force of one-gram is required to accelerate a one-gram mass by 1 cm./sec./sec.

T g. A force of one dyne will impart an acceleration of 1 cm./sec./sec. to a one-gram mass.

F h. If a net force of one poundal be applied to a body of one-pound mass, the body will gain a velocity of 1 ft./sec. in a time of one second.

1. (a) What force is required to accelerate a 10-gram bullet 4900 cm./sec./sec.? (Express force in absolute units)
   (b) How many grams of force?

(a) 49,000 dynes

(b) 50 g

2. What thrust would be necessary to give an acceleration of 25 ft./sec./sec. to an airplane whose weight (mass) is 2000 lb.? Express thrust in

   (a) Poundals of force.
   (b) Pounds of force.

(a) 50,000

(b) _____

3. A force of 64 poundals will give a 10-lb. mass how much acceleration?

Ans. 6.4

4. How much acceleration will a 100-lb. force impart to a body whose mass is 16-lb.?

Ans. 400

5. If the body in problem 4 above starts from rest what will be its speed

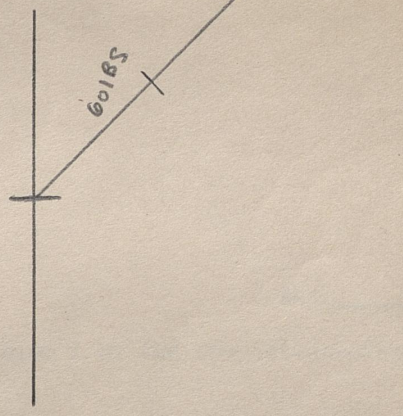
   (a) At the end of one second? (a) _____

   (b) At the end of two seconds? (b) _____

   (c) At the end of five seconds? (c) _____

12-15-42-mi PRACTICE EXERCISES PHYSICS FORM Q-9
2204

1. Find the easterly component of a 60 lb. force acting in a direction of 45°.




Ans._____

2. A plane flies a course of 300° with a ground speed of 100 m.p.h. If the plane leaves Base A at 9:00 o'clock

   (a) How many miles north of A will the plane be at 10:00 o'clock?
   (b) How many miles west of A will the plane be at 10:00 o'clock?

   Solve graphically.

Ans._____

PRACTICE EXERCISES



1. What is the resultant of a 10-lb. force acting at 30° and a force of 25 lb. acting in a direction of 100°. Solve graphically by the completion-of-polygon method.

Ans._____

2. Find the resultant of problem 1 by the completion-of-parallelogram method.

Ans._____

3. A 90 lb. force acts on a body in a direction of 40°. The body is free to move only in a direction of 85°. The body will react as tho a force of what magnitude is applied in a direction of 85°?

Ans._____

12-15-42-mi
2206

PRACTICE EXERCISES

PHYSICS FORM Q-11

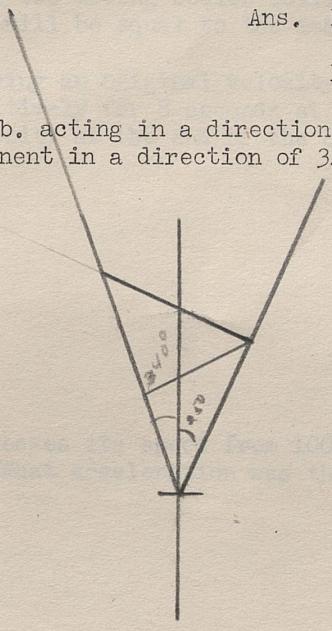
1. Find the resultant of the following forces. (Use any method you wish)

120 lb. at 40°
300 lb. at 270°
290 lb. at 150°

Ans. Magnitude: 21

Direction: _____

2. A force of 30 lb. acting in a direction of 25° will have what effective component in a direction of 340°?




Ans. 21

12-15-42-mi
2207

PRACTICE EXERCISES

PHYSICS FORM Q-12

I. TRUE-FALSE SECTION:

True 1. Bodies in motion will continue moving in a straight line at a constant speed unless forced to change their velocity by the application of force.

False 2. Inertia is the ability of a body to change its direction without a decrease or increase of speed.

True 3. When an outboard motor drives a boat, the water is pushed away from the boat with the same force with which the boat is pushed forward.

True 4. A falling body will have a final velocity of 32 ft./sec. at the end of the first second it falls, it will therefore fall 32 ft. during the first second.

True 5. For a body starting from rest and having a constant acceleration, the final velocity is equal to the product of the acceleration and the time.

True 6. When two moving bodies collide the momentum gained by one will be equal to the momentum lost by the other.

II. An airplane, having an original velocity of 100 mi./hr., is accelerated positively for 8 seconds at the rate of 22 ft./sec./sec. What is its velocity at the end of the 8 seconds?

Ans. 220 MPH

III. An airplane increases its speed from 100 mi./hr. to 205 mi./hr. in 28 seconds. What acceleration was the plane given?

Ans._____

12-15-42-mi
2208

PRACTICE EXERCISES

PHYSICS FORM Q-13

1. A bomb is released at a height of 30,000 ft. with an acceleration of 32 ft./sec./sec., the bomb will require how much time to reach the ground?

Ans. 43.3

2. An 8 oz. bullet whose velocity is 2000 ft./sec. will give a body of 20 lb. mass what velocity, if the bullet strikes the body and remains imbedded in it? (Body is at rest before impact).

Ans. 47.1

3. a. An airplane, moving with an initial velocity of 110 ft./sec. is accelerated positively 4 ft./sec./sec. for 27.5 sec. What will be its final velocity?

Ans. 220

b. What would have been its final velocity if the acceleration had been negative?

Ans. 0

PRACTICE EXERCISES



1. What distance will an airplane travel in 12 seconds, if, starting from rest, it is accelerated positively 22 ft./sec./sec.?

Ans. 1584

2. What will be the final velocity of the plane in the above problem?

Ans. 264

3. If a certain type airplane can accelerate positively at the rate of 22 ft./sec./sec. and requires 6 seconds to attain its minimum air speed for take-off, what is the minimum length of runway it will need?

Ans. 396

4. A certain type plane can accelerate 33 ft./sec./sec. How long a time would be required for such a plane, starting from rest, to cover a distance of 1200 ft.? What would be its final velocity at the end of that time? What would be its average velocity over that distance?

(a)_____

(b)_____

(c)_____

PRACTICE EXERCISES PHYSICS FORM Q-15

1. A pilot throws a ball downward from an airplane. The ball is thrown with an initial velocity of 88 feet per second.

   (a) If the ball reaches the earth in 10 seconds, how high was the plane when the ball was thrown?

   (b) What was the velocity of the ball at the time it hit the ground?

(a)_____

(b)_____

2. A bomb dropped from a plane hits the ground with a velocity of 200 feet per second. From what altitude was it dropped?

Ans. 625 ft

3. A plane's take-off speed is 80 miles per hour. If the motor can accelerate the plane 40 feet per sec./sec., how far must that plane travel on the runway before it takes off. (Neglect wind)

Ans._____

$P = \frac{W}{T}$

$W = FD$

$F = ma$ (av) Power + work

$d = \frac{1}{2} a T^2$

$v^2 = 2ad$

---

$p = hd$

$p = \frac{F}{a}$

---

$c = \frac{p}{F}$

$PE = hd$

$KE = \frac{mv^2}{2}$ (av).

