EOT Physics Term 3 Exams 2023/2024
Grade 9 Advance

Done by : Mr. Rami Akkari

0508126904

Haykal 1.Explain Keppler's second law:
The imaginary line of planet's path sweeps out equal areas at equal periods of time
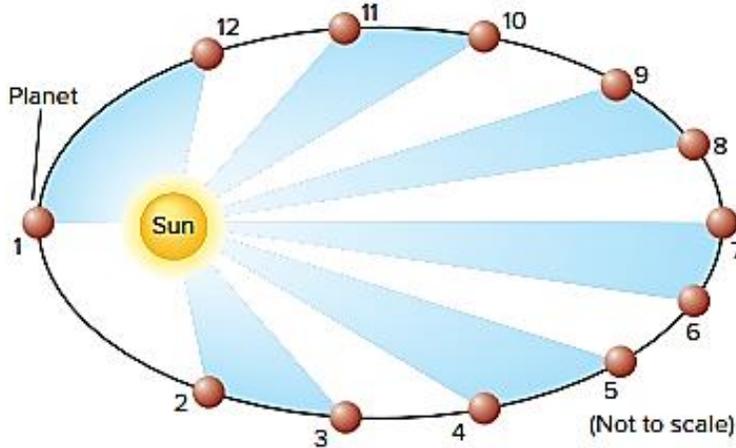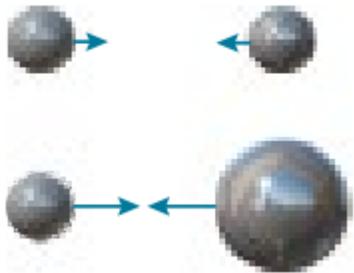

Haykal 1.Explain Keppler's second law:
The imaginary line of planet's path sweeps out equal areas at equal periods of time

Figure 3 Kepler found that elliptical orbits sweep out equal areas in equal time periods.

Explain why the equal time areas are shaped differently.

1. Planets orbit the Sun in a shape called a(n)
   a. Circular   b. Elliptic   c. Parabolic   d.focus
2. The speed of planet is _____ when it is nearest to earth
   a. Smallest   b. Largest   c.constant
3. If the area swept by a planet in one month was 25 AU² when it is at the farthest point of ellipse , what would be the area swept in one month at the closet point ?
   a. 50 AU²   b. 12.5 AU²   c. 25 AU²   d. 2.5 AU²

Haykal 2. Explain the law of universal

Any two objects of masses m_1 and m_2 undergo gravitational interaction force that :
1. Depends on their product of masses $m_1.m_2$
2. Inversely proportional to the square of the distance between them
3.
$$F_g = \frac{Gm_1 m_2}{r^2}$$

2.1 practice 1 :
Tom's mass is 70.0 kg, and Sam's mass is 50.0 kg. Tom and Sam are standing 20.0 m apart on the dance floor. What is the gravitational force between Sam an Tom
Answer is : 5.84×10^{-10} N which is very small compared to Sam and Tom's weights

Direct and Inverse Relationships Newton's law of universal gravitation has both direct and inverse relationships.

| $F_g \propto m_1 m_2$		$F_g \propto \frac{1}{r^2}$	
Change	Result	Change	Result
$(2m_1)m_2$	$2F_g$	$2r$	$\frac{1}{4}F_g$
$(3m_1)m_2$	$3F_g$	$3r$	$\frac{1}{9}F_g$
$(2m_1)(3m_2)$	$6F_g$	$\frac{1}{2}r$	$4F_g$
$(\frac{1}{2})m_1 m_2$	$\frac{1}{2}F_g$	$\frac{1}{3}r$	$9F_g$

2.2 Practice 2 :

The distance between the blue and green ball is quadruples (4 times larger) and the mass of m_1 doubles and m_2 triples what will be the new gravitational force ?

a. $\dfrac{F}{16}$ b. 24 F   c. $\dfrac{3F}{8}$ d. $\dfrac{3F}{2}$
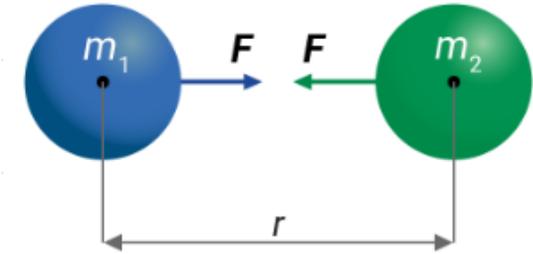
2.3 Practice 3 : Suppose that planet X of mass M , exerts a force on one of its moons that of mass 24x10²² Kg , if the distance separating the center of the moon and the planet X was 2500 Km , calculate the mass of X
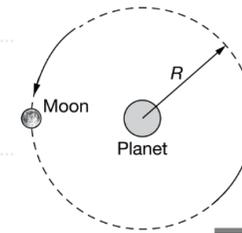
2.4 Practice 4: Two spheres are 1.02 km apart. One of the spheres has a mass of 57.0 kg, and the gravitational force between the spheres is 1.79×10⁻¹⁴ N. What is the mass of the other sphere?

Haykal 3-19(1) : Calculate the orbital period and speed of a satellite

3.1 practice 1 :

The speed of a satellite orbiting Earth is proportional to _____.

A) the square root of the satellite's mass

B) Earth's mass

C) the square root of the Earth's mass

D) the satellite's mass

3.2 practice 2 :

Calculate and fill in the missing values in the table below. The mass of the Sun is $1.99×10^{30}$ kg.

Planet	Distance from the Sun (km)	Period (Days)
Mercury	$5.79×10^7$	
Venus	$1.09×10^8$	224.7
Earth	$1.50×10^8$	365.2
Mars	$2.28×10^8$	

3.3 Practice 3: Recall that a satellite's speed is calculated using the formula $v = \sqrt{\dfrac{GM_E}{r}}$. If Earth is closer to the Sun in December than it is in July, in which month is Earth moving faster and why?

- December
- July
- April
- September

3.4 Practice 4:

For a satellite to move around Earth in an orbit at an altitude of (10km), what orbital speed must it have? [Earth's mass (m_E)= $5.97×10^{24}$ kg, Radius of earth r_E= 6380 Km]

3.4 : Practice 4:

A planet orbits the Sun at a distance of $2.87×10^9$ km. The mass of the Sun is $1.99×10^{30}$ kg.
Calculate the period in days then in years
Calculate the speed of this planet

Haykal 4 : Explain Keppler first law

4.1 Practice 1 :

Which of the following physics laws describes the planets orbits as represented by the figure below?
a. Keppler's first law
b. Keppler's second law
c. Keppler's third law
d. Newton's law of gravitation
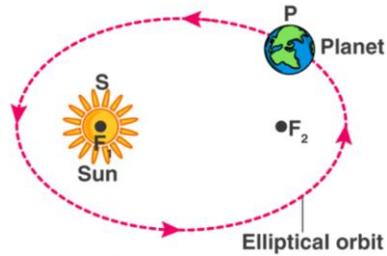
4.2 Practice 2 : **According to Kepler's first law, the path a planet follows around the Sun is**
a. Circle   b. Ellipse   c. Parabolic   d. focus

4.3 Practice 3 : **According to Kepler's first law , what does the sun represent with respect to the path of orbiting planets:**
a. Center   b. Focus   c. parabola   d. represents nothing

Haykal 5: Define Gravitational force

Newton found that the gravitational force between two masses is inversely proportional to the

O **A)** the sum of the masses

O **B)** the strength of the gravitational field

O **C)** the product of the masses

O **D)** the distance between them

When a force is applied through a displacement, **work** (W) is done on the system.

Work is the transfer of energy that occurs when a force is applied through a distance; equal to the product of the system's displacement and the force applied to the system in the direction of displacement. $W = F\,d$.

The SI unit of work is called a Joule (J). One joule is equal to 1 N.m. One joule of work is done when a force of 1 N acts on a system over a displacement of 1 m.

d

F

$F_{\text{on box by you}} = 3\,N$
$W_{\text{on box by you}} = 3\,J$

$F_{\text{on box by friend}} = -1.5\,N$
$d = 1\,m$
$W_{\text{on box by friend}} = -1.5\,J$

$F_g = -mg$
$W_g = 0\,N$
$F_{\text{normal}} = mg$
$W_{\text{normal}} = 0\,N$
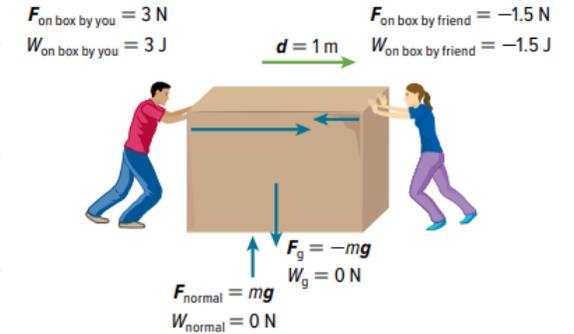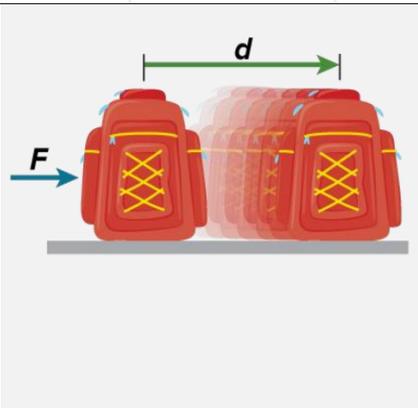
The total work done on the box is

$$W = F_{\text{on box by you}}\,d - F_{\text{on box by friend}}\,d.$$

6.1: Practice 1 :

Work is done on an object when a force is exerted on the object causing the object to be displaced _____.

a. Perpendicular to force   b. Parallel to force   c. in a circle   d.

6.2: Practice 2 : e direction

In which of the following situations is no work done on a book?

A) pushing the book across the desk

B) picking up the book

C) carrying the book down the hall

D) dropping the book

6.3: Practice 3: Salem ties a ball to the end of a string of length (1.0 m) and swings the ball in a circle. If the string exerts a (10 N) force on the ball. How much work does the string do on the ball during a swing of one complete circle?

a. 0J   b.10 J   c.62.28   d.31.14

6.4: Practice 4: which of the following is NOT a unit for work

a. N.M   b. Joules   c.Kg.m^2/s^2 d. Kg.m^2/s^3

6.5: Practice

WORK A hockey player uses a stick to apply a constant 4.50-N force forward to a 105-g puck sliding on ice over a displacement of 0.150 m forward. How much work does the stick do on the puck? Assume friction is negligible.

6.6: Salma pulls a suitcase with a force of (**50N**),that is applied along the handle at an angle of (**60°**) to the horizontal. How much **work** has she done after walking a horizontal distance of (**15m**)?

15 m
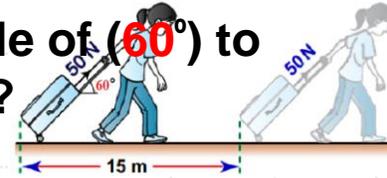
6.7:

CHALLENGE Marisol pushes a 3.0-kg box 7.0 m across the floor with a force of 12 N. She then lifts the box to a shelf 1 m above the ground. How much work does Marisol do on the box?

6.8:

An airplane passenger carries a 215-N suitcase up the stairs, a displacement of 4.20 m vertically and 4.60 m horizontally.

a. How much work does the passenger do on the suitcase?

b. The same passenger carries the same suitcase back down the same set of stairs. How much work does the passenger do on the suitcase to carry it down the stairs?

6.9:

275 m

25 N

25°
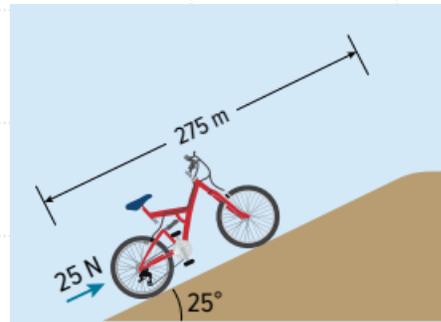
Figure 5

. **CHALLENGE** A bicycle rider pushes a 13-kg bicycle up a steep hill. The incline is 25° and the hill is 275 m long, as shown in **Figure 5**. The rider pushes the bike parallel to the road with a force of 25 N.

a. How much work does the rider do on the bike?

b. How much work is done by the force of gravity on the bike?

6.10

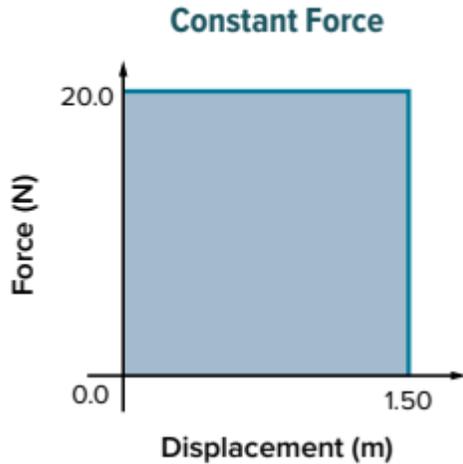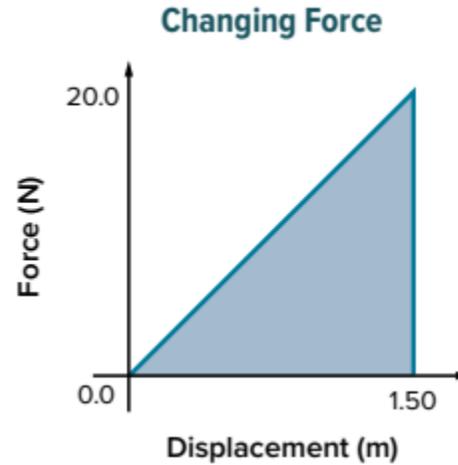The SI unit of work is called a **joule** (J). What does one joule is equal to?