$v^2 = 2ad$

$KE = mad$

$\frac{F_1}{F_2} = \frac{a_1}{a_2} = \frac{r^2}{r^2}$

$(r^2)$ $(r^2)$ $a_2$

$A_1 v_1 = a_2 v_2$

1. How much is "g"? Why?

Ans. 32

2. What force must be exerted on a plane, weight 4500 lb., making a turn whose radius is 1000 yd., if a velocity of 90 miles/hr. is maintained through the turn. Give answer in

   (a) Absolute units
   (b) Gravitational units

(a)_____

(b)_____

3. A ball with a mass of 40 pounds is attached to a chain 2 ft. long and whirled in a circle with a velocity of 100 ft./sec.

   (a) What is the Centrifugal force in absolute units?
   (b) In Gravitational units?

(a)_____

(b)_____

12-16-42-mi
2304

PRACTICE EXERCISES

PHYSICS FORM Q-17

1. What distance can a plane travel in 10 seconds, if, starting from rest, it is accelerated positively 8 ft./sec./sec.?

Ans. 400 ft

2. A plane dropped a bomb. Nine seconds later the bomb struck the earth. At what height above the ground was the plane?

Ans. 1296 ft

3. A bomb dropped from a height of 20,000 ft. will strike the earth how long after it is released? With what velocity will it strike the earth?

Ans. 35.355 sec

Ans.

4. If the bomb in the above problem is dropped from a plane whose horizontal velocity is 240 mi./hr., at what distance (measured along the ground) from the target must the bomb be released?

Ans.

$W = FXD$ or $W = FD$

$F = MA$

w = dynes x cm

METRIC = Erg

10,000,000 erg = 1 joule

ENG. w = lb x FT = Ft lbs

1 joule = .74 ft lbs = .215 cal

1 ft lb = 1.35 J.

$P = \frac{W}{T} = P = \frac{\text{Ft lbs}}{\text{sec}}$ metric $= \frac{\text{joules}}{\text{sec}} =$ watt

1 kw = 1000 watts $\quad 550 \frac{\text{ft lbs}}{\text{sec}} = 1 \text{ hp}$

746 w = 1 h.p.

also $P = \frac{FD}{T}$

PRACTICE EXERCISES



1. How much work is done when a 100-lb. weight is lifted a distance of 12 ft.? If the same energy had been expended on a 46-lb. body, how high could the body have been lifted?

Ans. 1200 ft lbs.

Ans. 26.09 ft

2. How high could a 100-lb. mass be lifted by 400 ft.-lb. of work?

$W = FD =$

Ans. 4 ft

3. What is the horsepower of a motor which can lift a 110 lb. mass, starting from rest, a distance of 100 ft. in 4 seconds? (Minimum)

$P = FD/T$

Ans. 5 h.p.

12-16-42-mi
2306

PRACTICE EXERCISES

PHYSICS FORM Q-19

1. How much work is done when a 2000 lb. car, starting from rest, is moved a horizontal distance of 100 feet in 5 seconds?

Ans._____

2. How much power is needed for the moving of the car in problem 1?

$P = \frac{W}{t}$

Ans._____

3. An airplane weighs 2000 pounds. It is powered by a 400 h.p. motor. If 20% of the power is used to overcome friction and drag, how long would such a plane require to reach an altitude of 1000 ft.? (Assume plane in motion, and consider only that work necessary to overcome gravity).

$320 \times 550 = 176,000$ ft lbs/sec

$W = 2000 \times 1000$

$W = 2,000,000$ ft lbs.

$176,000 = \frac{2000000}{T}$

$T = 11.36$

Ans. 11.36 sec.

Remember ⇒ $\begin{pmatrix} w = i = D \\ F = ma \\ D = \frac{1}{2}at^2 \\ v = at \end{pmatrix}$

1. How much work is done when a 20 kilogram body, starting from rest, is moved a distance of 25 meters in 4 seconds? Give answer in:

   (a) Ergs (dyne-centimeters)
   (b) Joules

1.36 $d = \frac{1}{2}at^2$

$2500 = \frac{1}{2}a16$

$a = 312.5 \text{ cm/sec}^2$

$F = ma$

$= 20,000 \times 312.5$

$F = 6,250,000 \times 25000 = 15,625,000,000$

Ans. 15,625,000,000 ergs
1562.5 joules

2. What power would be required for moving the body in problem 1, above?

$4 \overline{)\,156.25}$ 39.063

Ans. 39.063

3. A 3000 lb. plane, originally at rest, was lifted to a height of 100 ft. in 4 seconds.

   (a) How much work was done?
   (b) How much power was required?

(a) 300,000

(b) 136.36 hp

$KE = \frac{mv^2}{2}$ ↑

$g = 32$

KE kenetic Energy

$acl = \frac{v_2}{2}$ ans ft pounds or dynes cm.

12-16-42-mi
2212

PRACTICE EXERCISES

PHYSICS FORM Q-21

1. How much kinetic energy does a mass of 150 lb. have when it is moving with a velocity of 100 ft./sec.? Give answer in (a) gravitational and (b) absolute units.

(a) _____

(b) 150,000 foundals

2. (a) What is the potential energy of a 200-lb. mass suspended 25 ft. above the ground?

(b) How much work was required to raise the body to 25 ft.?

(a) 5000 ft lbs

(b) 5000 ft lbs

3. A 2000-lb. bomb falls a distance of 20,000 ft. Neglecting air resistance, what is its kinetic energy at the moment of impact? (Disregard contained explosive energy).

320 x 550 = 176,000 ft lbs./sec

Ans. 40,000,000 ft lbs.

$C = \frac{R}{F}$ (fractions)

PRACTICE EXERCISES PHYSICS FORM Q-22

1. (a) If a joule of energy was used to lift a 10 gram mass, how high would the mass be lifted?

   (b) How much potential energy did the 10-gram mass have after it was lifted?

(a)_____

(b) 1 Joule

2. The Coefficient of Friction of glass on iron is .16. What force will be required to give a 10-lb. block of glass a uniform velocity on a sheet of iron?

$.16 = \frac{R}{10} = 160$ or 16

Ans. 1.6 lbs

3. Assume 5000 tons of water behind a large dam. If the average depth of water is 50 feet, what is the potential energy of the body of water? Give answer in:

   (a) Ft.-lb.
   (b) KWH (1 kw. hr. = $2.66 \times 10^6$ ft. lb.)

(a) Box, worm

(b)_____

1. 1200 ft.-lb. of work was required to bring a moving 400-lb. body to rest.

   (a) What amount of kinetic energy did the body have originally?
   (b) What was the velocity of the body before the work was applied to stop it?

(a) 1200 ft

(b) _____

2. How much work must be done on a 4000 lb. plane to raise it 500 ft.? (Assume plane already in motion)

W = F X D
W = 4000 X 500
W = 2,000,000

Ans. 2,000,000 ft lbs

3. A 3000-lb. plane initially at rest was elevated to an altitude of 1000 ft. in 1 minute.

   (a) What acceleration was necessary?
   (b) How much work was done?
   (c) How much potential energy did the plane have at the end of the minute interval?
   (d) What power was required? (Neglect accelerative force).