$1 N \cdot m$

$1 N \cdot m^2$

$1 N/m$

$1 N/m^2$

Haykal 8: Determine graphically the work done by a force from the gra
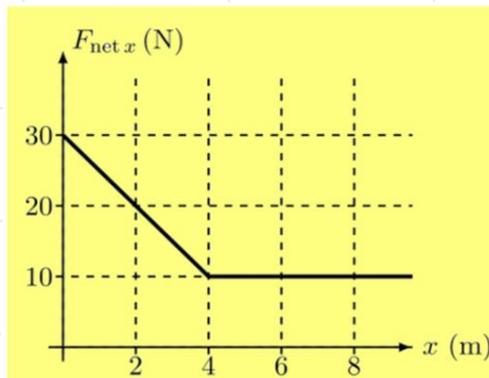
Constant Force

$W = Fd = (20.0 \text{ N})(1.50 \text{ m}) = 30.0 \text{ J}.$

Changing Force

$W = \left(\frac{1}{2}\right)(20.0 \text{ N})(1.50 \text{ m}) = 15.0 \text{ J}.$

8.1 practice :A particle experiences a force that varies with position as shown in the graph. What is the work done by this force between (x = 4), and (x = 8)?

a. 40 J
b. 60 J
c. 80 J
d. 120 J

8.2 practice : The force - displacement graph below represents the force applied when moving a block through a displacement of 2.4 m. What is the work done on the block by the force?
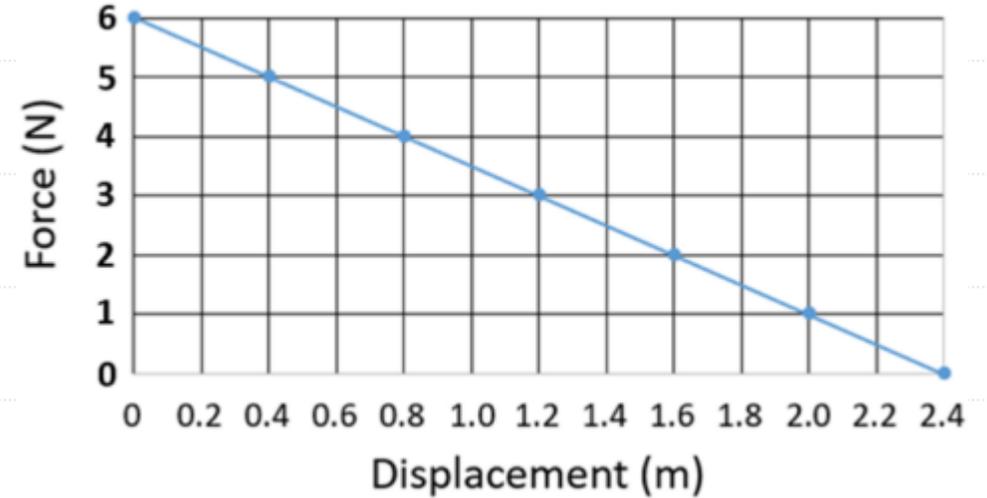
a. 7.20 J
b. 14.4 J
c. 2.5 J
d. 0.4 J

Haykal 9: Apply relationship between work , power and time

Practice 9.1 You decide to do pull-ups in the gym. You lift your 50 kg body by 0.5 meters, in 0.25 seconds. How much power are your arms providing?

Practice 9.2 :

What is the correct equation to calculate power (P)?

○ $P = W + t$

○ $P = W \times t$

○ $P = \dfrac{W}{t^2}$

○ $P = \dfrac{W}{t}$

Practice 9.3 : Which of the following is not unit of power

a. $\dfrac{J}{S}$

b. $Kg\dfrac{m^2}{S^3}$

c. $Kg\dfrac{m^2}{S^2}$

d. $N\dfrac{m}{S}$

Practice 9.4:

POWER An electric motor lifts an elevator 9.00 m in 15.0 s by exerting an upward force of 1.20×10^4 N. What power does the motor produce in kW?

Known	Unknown
$d = 9.00$ m	$P = ?$
$t = 15.0$ s	
$F = 1.20 \times 10^4$ N	

2 SOLVE FOR THE UNKNOWN

Use the definition of power.

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

$= \dfrac{Fd}{t}$ Substitute $W = Fd \cos 0° = Fd$.

$= \dfrac{(1.20 \times 10^4 \text{ N})(9.00 \text{ m})}{(15.0 \text{ s})}$ Substitute $F = 1.20 \times 10^4$ N, $d = 9.00$ m, $t = 15.0$ s.

$= 7.20$ kW

Practice 9.5:

An electric motor develops 65 kW of power as it lifts a loaded elevator 17.5 m in 35 s. How much force does the motor exert?

Practice 9.6 : A car engine uses a force of (29 kN) to power a car at an average speed of (7.5 m/s). What is the average power of the engine?

Practice 9.7 : A weightlifter lifts (300 kg), from the ground to a height of (2.0 m) in (3.0 s). What is the average power generated by him?

Haykal 10: Relate the rotational kinetic energy to the moment of inertia and the angular velocity

Practice 10.1 : A merry go round having a moment of inertia I = 2.45 Kgm² , rotates with an angular velocity w= 5.65 rad/s , determine the type and the value of merry go round's kinetic energy

Practice 10.2 : During his famous shot Roberto Carlos shoots a ball of mass M= 1.4 Kg with a linear speed V= 35 m/s , the ball also spins rapidly with an angular speed w= 45 rad/s , the moment of inertia of the ball was I=0.07 Kgm² calculate :
1. The translational kinetic energy of the ball
2. The rotational kinetic energy of the ball
3. The total kinetic energy of the ball
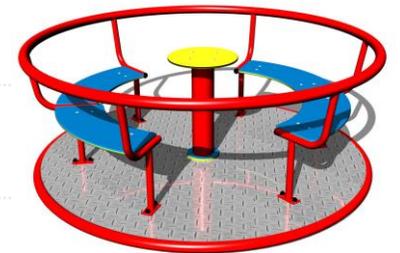
10.3 When a car wheel rolls down over a hill, which of the following statement is **true**?