(a) 3

(b) 3,000,000

(c) 3,000,000

(d) _____

$\phi = F/a$ 62.4 lbs. per cu. ft. water

$\frac{F_1}{F_2} = \frac{a'}{a_2}$ or $\frac{F'}{F_2} = \frac{a'}{a_2}$ or Circumference $\frac{F_1}{F_2} = \frac{(r_1)^2}{(r_2)^2}$

12-16-42-mi PRACTICE EXERCISES PHYSICS FORM Q-24
2302

1. In what forms may a fluid exist? liquids or gas
2. Are liquids compressible? To what extent? no
3. To what extent may gases be compressed? to some
4. How are gases changed to liquids? Compression or cooling
5. Do fluids exert pressure? Why? yes
6. How is pressure expressed? (Three ways) dyne/cm² lb/in² kg/cm²
7. How is atmospheric pressure measured? inches or cm of mercury
8. Why is fluid pressure a scalar quantity? force in all directions
9. How does an increase in the height of a column of a fluid effect the pressure? Why? increases with.
10. Explain the principle of the hydraulic jack.
11. Explain the terms in the following formulas.

$$\frac{F_1}{F_2} = \frac{A_1}{A_2}; \quad \frac{F_1}{F_2} = \frac{(r_1)^2}{(r_2)^2}$$

12. If you wished to exert a force of 1000 lbs. on a piston of 10 inch radius, how much force would you have to apply to a piston with a 2 inch radius?

Ans. 39 or 7

13. A pipe 24 inches in diameter is closed at one end and filled with water. If the density of water is 62.4 lb./ft. and the column of water 20 feet high, what is the total force on the bottom? What is the pressure?

Ans. 3 9 2 0. 7 lbs.

Ans. 12 8 8 7 lbs/sq ft

12-16-42-mi
2303

PRACTICE EXERCISES

PHYSICS [illegible]

1. A fluid may be either a liquid or a gas.

2. Liquids are practically incompressible.

3. Gases may be compressed almost without limit.

4. Fluids have weight and therefore exert pressure.

5. Pressure is expressed in terms of force per _____

_____.

6. Since the force in fluids acts in all directions, the pressure of a fluid is a scalar quantity.

7. The increase in the height of a column of a fluid always increases its pressure.

8. Gases condense to the liquid state if sufficiently cooled and/or heated in compressed.

9. The ratio of the radii of the pistons in a hydraulic jack is 1:10. If a mechanic wishes to lift an airplane that weighs 3000 lb., how much force must he apply?

Ans._____

10. What is the force on the bottom of a rectangular tank 10' deep x 20' long x 10' wide if the tank is full of water. What is the pressure? Density of water 62.4 lb./ft.$^3$?

Ans. 1248, [illegible]

11. What pressure will water 2 feet deep exert at the bottom of a tank?

Ans. 624

12. A vertical cylindrical pipe closed at an end, 20 ft. long and 2 ft. in diameter is filled with water.

(a) What is the pressure on the bottom? (a)_____

(b) What is the pressure 10 ft. from the top?

(b)_____

(c) Fifteen feet from the top? (c)_____

(d) What is the force on the bottom? (d)_____

$P = h\delta$

$F = ahD$

12-16-42-mi
2309

PRACTICE EXERCISES

PHYSICS FORM Q-26

1. Any body will float in a fluid if its density is less than that of the fluid.

2. A certain body floats in water such that only .6 of the body is below the surface of the water. What is the density of the body?

Ans. 6 gm/cm$^3$

3. A flat block of wood, density 50 lb./ft.$^3$, 10 feet long 5 feet wide, and 2 feet thick, will support how much weight without sinking when it floats in water?

$\rho = 50$ lb/ft$^3$
$10 \times 5 \times 2 = V$
$V = 100$ ft$^3$

$BF = 100 \times 62.4$
$= 6240$ lbs
$= 5 \text{ tons}$
$1240$ lbs

Ans. 1240 lbs

4. A barometer reading is 28 inches of mercury. What would the reading be in centimeters of mercury? Millibars? (1 in. of mercury = 34 millibars).

Ans. 71.12

Ans. 952 mb

5. What would be the pressure in millibars if the barometer reading was 76 cm. of mercury?

Ans. 1013.2

6. Wind moves from high pressure areas toward low pressure areas.
7. The barometer reading on Pike's Peak would be less than the reading at sea level because an increase in altitude decreases the barometer reading.
8. Under standard conditions the atmospheric pressure is 29.92 in. of mercury, 76 centimeters of mercury or 1013.2 millibars.
9. The pressure of the atmosphere under standard conditions is 14.7 lbs. per square inch.

PRACTICE EXERCISES



1. What determines whether a body will sink or float in a fluid?

its density is less than the fluid

2. Name two kinds of mercurial barometers? What is their difference?

3. What is a pressure gradient? How is it used?

4. Explain the construction and operation of an aneroid barometer.

5. A block of wood, density 41.6 lb./ft., is 1 foot thick, 6 ft. long, and 4 ft. wide.

   (a) How much does it weigh?
   (b) What weight of water will it displace?
   (c) When it floats flat on the water, how deep will it sink in the water?

(a) 998.4 lbs

(b) 998.4

(c)

PRACTICE EXERCISES



1. Distinguish between hydrostatics and hydrodynamics.

2. If a fluid is incompressible the volume of the fluid entering a certain space in a unit of time and the volume of the fluid leaving the place at the same time are _____.

3. The velocity with which a fluid will move through a section of a pipe is inversely proportional to the _____ _____ of the section.

4. The icing of carburetors is based on the principle of the difference of _____ of air at two points in carburetor.

5. The lift of an airplane is an application of the principle based on the work of _____.

6. The air speed indicator is an application of the principle of the _____ tube.

7. Indicated air speed is _____ than true air speed at high altitudes.

8. The icing of carburetors is prevented by the installation of _____.

9. The indicated air speed (at sea level) is _____ than the true air speed in extremely cold weather.

10. If the velocity of a fluid is 20 ft. per second in a pipe whose diameter is 2 inches, what would be the velocity in a pipe whose diameter is 4 inches?

Ans._____

11. 250 liters of air per minute move through a pipe whose diameter is 20 cm. Assuming the air to be incompressible, what would be the velocity of the air in the pipe?

Ans._____

Total Vol. = Area × distance

$A_1 D_1 = A_2 D_2$ $(D = VT)$ or $D_1 = V_1$, $D_2 = V_2$

or

$A_1 V_1 = A_2 V_2$

(Bernoulli's principle that energy will be the same in any two pts is the same.

① $PE = hm$ ② $KE = \frac{mV^2}{2}$ (alt) $(P = h \cdot \ell)$

③ Pressure energy flow = P

$(KE)_A + P_A = (KE)_B + P_B$ or $V_A + P_A = V_B + P_B$

indicated air speed $V_I = \sqrt{\frac{2(P_B - P_A)}{d}}$

$V_{Ta} = V_I + \frac{.02 \times V_I \times Alt}{1000}$

12-16-42-mi
2312

PRACTICE EXERCISES

PHYSICS FORM Q-29

1. What air speed would be indicated on the air speed indicator if the difference in pressure at points B and A were 30 millibars? (1 millibar = 1000 dynes per cm.$^2$. Density .0013)

Ans. 152 MPH

2. What would be the true air speed in the problem above if the plane were flying at 16,000 ft.? (Assume the temperature of air remains constant).