1. The wheel has both rotational and translational kinetic energies
2. The wheel has rotational kinetic energy only
3. The wheel has translational kinetic energy only
4. The wheel does not have any kinetic energy

10.4

Which of the following equations is used to calculate the **rotational kinetic energy**?

أي المعادلات التالية تستخدم لحساب طاقة الحركة الدورانية؟

$$\frac{1}{2}I\omega^2$$

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

$$-mgh$$

$$mc^2$$

10.5

A basketball player spins a basketball on his finger at 3 rad/s, as shown below. If he then spins the basketball at 6 rad/s, the rotational kinetic energy of the basketball will _____
a. Increase by factor of 4
b. Increase by factor of 2
c. Decrease by factor of 4
d. Decrease by factor of 2

10.6
Given that

$$KE = \frac{1}{2}I\omega^2$$

What is ω equal to? $\dfrac{2KE}{I}$ $\sqrt{\dfrac{KE}{2I}}$ $\sqrt{\dfrac{I}{2KE}}$ $\sqrt{\dfrac{2KE}{I}}$

GRAVITATIONAL POTENTIAL ENERGY You lift a 7.30-kg bowling ball from the storage rack and hold it up to your shoulder. The storage rack is 0.610 m above the floor and your shoulder is 1.12 m above the floor.

a. When the bowling ball is at your shoulder, what is the ball-Earth system's gravitational potential energy relative to the floor?

b. When the bowling ball is at your shoulder, what is the ball-Earth system's gravitational potential energy relative to the rack?

c. How much work was done by gravity as you lifted the ball from the rack to shoulder level?
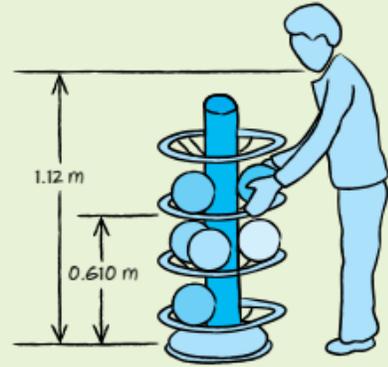
1 ANALYZE AND SKETCH THE PROBLEM

- Sketch the situation.
- Choose a reference level.
- Draw an energy bar diagram showing the gravitational potential energy with the floor as the reference level.

Known
$m = 7.30$ kg $g = 9.8$ N/kg
$h_r = 0.610$ m (rack relative to the floor)
$h_s = 1.12$ m (shoulder relative to the floor)

Unknown
$GPE_{s\,rel\,f} = ?$
$GPE_{s\,rel\,r} = ?$
$W = ?$

2 SOLVE FOR THE UNKNOWN

a. Set the reference level to be at the floor.
Determine the gravitational potential energy of the system when the ball is at shoulder level.
$GPE_{s\,rel\,f} = mgh_s = (7.30$ kg$)(9.8$ N/kg$)(1.12$ m$)$ Substitute $m = 7.30$ kg, $g = 9.8$ N/kg, $h_s = 1.12$ m
$= 8.0 \times 10^1$ J

b. Set the reference level to be at the rack height.
Determine the height of your shoulder relative to the rack.
$h = h_s - h_r$
Determine the gravitational potential energy of the system when the ball is at shoulder level.
$GPE_{s\,rel\,r} = mgh = mg(h_s - h_r)$ Substitute $h = h_s - h_r$
$= (7.30$ kg$)(9.8$ N/kg$)(1.12$ m $- 0.610$ m$)$ Substitute $m = 7.30$ kg, $g = 9.8$ N/kg, $h_s = 1.12$ m, $h_r = 0.610$ m
$= 36$ J   This also is equal to the work done by you as you lifted the ball.

c. The work done by gravity is the weight of the ball times the distance the ball was lifted.
$W = Fd = -(mg)h = -(mg)(h_s - h_r)$ The weight opposes the motion of lifting, so the work is negative.
$= -(7.30$ kg$)(9.8$ N/kg$)(1.12$ m $- 0.610$ m$)$ Substitute $m = 7.30$ kg, $g = 9.8$ N/kg, $h_s = 1.12$ m, $h_r = 0.610$ m
$= -36$ J

1.12 m
0.610 m

$GPE_{s\,rel\,f}$
$GPE_{r\,rel\,f}$ $+$ $W_{by\,you}$ $=$

11.1 Practice :

In Example Problem 4, what is the potential energy of the ball-Earth system when the bowling ball is on the floor? Use the rack as your reference level.

11.2 Practice :

A boy lifts a 2.2-kg book from his desk, which is 0.80 m high, to a bookshelf that is 2.10 m high. What is the potential energy of the book-Earth system relative to the desk when the book is on the shelf?

11.3 Practice: A 25.0-kg shell is shot from a cannon at Earth's surface. The reference level is Earth's surface.
a. What is the shell-Earth system's gravitational potential energy when the shell's height is 425 m?
b. What is the change in the system's potential energy when the shell falls to a height of 225 m?

11.4 Practice: **A pole vaulter of mass (52 kg) jumps to a height of (6.12 m) to clear the bar as shown in the figure . What is his gravitational potential energy at this height ?**

(6.12 m)
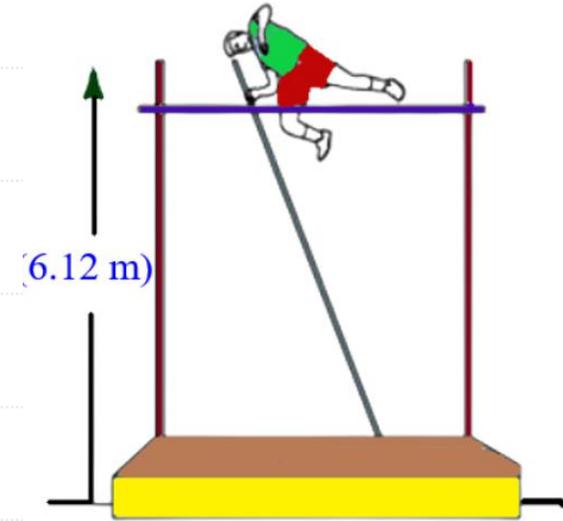
Haykal 12 : Apply law of conservation of mechanical

A soccer ball moves across a horizontal surface and up a frictionless ramp. The speed of the ball at the bottom of the ramp is 5.5 m/s.

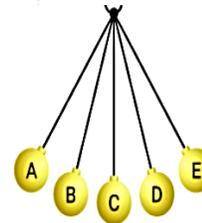If the horizontal surface is the reference level, what is the maximum height the ball will reach on the ramp?

- ○ 2.5 m
- ○ 1.5 m
- ○ 2.0 m
- ○ 1.0 m

A pendulum is swinging freely between points A-E. The system is closed and isolated.

At which point will the pendulum have maximum kinetic energy?

- ○ A
- ○ E
- ○ C
- ○ B

The illustration below shows a box on a curved, frictionless track. The box starts with zero velocity at the top of the track. It then slides from the top of the track to the horizontal part at the ground. Its velocity just when it reaches the ground is 15 m/s. What is the height (h) from the ground to the top of the track?
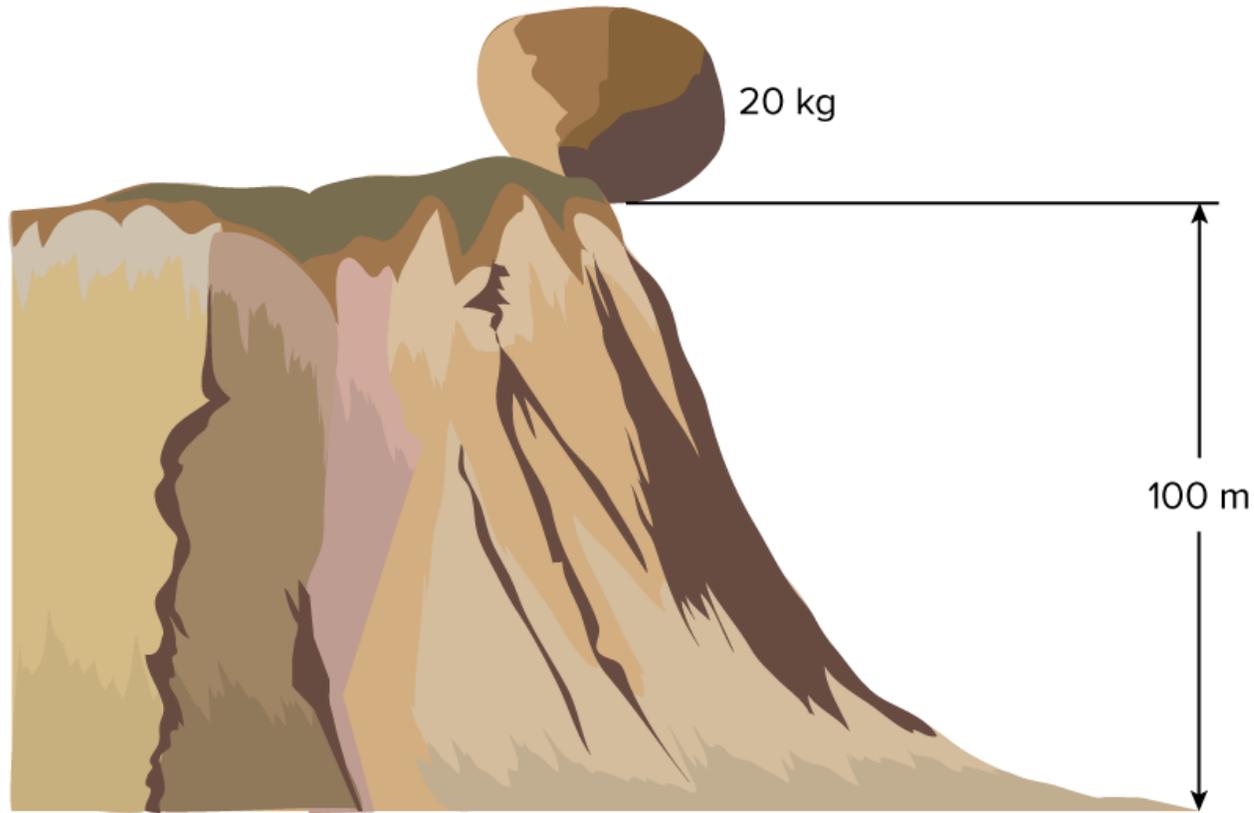
- 12.2 m
- 11.5 m
- 4.3 m
- 6.0 m

A 20 kg rock sits on the edge of a cliff that is 100 m high, as shown in the image.

20 kg

100 m

a. What potential energy does the rock-Earth system possess relative to the base of the cliff?

[   ] kJ

b. The rock falls without rolling from the cliff. What is its kinetic energy just before it strikes the ground?

[   ] kJ

c. What is the rock's speed as it hits the ground?

[   ] m/s

Kelli weighs 420 N, and she sits on a playground swing that hangs 0.40 m above the ground. Her mom pulls the swing back and releases it when the seat is 1.00 m above the ground.

How fast is Kelli moving when the swing passes through its lowest position?

A ball is released at the top of a smooth inclined plane that is (0.6 m) above ground as shown in the figure. What is the velocity of the ball when it reaches the bottom of the inclined plane?
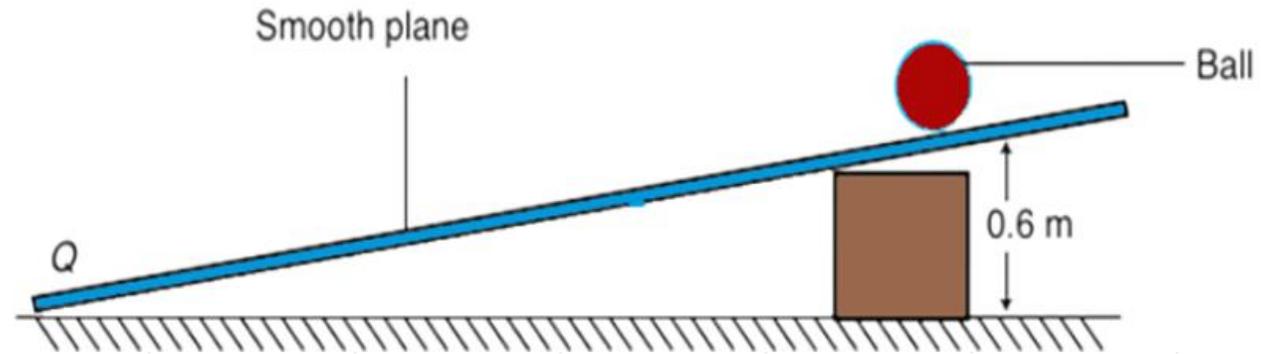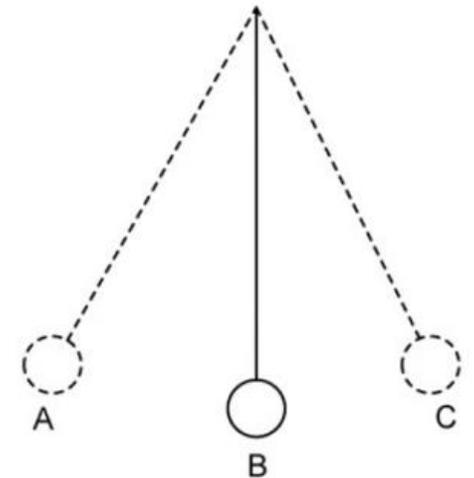
Smooth plane