Ans._____

3. A plane flying at 8000 ft. has a true air speed of 180 m.p.h. What is the indicated air speed?

$V_{IA} = \frac{.02 \times V_{TAS}}{100} = 180 - .16 V_I$

Ans. 155.5

PRACTICE EXERCISES



1. 10 grams of a fluid is 100 cm. above a surface. What is the potential energy of the fluid?

Ans. 1000 grams

2. If 1 kilogram of a fluid moves with a velocity of 2 meters per second, what is the kinetic energy of the fluid?

Ans._____

3. 500 lb. of water move with a velocity of 20 feet per second. What is the kinetic energy in absolute units? In gravitational units?

$\frac{500 \cdot 20}{10000}$

Ans. 100 lbs 3125 ft lbs.

COMPLETION SECTION:

1. There are three forces acting on a plane in motion. These forces are lift, Drag, and Thrust.
2. The lift is that force which overcomes the force of gravity and holds the plane in the air.
3. The Drag is the force on an airplane that may be reduced by streamlining.
4. It is very difficult to increase the lift of a plane without increasing the Drag.
5. The stationary elements in a tail assembly are the fin and the stabilizer.
6. The movable elements of a tail assembly are the rudder and the elevators.
7. The thrust of a plane is the force that is produced by the prop. This force produces the relative motion necessary for the speed of the plane and overcomes the force of Drag.
8. The instruments most generally used in flight are air speed ind. altimeter, Compass, bl pressure or climb Bank & turn, and rate climb.

TRUE-FALSE SECTION:

1. The wing area of a plane does not effect the lift. (1) F
2. The ailerons of a plane are not movable. (2) F
3. The nose of a plane is raised or lowered by the use of the rudder. (3) F

TRUE-FALSE SECTION

T 1. Landing flaps are located on the trailing edges of the wings.

_____ 2. The aileron of a plane, when properly used, facilitate cross-wind landings possible.

T 3. The compass of a plane has to be corrected for deviation.

T 4. The altimeter is subject to an error of "lag".

_____ 5. Due to variations of temperature from the standard temperature of 15°C., the altimeter reading is incorrect and must be corrected.

_____ 6. When the temperature is very low the true altitude may be as much as 20% less than indicated altitude.

_____ 7. The lag in an altimeter may be as much as 6 or 8 seconds.

T 8. The deviation card for a plane is made by swinging ship.

_____ 9. The correction of an altimeter for error due to variation of temperature is 2% of the indicated altitude for each 10°F. or 5.5°C. that the temperature differs from the standard temperature.

T 10. To correct air speed indicator for error due to change of pressure at different altitudes, add 2% of the indicated air speed for each 1000 feet increase of altitude.

T 11. The true air speed is always greater than indicated air speed.

12. The altimeter reads 16,000 feet when the temperature is -1.5°C.

_____ (a) What correction in feet should be made to arrive at a true altimeter reading?

greater (b) Would the true reading be greater or less than the indicated reading?

PRACTICE EXERCISES



I. COMPLETION SECTION:

A thermometer is a device for measuring the temperature of a body or substance. _____ may be thought of as the kinetic energy possessed by the molecules of a substance. Most substances _____ when their temperature is increased. A gain of heat by a substance usually results in an increase of its _____. _____ is the transmission of heat by wave motion through space. _____ is the transmission of heat from one substance to another by molecular contact. _____ may be thought of as the degree to which heat is concentrated in a body or substance. Usually when heat is transferred from one substance to another, there must be a change in the temperature of the two substances. The _____ thermometer scale is usually used to describe the temperature of the atmosphere. Whenever heat is exchanged by two substances, the heat flows from the substance of high temperature to the substance of lower temperature.

II. What is the Linear Coefficient of Thermal Expansion of a substance? Why is it valuable in computing clearance of a piston, tolerance of a bridge beam, correction of error in metal tape measures?

III. How does the Law of Conservation of Energy apply to heat transfers?

IV. A 50-ft. aluminum tape measure is calibrated. What correction in its length must be made when it is used at a temperature of 40°C.? (See Table IV, TM 1-233)

Ans._____

Specific heat is the heat required to raise 1g of the substance 1°

water = 1 ice = $\frac{1}{2}$ steam = .43

$Q = m s T$ $Q_2 = m s (T_f - T_i)$ gained

$Q_1 = m s (T_0 - T_f)$ lost

12-16-42-mi PRACTICE EXERCISES PHYSICS FORM Q-34
2315

1. Give equivalent Fahrenheit thermometer scale readings for the following Centigrade scale readings:

   a. 42°C. (a) 107.6

   b. -14°C. (b)_____

   c. -20°C. (c)_____

2. Give equivalent Centigrade thermometer scale readings for the following Fahrenheit scale readings:

   a. 80°F. (a) 26.67°C

   b. 19°F. (b)_____

   c. -20°F. (c)_____

3. Give equivalent Absolute thermometer scale readings for the following thermometer scale readings:

   a. 32°C. (a)_____

   b. 0°C. (b)_____

   c. 50°F. (c)_____

4. A piece of aluminum wire is 40 ft. long at 0°C. At what temperature is its length 40 ft., 1 in.?

   Ans._____

   Ans._____

5. An iron beam is 60 ft. long at 0°C. How many inches in length does it gain when its temperature is increased to 100°C.?

   Ans._____

PRACTICE EXERCISES



1. How many calories are required to change the temperature of 20 g. of iron from 0°C. to 20°C.? (See Table V)

Ans._____

2. How much heat will 250 g. of copper give up when it cools from 90°C. to 48°C.?

Ans._____

3. 400 calories of heat are applied to 400 grams of iron fillings originally at a temperature of 14° Centigrade.

   (a) How much does the temperature of the iron increase?
   (b) What is the final temperature of the iron?

Ans. 8.85 Cal

Ans._____

4. 454 grams of iron is raised in temperature from 50°F. to 68°F.

   (a) How many calories does the iron gain?
   (b) How many B.T.U.?

Ans._____

Ans._____

76 6+6 68 1

12-16-42-mi
2317

PRACTICE EXERCISES

PHYSICS FORM Q-36

1. What was the resulting temperature when 450 grams of lead at 140°C. were added to 400 grams of water at 15°C.?

140 - x  x - 15

Ans._____

2. 400 grams of brass pellets were added to 310 grams of water at 20°C. If the final temperature of the mixture was 25°C., what was the original temperature of the brass pellets?

Ans._____

3. 500 $cm.^3$ of water, contained in a brass vessel whose weight is 200 grams, has a temperature of 15°C. 400 grams of brass pellets at a temperature of 90°C. are added to the water. What is the final temperature of the water? (Water and container have same temperature)

Ans._____

4. (a) What is the difference between temperature and heat?
   (b) Define Specific Heat.