Ball

0.6 m

Q

$KE_i + PE_i = KE_f + PE_f$

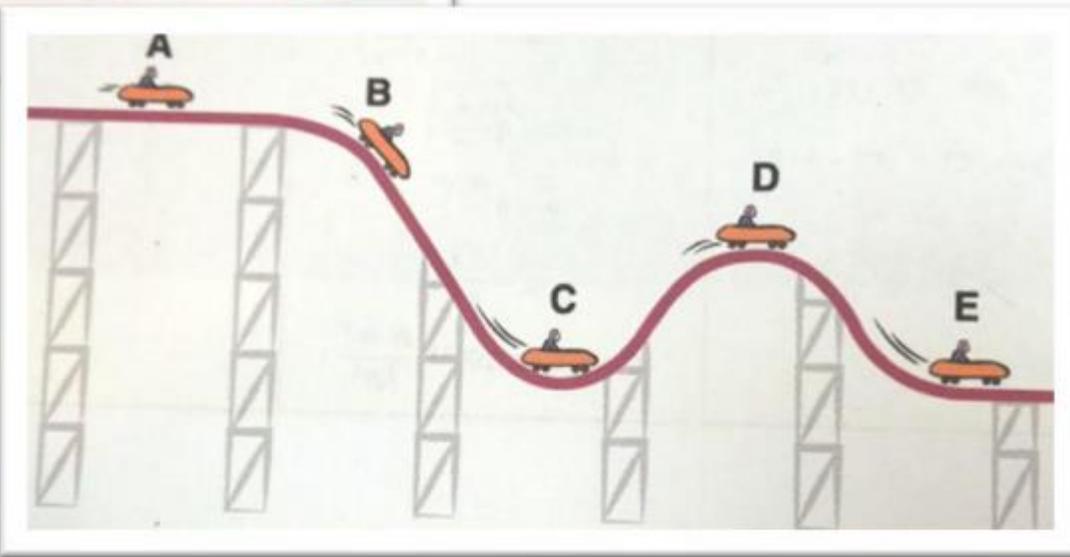$KE_i + PE_f = KE_f + PE_i$

$KE_i - PE_i = KE_f - PE_f$

$KE_i + PE_i = 0$

The diagram below indicates the instantaneous positions of a simple pendulum in simple harmonic motion. At which position(s) is the potential energy of the system maximum?
1. A and C only
2. B only
3. A and B only
4. B and C only

A

B

C

Car's energy.

Haykal 13 : Define kinetic energy and apply relation between kinetic energy , mass and speed of particle

13.1 A motorcycle of mass 400 kg speeds up from 10 m/s to 20 m/s. How much work is done on the motorcycle to incr

A ball is rolling initially with velocity (v), If the velocity is doubled to (2v), what change will occur on ball's kinetic energy (KE)?

13.2

$KE_2 = 2\ KE_1$

$KE_2 = 3\ KE_1$

$KE_2 = 4\ KE_1$

$KE_2 = KE_1$

13.3 What is the true relation of velocity V give the kinetic energy KE

a. $V = \dfrac{2.KE}{m}$

b. $V = \sqrt{\dfrac{2.KE}{m}}$

c. $V = \sqrt{\dfrac{2m}{KE}}$

d. $\sqrt{\dfrac{KE}{2m}}$

13.4

Which of the following examples shows kinetic energy?

أي من الأمثلة التالية يعبر عن الطاقة الحركية؟

A river flowing down a hill
نهر يتدفق إلى اسفل التل
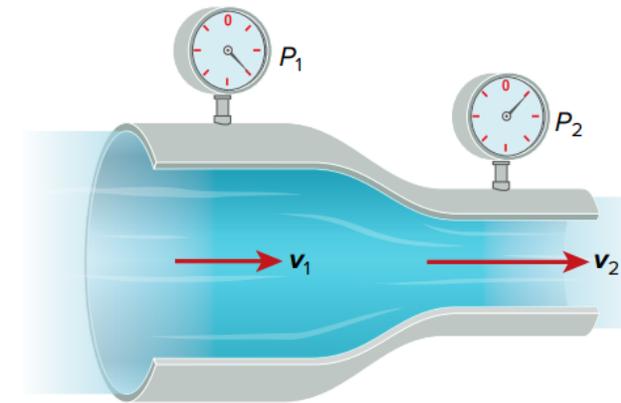
The battery of light flash
بطارية ضوء الفلاش

A golf ball placed at the edge of the hole
كرة جولف موضوعة عند حافة الحفرة

Energy stored in a bow and arrow
الطاقة المختزنة في القوس والسهم

Haykal 14 : Describe the relation between the velocity of fluid and pressure exerted according to

If the fluid velocity at position 1 was $V_1 = 12$ m/s what possible value should be V_2?

a. 6 m/s
b. 12 m/s
c. 40 m/s
d. 9 m/s

Figure 15 The fluid flowing through this pipe also demonstrates Bernoulli's principle. As the velocity of the fluid increases (v_2 is greater than v_1), the pressure it exerts decreases (P_2 is less than P_1).

Critical Thinking A tornado passing over a house sometimes makes the house explode from the inside out. How might Bernoulli's principle explain this phenomenon? What could be done to reduce the danger of a door or window exploding outward?

a. The high speed of air in the tornado has a lower pressure so it will be sucked inside the house so nothing can be done
b. The high speed wind of tornado has a high pressure thus it will be pushed inside house so doors must be closed
c. The high speed wind of tornado has a low pressure , this causes higher pressure air inside house to push outwards , so it is recommended to open the doors or windows to let the air goes out freely without breaking the windows or doors

The Diagram shows a piece of paper hanging from one end of a support (a). When air is blown across the upper surface of the paper, it moves up as shown in (b). Which Physics principle explains what happened to the paper?

air flow

paper

support

(a)

paper

support

(b)
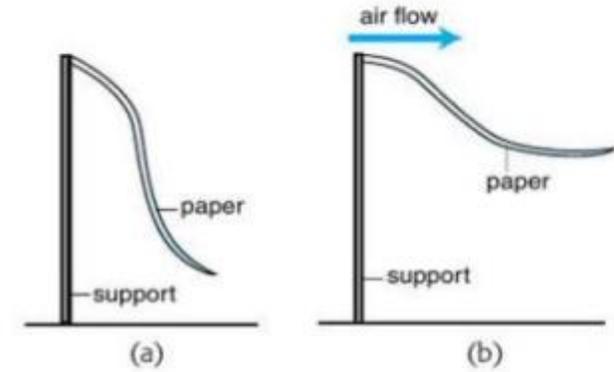
A. **BERNOULI'S PRINCIPLE**

B. **PASCAL'S PRINCIPLE**

C. **ARCHIMEDES PRINCIPLE**

D. **ENERGY CONSERVATION PRINCIPLE**

Haykal 15 : Recall pascal principle , apply pascal principle to

**15.1** An automobile weighing 2.3×10^4 N is lifted by a hydraulic cylinder with an area of 0.15 m².

a. What is the pressure in the hydraulic cylinder?

b. The pressure in the lifting cylinder is produced by pushing on a 0.0083

m² A worker exerts a force F1on a ($0.05m^2$) hydraulic piston to lift an au automobile of weight of (9000N) . The piston that the automobile sits on

15.2 has an area of ($5.0m^2$). What is force F1 exerted by the worker?
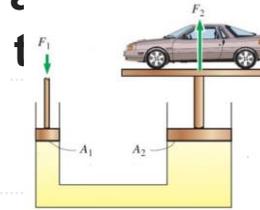
90 N
100 N
450 N
9000 N

The figure shows a hydraulic system. If a force of (12N) is exerted on the small piston, what is the output force on the large piston (F_2)?

15.3

يُظهر الشكل المجاور نظامًا هيدروليكيًا. إذا أثرت قوة مقدارها(12N)على المكبس الصغير، فما مقدار القوة المؤثرة على المكبس الكبير(F_2)؟
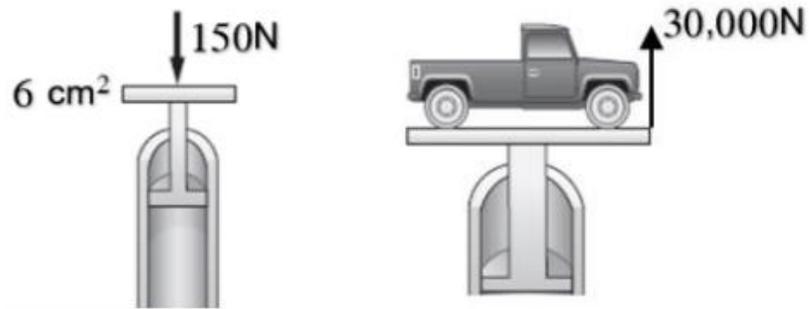

$F_1 = 12$ N

F_2

$A_1 = 10$ cm²

$A_2 = 50$ cm²

Hydraulic fluid
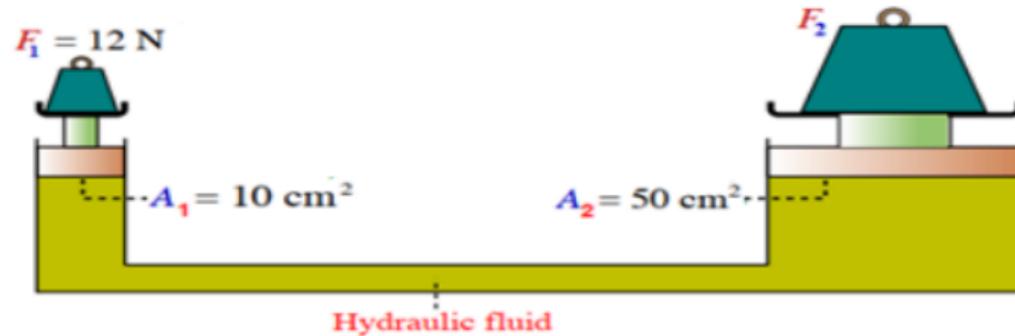
60.0 N
24.0 N
120 N
2.8N

The diagram below shows a hydraulic lift, **what is the area of the large piston?**

150N

30,000N

6 cm²

a.1200 cm²

b.750000 cm²

c.0.03 cm²

d.33.3 cm²

In the hydraulic system shown in the figure below, the pressure on the small piston is P1, and the pressure on the large piston is P2. According to pascal's law, which of the following is correct?

1. $P_1 = P_2$
2. $P_1 > P_2$
3. $P_1 < P_2$
4. $A_1 > A_2$

F1

F2

A1

A2
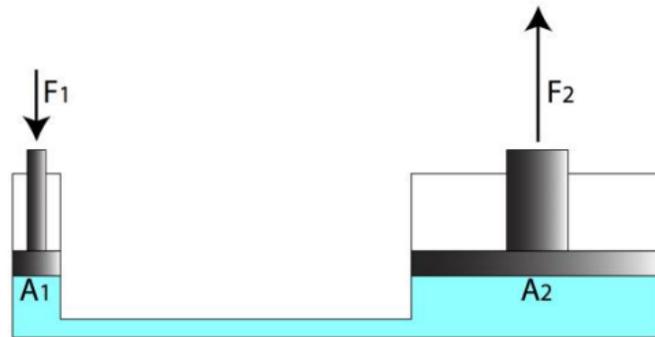
Which of the following statements represents pascal principle?

1. When the volume of gas decrease , its pressure increase
2. A body immersed in liquid , will be affected by a force exerted by this liquid
3. Liquid transmits any external pressure exerted on it in all directions and at any point on liquid
4. For any action there is equal and opposite reaction

Haykal 16 :

(1) Apply the relationship between a force $\vec{F}$ and the work done on a system by the force when the system undergoes a displacement $\vec{d}$, $W = |\vec{F}| \times |\vec{d}| \cos(\theta)$ where θ is the angle between the direction of the force and the direction of displacement.

(2) Apply the work–energy theorem to relate the net work done on a system and the resulting change in kinetic energy

16.1

A rope is used to pull a metal box a distance of 20.0 m across the floor. The rope is held at an angle of 50.0° with the floor, and a force of 303 N is applied to the rope. How much work does the rope do on the box?
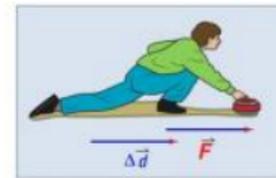

F pull

50.0°
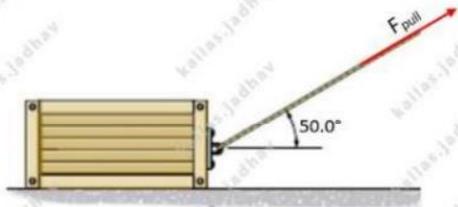
303000 J _____

3895 J _____

4642 J _____

6060 J _____

16.2

In a curling game, a player does work to slide a stone of mass (2.5kg) from rest on the ice surface, as shown in the figure. He exerts a horizontal force of (40N) on the stone over a distance of (1.5m) then releases the stone. What is the velocity of the stone at the point of release on ice surface?

$\Delta \vec{d}$ $\vec{F}$

| 6.93m/s |
| 3.45m/s |
| 2.37m/s |
| 13.8m/s |

19- A $(1600kg)$ vehicle moves with a velocity of $(20\ m/s)$.
- Calculate the work required to reduce the velocity to $(5.0\ m/s)$.