12-18-42-mi
2318

PRACTICE EXERCISES

PHYSICS FORM Q-37

1. The source of all terrestrial energy is the Sun.
2. Heat is transmitted by Radiation, Conduction and Convection.
3. A good radiator is a good absorber of heat and a good reflector is a poor absorber of heat.
4. Radiation is thought to be a _____ disturbance, similar to _____.
5. The amount of energy reaching the earth is also called the amount of _____.
6. The amount of heat that any area of the earth receives is dependent upon the angle of _____ of the sun.
7. Insolation comes to the earth at the rate of _____ calories per sq. cm. per min., and this value is known as the solar _____. The rate of insolation is equivalent to _____ horsepower per sq. yd.
8. About _____% of the energy directed toward the earth is ultimately absorbed by the earth.
9. Vertical convection currents are evidenced by _____ and _____.
10. The normal lape rate is 2 per 1000 feet. This is important in determining the altitude at which clouds may occur.
11. Atmosphere in contact with the earth and vegetation is warmed or cooled by Earth.
12. Hot air is generally more dense (less dense or more dense) than is cold air.

12-18-42-mi
2319

PRACTICE EXERCISES

PHYSICS FORM Q-38

1. If a pilot started a flight when the ground temperature was 20°C., how high could he fly before he could encounter danger of icing? (Assume icing will occur at 0°C. temperature)

Ans._____

2. If the temperature at 10,000 feet was 68°F., what would the Centigrade reading be on the ground?

Ans._____

3. How do high and low pressure areas originate?

Ans._____

4. In what respect does difference in insolation cause wind and air movements?

12-18-42-mi
2471

PRACTICE EXERCISES

PHYSICS FORM Q-39

COMPLETION: Fill each of the following blanks with the one word or term which makes each statement complete and correct.

According to the Kinetic Theory, all matter is composed of small independent units, called molecules, each of which for a given pure substance are exactly alike. In a solid these small units have almost no motion, in a liquid their motion is greater, while in a gas the velocity of these small units is great and enables the gas to exert a pressure in all directions. According to Charles Law, the volume of a given sample of a gas is directly proportional to the absolute temperature if the pressure is held constant, Boyle's Law maintains that, for a constant temperature, the volume of a given sample of a gas is inversely proportional to the ~~of~~ external pressure on the gas. For a constant temperature, the greater the pressure, the smaller will be the volume. For a constant pressure, the lower the temperature, the lower the volume of a sample of gas. An isothermal change is one in which the volume of gas is allowed to change with pressure without a change in temperature. Adiabatic change is one in which the temperature is allowed to fluctuate as the volume of the gas changes with a decrease or increase in pressure. When a column of air rises in the atmosphere, precipitation or cloud formation usually occurs as a direct result of the decrease in temp.

PRACTICE EXERCISES



1. A liter of air under a pressure of 76 cm. of mercury was reduced to a volume of .5 liter. If no temperature change occurred, what was the final pressure required?

Ans. 152 cm

2. Assume 1000 $cm.^3$ of helium under a pressure of 1033.6 $g./cm^2$. If the pressure is increased to 1267.0 $g./cm.^2$ what will then be the volume of the same sample of helium?

$V_1 P_1 = V_2 P_2$

Ans. 815.8 cm

3. A 2 liter, air-tight container is filled with air under a pressure of 15 $lb./in.^2$ and at a temperature of 2°C. If the temperature is raised to 27°C. without allowing any of the air to escape, what pressure will the air then exert against the sides of the container?

Ans. _____

12-18-42-mi
2473

PRACTICE EXERCISES

PHYSICS FORM Q-41

1. What will be the final volume of an original 15 liters of air if the temperature is raised to 97°C. from an original temperature of 0°C., provided the pressure is kept constant?

$\frac{V_1 P_1}{T_1} = \frac{V_2 P_2}{T_2} = \frac{x}{370} = \frac{15}{273} = 273x$

Ans. 20.33

2. 25 liters of air at a temperature of 77°C. are under a pressure of 1000 mb. What volume will the same sample of air have after the temperature has been increased to 212°F. and the pressure has been raised to 2250 millibars?

Ans._____

3. What will be the final temperature of a gas which has been reduced in volume from 4 liters to 1 liter by changing the pressure from 76 cm. to 300 cm., if the original temperature was 40°C.?

$\frac{4 \cdot 76}{40} = \frac{1 \cdot 300}{x}$

Ans. 35.88

4. Assume 1 liter of air under standard conditions. What will be its volume when the temperature is increased to 20°C. and pressure changed to 57 cm. of mercury? (Standard conditions are 0°C. and 76 cm.)

Ans._____

12-18-42-mi
2474

PRACTICE EXERCISES

PHYSICS FORM Q-42

1. Matter exists in three states, namely liquid, solids, _____.

2. The three forms of water are solid, liquid, gas.

3. Water may be changed in form by increasing its _____ or by decreasing the _____ when the pressure is kept constant.

4. The specific heat of water is 1, of ice .5 and of steam .43.

5. The heat of fusion of ice is 80 calories per gram and the heat of vaporization of water is 540 calories per gram.

6. At standard pressure, water boils at 100° Centigrade and freezes at 0° Centigrade.

7. Water has its greatest density at 4° Centigrade.

8. When matter in a solid passes into a gaseous state the process is called sublimation. An example of this process is Dry ice.

9. Icing of wings of an airplane is usually due to the presence of supercooled water in the atmosphere.

10. From night to day the maximum change in temperature of air over an ocean surface is seldom over _____ degrees.

11. Water exists in 3 states in the atmosphere.

12. Water vapor is gas and acts like most other gases obeying the natural laws of _____, as long as the concentration is normal.

13. Water gets into the air by the process of ~~evaporation~~, and precipitation is a result of the process of condensation.

14. If a volume of air has all of the water in it that it will hold at a given temperature it is said to be saturated, and this phenomenon is the direct cause of all condensation.

15. Air will, within certain limits, hold more water as its temperature is warm air.

16. The process of sublimation in the atmosphere causes Cirrus clouds and ground fogs.

12-18-41 PRACTICE EXERCISES PHYSIC FORM Q-43
2475

1. What is the difference in method of formation of snow and fog?

2. (a) What is sublimation?
(b) What is super-cooled water? What flying hazards does it offer?

3. How many calories of heat would be required to raise 100 grams of ice at 0°C. to water vapor (steam) at 140°C.?

$Q = MS\Delta T$ 100 5 500 100 540 100.0

Ans. 1 mCal

4. How much heat would be required to raise 100 pounds of ice at -30°F. to 45°F.?

100 50 45 250 200 4240

Ans. _____

12-18-42-mi
2476

PRACTICE EXERCISES

PHYSICS FORM Q-44

1. COMPLETION: The dew point is the temperature to which air must be _____, (pressure constant) in order for condensation to begin. Three methods for expressing humidity are _____ humidity, _____ humidity and _____ humidity. The _____ humidity is the ratio of the amount of water actually contained by the atmosphere to the amount it could possibly contain at the same temperature; it is always expressed as a percent. The two general classification of clouds are _____ and _____. Three instruments used for measuring humidity are _____, _____ and _____.

2. What is precipitation? What relation does saturation bear to it?

3. Explain the principle and operation of the hair hygrometer.

4. What is a sling psychrometer? How is it used? Upon what principles is its use based?

5. Give several different examples of hydrometeors and explain the formation of each.

1. If the wet-bulb thermometer of a psychrometer indicates a dew point of 10°C. when the dry-bulb indicates an air temperature of 25°C., what is the relative humidity of the air tested? (See Table VI, pp. 111)

$\frac{10°C}{25} = \frac{7.58}{14.50} =$

Ans. 38.81%

2. (a) If one kilogram of air at 15°C. contains 5.25 g. of water, what is the relative humidity?

(b) Specific humidity?

$\frac{5.25}{1000}$

(a) 50%

(b) 5.25 g per kg

3. The dew point of a sample of air was found to be 32°F. What was the Specific Humidity of the sample of air?

Ans. 3.77 or 6.11

12-23-42-mi
2214

PHYSICS FORM S-1

# COMMON UNITS OF MEASUREMENT AND DIMENSIONAL RELATIONS

## I. FUNDAMENTAL UNITS

### A. Linear Measure

#### 1. U. S. Standard Measure

12 inches (in.) = 1 foot (ft.)
3 ft. = 1 yard (yd.)
5280 ft. = 1 statute mile (mi.)
6080 ft. = 1 nautical mile (naut. mi.)

#### 2. Metric Units

1 meter (m.) = 100 centimeters (cm.) = 1000 millimeters (mm.)
1000 m. = 1 kilometer (km.)

#### 3. Important Relations

1 m. = 39.37 in.
1 cm. = .3937 in.
1 in. = 2.54 cm.
1 mi. = 1.6 km.
1 ft. = 30.48 cm.
1 nautical mile = 1.15 statute miles

### B. Weight

#### 1. Avoirdupois

16 ounces (oz.) = 1 pound (lb.)
2000 lb. = 1 ton

#### 2. Metric Units

1 gram (g.) = 1000 milligrams (mg.)
1000 g. = 1 kilogram (kg.)

(A gram is the weight of one $cm.^3$ of water at its greatest density).

#### 3. Important Relations

1 lb. = 454 g. = .454 kg.
2.20 lb. = 1 kg.

## II. DERIVED UNITS

### A. Surface Measure (Areas)

1. 144 square inches ($in.^2$) = 1 square foot ($ft.^2$)
2. Metric system of surface measures is determined by squaring each unit in the linear table.
3. 1 $in.^2$ = 6.45 $cm.^2$

### B. Volumetric Measures (Capacity)

1. 1728 cubic inches ($in.^3$) = 1 cubic foot ($ft.^3$)

   1 $ft.^3$ = 7.48 gallons (gal.)

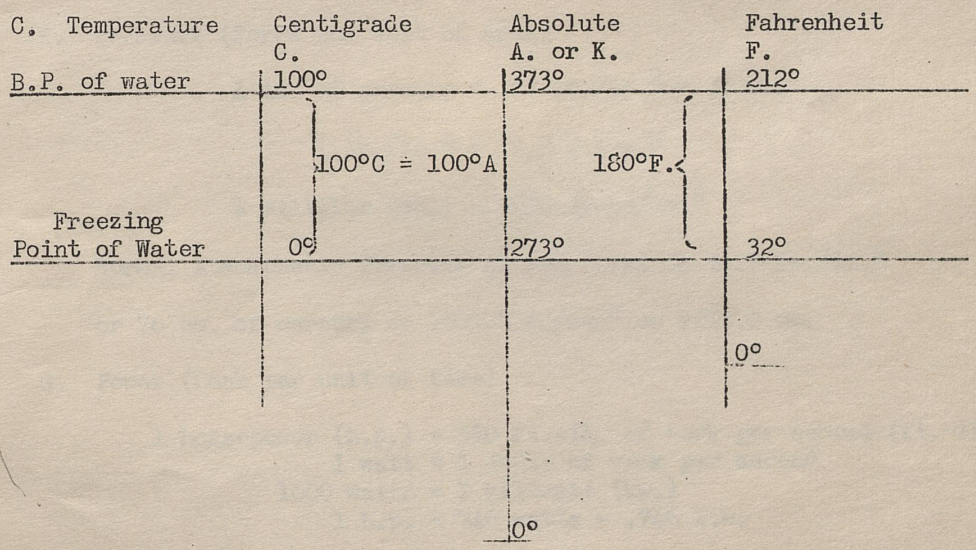
   8 pints = 4 quarts (qt.) = 1 gal. = 231 $in.^3$

2. Volumetric measures in metric system are determined by cubing each unit in linear table.

   Also 1000 cubic centimeters ($cm.^3$) = 1 liter (l.)

3. 1 liter = 1.06 quarts

### C. Temperature




1 A. = 1 C. = 1.8 F. (Magnitude only)

For conversion: F. = 1.8 C. + 32

A. = C. + 273

D. Density: Density of a body or substance is the ratio of its weight to its volume.

Density of water at 4°C. is 1 gram per $cm.^3$ ($g./cm.^3$) or

62.4 $lb./ft.^3$.

Density of air is .0013 $g./cm.^3$ or .08 $lb./ft.^3$. (Actually .075)

E. Force

A 1-lb. force is the force exerted at sea level by gravity on a one-pound mass.

A poundal of force is the force required to accelerate a freely moving one-lb. mass by 1 ft./sec./sec.

1 lb. of force = 32 poundals

A gram of force is the force exerted by gravity at sea level and a one-gram mass.

A dyne of force is the force required to accelerate a freely moving one-gram mass by 1 cm./sec./sec.

F. Pressure (Force per unit of area)

1 in. of mercury = .49 $lb./in.^2$ = 34 mb.

1 $lb./in.^2$ = 70.3 $g./cm.^2$

1 millibar (mb.) = 1000 $dynes/cm.^2$

Normal Atmospheric Pressure at sea level is 14.7 $lb./in.^2$

or 76 cm. of mercury or 1033.6 $g./cm.^2$ or 1013.2 mb.

G. Power (Work per unit of time)

1 horsepower (h.p.) = 550 ft.-lb. of work per second (ft.-lb./sec.)
1 watt = 1 joule of work per second
1000 watts = 1 kilowatt (kw.)
1 h.p. = 746 watts = .746 k.w.

H. Velocity (Distance per unit of time)

60 mi./hr. = 88 ft./sec. or 1 mi./hr. = $1\frac{7}{15}$ ft./sec.

PHYSICS ANSWER SHEET



PHYSICS FORM Q-1: I. A. Mathematical; Metric (c.g.s.) feet, pounds, seconds; density; change (increase or decrease); acceleration, acceleration. B. 1. m = dv; 2. $t = \frac{d}{v}$; 3. V = at. II. (a) 4.5 m.p.h./sec.; (b) .075 mi./min./sec.; (c) .00125 mi./sec./sec. (d) 6.6 ft./sec./sec.

PHYSICS FORM Q-2: 1. a. 250 cm.; b. 3.94 in.; c. 66.04 cm.; d. 15.7 in.; e. 1.5 g.; f. 5 mi.; g. 3000 g.; h. .454 kg.; i. 2 lb.; j. 4.617 g.; 2. 270 $cm.^2$; 3. a. 129 $cm.^2$; b. 4.72 liters; c. .453 liters; d. 4500 $cm.^3$; 4. .812 $g./cm.^3$; 5. 780 kg.

PHYSICS FORM Q-3: 1. 32 ft./sec./sec.; 2. 312 lb.; 3. 1000 $cm.^3$; 4. 3.33 sec.

PHYSICS FORM Q-4: 1. a. .2858 g.; b. 2 liters; 2. a. 33.33 mi./hr. b. 48.88 ft./sec.; 3. a. 293.3 ft./sec.; b. 1466.5 feet; 4. 4 cm./sec./sec.

PHYSICS FORM Q-5: 1. True; 2. True; 3. True; 4. True; 5. True; 6. True; 7. False; 8. True; Troposphere, Tropopause, Stratosphere, Meteorology, Weather.

PHYSICS FORM Q-6: 1. Experimenter has no control over conditions of experiment; 2. 4% by weight; 3. fogs, thunderstorms, icing; 4. Pilot can not get sufficient oxygen from air at high altitudes; 5. 35,000 ft.; 6. (a) 18,000 ft.; (b) Yes; 7. Stratosphere 8. 2°C. per 1000 ft.; 9. -14°C.; 10. 25,000 ft. 11. Decreases both.

PHYSICS FORM Q-7: 1. Two forces acting together to produce the same effect as a single force are called Components of that force. 2. effective component; more than 90°. 3. when sum of all forces acting on it is zero; 4. That push or pull that produces or tends to produce motion. 5. Those units which are not affected by gravitational pull (Poundals in F.P.S. and dynes in C.G.S.) 6. 20 lb. 7. a. False; b. True; c. True; d. True; e. False; f. False g. True; h. True.

PHYSICS FORM Q-8: 1. (a) 49,000 dynes; (b) 50 g.; 2. (a) 50,000 poundals; (b) 1562.5 lb.; 3. 6.4 ft./sec./sec.; 4. 200 ft./sec./sec. 5. (a) 200 ft./sec.; (b) 400 ft./sec.; 1000 ft./sec.

PHYSICS FORM Q-9: 1. 41-43 lb.; 2. (a) 50 mi.; (b) 86-88 mi.

PHYSICS FORM Q-10: 1. 29-31 lb. at 81°-83°; 2. 29-31 lb. at 81°-82°; 3. 62.5-64.5 lb.

PHYSICS FORM Q-11: 1. 177-179 lb. at 206°-208°; 2. 20-23 lb.

PHYSICS FORM Q-12: I. 1. True; 2. False, 3. True; 4. False; 5. True; 6. True. II. 220 m.p.h.; III. 5.5 ft./sec./sec.

PHYSICS FORM Q-13: 1. 43.3 sec.; 2. 48.78 ft./sec.; 3. a. 220 ft./sec.; b. 0 ft./sec.

PHYSICS FORM Q-14: 1. 1584 ft.; 2. 264 ft./sec.; 3. 396 ft.; 4. a. 8.53 sec.; b. 281.49 ft./sec.; c. 140.7 ft./sec.

PHYSICS FORM Q-15: 1. (a) 2480 ft.; (b) 408 ft./sec.; 2. 625 ft.; 3. 172 ft.

PHYSICS FORM Q-16: 1. 32 ft./sec./sec. or 980 cm./sec./sec. (because this is the acceleration of gravity) 2. (a) 26,136 poundals; (b) 816.75 lb. 3. (a) 200,000 poundals 3. (b) 6250 pounds.

PHYSICS FORM Q-17: 1. 400 ft.; 2. 1296 ft.; 3. 35.355 sec.; 1131.36 ft.; 4. 12,444.96 ft.

PHYSICS FORM Q-18: 1. 1200 ft. lb.; 26.09 ft.; 2. 4 ft.; 3. 5 h.p.

PHYSICS FORM Q-19: 1. 1,600,000 ft. poundals or 50,000 ft. pounds; 2. 18.18 h.p.; 3. 11.36 sec.

PHYSICS FORM Q-20: 1. (a) 15,625,000,000 ergs; (b) 1562.5 joules; 2. 390.63 watts; 3. (a) 300,000 ft. lb. (b) 136.36 h.p.

PHYSICS FORM Q-21: 1. (a) 23,437.5 ft. lb.; (b) 750,000 ft. poundals; 2. (a) 5000 ft. lb. (b) 5000 ft. lb.; 3. 40,000,000 ft. lb.

PHYSICS FORM Q-22: 1. (a) 1020.4 cm.; (b) 1 joule; 2. 1.6 lb. 3. (a) 500,000,000 ft. lb.; (b) 187.9 k.w.h.

PHYSICS FORM Q-23: 1. (a) 1200 ft.-lb. or 38,400 ft.-poundals; (b) 13.96 ft./sec.; 2. 2,000,000 ft.-lb.; 3. (a) Problem omitted.

PHYSICS FORM Q-24: 1. Liquid or gas; 2. Yes, but very, very slightly; 3. Indefinitely; 4. Compression or cooling; 5. Yes, because of their weight; 6. dyne/cm.$^2$, lb./in.$^2$; kg./cm.$^2$; 7. inches or cm. of mercury, lb./in.$^2$ and millibars; 8. It exerts pressure in all directions; 9. Increases the pressure because it increases the weight of the fluid; 10. pressure applied to an inclosed fluid is transmitted equally in all directions; 11. $F_1$ is force on

small piston; $F_2$ is force on large piston; $A_1$ and $A_2$ are cross sectional area of small and large pistons $r_1$ and $r_2$ as radii of small and large pistons. 12. 40 lb.; 13. (a) 3920.7 lb. (b) 8.67 lb./in.$^2$

PHYSICS FORM Q-25: 1. Liquid, gas; 2. Liquids; 3. expanded 4. pressure; 5. unit of area; 6. scalar; 7. increases; 8. compressed; 9. 30 lb. 10. (a) 124,800 lb.; 10. (b) 624 lb./ft.$^2$; 11. 124.8 lb./ft.$^2$; 12. (a) 8.6 lb./in.$^2$; (b) 4.3 lb./in$^2$; (c) 645 lb./in$^2$; (d) 3920.7 lb.

PHYSICS FORM Q-26: 1. Less; 2. 6 g./cm.$^3$ or 37.44 lb./ft.$^3$ 3. 1240 lb.; 4. 71.12 cm. or 952 mb. 5. 1013.2; 6. high, low; 7. less; decreases; 8. 29.92; 76; 1013.2 mb.; 9. 14.7 lb.

PHYSICS FORM Q-27: 1. The densities of the body and the fluid; 2. Ken, Fortin, Fortin is adjustable; 3. Change in pressure per unit of distance; 4. See Text P. 53; 5. (a) 998.4 lb.; (b) 998.4; (c) .66 ft. or 8 in.

PHYSICS FORM Q-28: 1. Hydrostatics is the study of fluids at rest; hydrodynamics deals with fluids in motion; 2. equal; 3. cross-sectional areas; 4. pressure; 5. Bernoulli; 6. pitot; 7. less; 8. carburetor pre-heater; 9. more; 10. 5 ft./sec. 11. 795.78 cm./min. or 13.26 cm./sec.

PHYSICS FORM Q-29: 1. 152 m.p.h. 2. 200.64 mi./hr. 3. 155.1 mi./hr.

PHYSICS FORM Q-30: 1. 1000 gram cm. or 980,000 ergs; 2. 20,000,000 ergs or 2 joules; 3. 100,000 ft. poundals or 3125 ft. lb.

PHYSICS FORM Q-31: 1. lift, drag, thrust; 2. lift; 3. drag; 4. lift, drag; 5. fin, stabalizer; 6. rudder, elevator; 7. propeller, lift, drag; 8. compass, air speed indicator, altimeter, bank and turn indicator, rate of climb indicator, clock; TRUE-FALSE SECTION: 1. False; 2. False; 3. False.

PHYSICS FORM Q-32: 1. True; 2. True; 3. True; 4. True; 5. True; 6. True; 7. True; 8. True; 9. True; 10. True; 11. False; 12. (a) 960 ft.; (b) less.

PHYSICS FORM Q-33: I. 1. temperature; 2. heat; 3. expand; 4. temperature; 5. radiation; 6. conduction; 7. temperature; 8. difference; 9. Fahrenheit; 10. high; 11. low; II. See Text; III. heat gained equals heat lost; IV. .05 ft. or .6 in.

PHYSICS FORM Q-34: 1. a. 107.6°F.; b. 6.8°F.; c. -4°F.; 2. a. 26.67°C.; b. -7.2°C.; c. -28.8°C.; 3. a. 305°A.; b. 273°A.; c. 283°A.; 4. 83.33°C.; 5. .792 in. or .066 ft.

PHYSICS FORM Q-35: 1. 45.2 cal.; 2. 976.5 cal.; 3. (a) 8.85°C.; (b) 22.85°C.; 4. (a) 513.02 cal. 4. (b) 2.03 B.T.U.

PHYSICS FORM Q-36: 1. 19.21°C.; 2. 69.03°C.; 3. 19.8 4. (a) Heat is total energy of a substance due to kinetic energy of its molecules. Temperature is the average kinetic energy of the molecules of the substance of the extent of concentration of heat in the substance. (b) Specific heat is amount of heat required to raise one gram of a substance one degree Centigrade.

PHYSICS FORM Q-37: 1. Sun; 2. radiation, convection, conduction; 3. absorber, absorber; 4. wave motion, light rays; 5. insolation; 6. elevation; 7. 1.94, constant, 1.5; 8. 43; 9. Cumuliform clouds, dust whirls; 10. 2°C.; icing; 11. conduction; 12. less.

PHYSICS FORM Q-38: 1. 10,000 ft.; 2. 40°C.; 3. See Text; 4. See Text.

PHYSICS FORM Q-39: Molecules, solid, liquid, gas, pressure, directly, absolute, inversely, absolute, less, less isotheral, adiabatic, temperature.

PHYSICS FORM Q-40: 1. 152 cm.; 2. 815.8 cm. 3. 16.35

PHYSICS FORM Q-41: 1. 20.33 l.; 2. 11.84 l.; 3. 35.88°C.; 4. 1.43 l.

PHYSICS FORM Q-42: 1. Solid, liquid, gas; 2. solid, liquid, gas; 3. pressure, temperature; 4. one, .5, .43; 5. 80 cal.; 540 cal.; 6. 100°C.; 0°C.; 7. 4°C.; 8. sublimation, Dry ice; 9. super-cooled; 10. 2°; 11. Three; 12. a gas, gases; Gases; 13. evaporation; condensation; 14. saturated, precipitation; 15. increases; 16. ice, ice.

PHYSICS FORM Q-43: 1. See Text; 2. See Text 3. 73,720 cal.; 4. 18,800 B.T.U. or 4,737,600 cal.

PHYSICS FORM Q-44: See Text.

PHYSICS FORM Q-45: 1. 38.87%; 2. 50%; 3. See Table V, Page 3.

12-24-42-mi
2484

ASSIGNMENTS

First Hour

1. TM 1-233: Paragraphs 1, 12-16 inc.
2. Workbook: Q-sheets 1, 2, 3, 4.
3. TM 1-233: pp. 20-21, problems 1, 2, 3, 4, 10-15 inc.

Second Hour

1. TM 1-233: Paragraphs 2-11 inc. (except i and j of Par. 8).
2. Workbook: Q-sheets 5, 6.
3. TM 1-233: pp. 11, all questions.

Third Hour

1. TM 1-233: Paragraphs 17, 18, 20 a, b, c, 21, 22 a.
2. Workbook: Q-sheets 7, 8.

Fourth Hour

1. TM 1-233: Paragraphs 18, 19 b, c (disregard use of cosine).
2. Workbook: Q-sheets 9, 10 11.
3. TM 1-233: pp. 32-33, problems 2, 3, 4, 7.

Fifth Hour

1. TM 1-233: Paragraphs 21-24 inc.
2. Workbook: Q-sheets 12, 13, 14, 15.
3. TM 1-233: pp. 43-44, problems 1, 3, 4, 8, 10.

Sixth Hour

1. TM 1-233: Paragraphs 22 d, e, 25, 26.
2. Workbook: Q-sheets 16, 17.
3. TM 1-233: pp. 43-44, problem 9.

Seventh Hour

1. Review of Hours 1 - 6

Eighth Hour

1. Examination: Hours 1 - 6.

12-24-42-mi
2485

Ninth Hour

1. TM 1-233: Paragraphs 40, 41.
2. Workbook: Q-sheets 18, 19, 20.
3. TM 1-233: pp. 61, Questions 1, 4, 5.

Tenth Hour

1. TM 1-233: Paragraphs 41-45.
2. Workbook: Q-sheets 21, 22, 23 (except 3 on Q-23).
3. TM 1-233: pp. 61, problems 2, 3, 6, 9.

Eleventh Hour

1. TM 1-233: Paragraphs 27-29, 31
2. Workbook: Q-sheets 24, 25.
3. TM 1-233: pp. 54, problems 1, 2.

Twelfth Hour

1. TM 1-233: Paragraphs 30, 32-39.
2. Workbook: Q-sheets 26, 27.
3. TM 1-233: pp. 54, problems 3, 5, 6.

Thirteenth Hour

1. TM 1-233: Paragraphs 46-49.
2. Workbook: Q-sheets 28, 29, 30.

Fourteenth Hour

1. Workbook: Q-sheets 31, 32.

Fifteenth Hour

1. Review of Hours 9 - 14.

Sixteenth Hour

1. Examination: Hours 9 - 14

12-24-42-mi
2486

Seventeenth Hour

1. TM 1-233: Paragraphs 50-63.
2. Workbook: Q-sheets 33, 34.
3. TM 1-233: pp. 49, problems 4, 5, 6.

Eighteenth Hour

1. TM 1-233: Paragraphs 64-68.
2. Workbook: Q-sheets 35, 36.
3. TM 1-233: pp. 78-79, problems 7, 9, 10, 11.

Nineteenth Hour

1. TM 1-233: Paragraphs 69-79.
2. Workbook: Q-sheets 37, 38, 39.
3. TM 1-233: pp. 89, 90, problems 1, 2, 4, 5, 7-9.

Twentieth Hour

1. TM 1-233: Paragraphs 80-85.
2. Workbook: Q-sheets 40, 41
3. TM 1-233: pp. 96, problems 3, 5, 6, 9, 10.

Twenty-first Hour

1. TM 1-233: Paragraphs 86-89.
2. Workbook: Q-sheets 42, 43.

Twenty-second Hour

1. TM 1-233: Paragraphs 90-95.
2. Workbook: Q-sheets 44, 45.
3. TM 1-233: pp. 111, all questions.

Twenty-third Hour

1. Review of Hours 17-22.

Twenty-fourth Hour

1. Examination: Hours 17-22.