_____

_____

_____

_____

_____

A force of 825N is exerted horizontally, pushing a car a distance of 35 m in the same direction. How much is the work done on the car?

A motorcycle of mass 400 kg speeds up from 10 m/s to 20 m/s. How much work is done on the motorcycle to increase its speed?
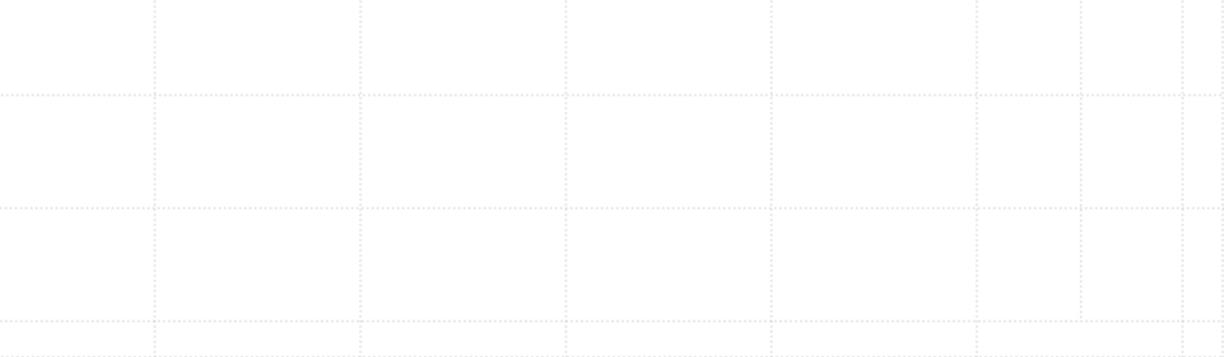
Haykal 17 :

(1) Apply the law of conservation of mechanical energy to solve problems ($KE_i + PE_i = KE_f + PE_f$).

(2) Apply the law of conservation of energy to examples like roller coaster rides, ski slopes, inclined planes/ hills, and pendulums

A skier starts from rest at the top of a hill that is 45.0 m high, skis down a 30° incline into a valley, and continues up a hill that is 40.0 m high. The heights of both hills are measured from the valley floor. Assume that friction is negligible and ignore the effect of the ski poles.

a. How fast is the skier moving at the bottom of the valley?

b. What is the skier's speed at the top of the second hill?

a. bottom of valley: 3.0×10^1 m/s

b. top of next hill: 9.9 m/s

c. No; the angles do not have any impact.

The diagram below shows a rollercoaster ride. The cart moves through different positions at **different** heights. What happens to the **Kinetic and Potential** energy as the cart goes from **point B to point C?**

1. Kinetic energy increases and gravitational potential energy decreases

2. Kinetic energy decreases and gravitational potential energy increases

3. Both kinetic and gravitational potential energy increase

4. Both kinetic and gravitational potential energy stay the same

---

CONSERVATION OF MECHANICAL ENERGY A 22.0-kg tree limb is 13.3 m above the ground. During a tropical storm, it falls on a roof that is 6.0 m above the ground.

a. Find the kinetic energy of the limb when it reaches the roof. Assume that the air does no work on the tree limb.

b. What is the limb's speed when it reaches the roof?
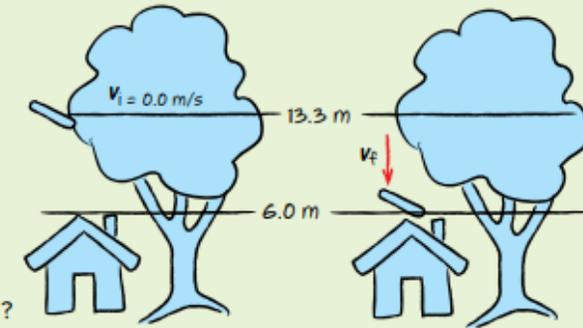
1 ANALYZE AND SKETCH THE PROBLEM

• Sketch the initial and final conditions.

• Choose a reference level.

• Draw an energy bar diagram.

Known	Unknown
$m = 22.0$ kg $g = 9.8$ N/kg	$GPE_i = ?$ $KE_f = ?$
$h_{limb} = 13.3$ m $v_i = 0.0$ m/s	$GPE_f = ?$ $v_f = ?$
$h_{roof} = 6.0$ m $KE_i = 0.0$ J	

2 SOLVE FOR THE UNKNOWN

a. Set the reference level as the height of the roof.

Find the initial height of the limb relative to the roof.

$h = h_{limb} - h_{roof} = 13.3$ m $- 6.0$ m $= 7.3$ m   Substitute $h_{limb} = 13.3$ m, $h_{roof} = 6.0$ m

Determine the initial gravitational potential energy of the limb-Earth system.

$GPE_i = mgh = (22.0$ kg$)(9.8$ N/kg$)(7.3$ m$)$ Substitute $m = 22.0$ kg, $g = 9.8$ N/kg, $h = 7.3$ m

$= 1.6 \times 10^3$ J

Identify the initial kinetic energy of the system.

$KE_i = 0.0$ J   The tree limb is initially at rest.

Identify the final potential energy of the system.

$GPE_f = 0.0$ J $h = 0.0$ m at the roof.

Use the law of conservation of energy to find KE_f.

$KE_f + GPE_f = KE_i + GPE_i$

$KE_f = KE_i + GPE_i - GPE_f$

$= 0.0$ J $+ 1.6 \times 10^3$ J $- 0.0$ J   Substitute $KE_i = 0.0$ J, $GPE_i = 1.6 \times 10^3$ J, and $GPE_f = 0.0$ J.

$= 1.6 \times 10^3$ J

b. Determine the speed of the limb.

$KE_f = \frac{1}{2} mv_f^2$

$v_f = \sqrt{\frac{2KE_f}{m}} = \sqrt{\frac{2(1.6 \times 10^3 \text{ J})}{22.0 \text{ kg}}}$ Substitute $KE_f = 1.6 \times 10^3$ J, $m = 22.0$ kg

$= 12$ m/s

Haykal 18 :

(1) Explain Kepler's First Law which states that the planets follow elliptical paths with the sun at one focus.

(2) Explain Kepler's Second Law which states that an imaginary line from the Sun to a planet sweeps out equal areas in equal time intervals.

(3) Explain Kepler's Third Law which states that the square of the ratio of the periods of any two planets revolving about the Sun is equal to the cube of the ratio of their average distances from the Sun and write it in equation form $\left[\left(\dfrac{T_A}{T_B}\right)^2 = \left(\dfrac{r_A}{r_B}\right)^3\right]$.

(4) Explain the law of universal gravitation and write it in equation form $\left[F_g = G\dfrac{m_1 m_2}{r^2}\right]$

According to Kepler's third law, which of the following represents the mathematical relationship between periods of planets and their mean distances away from the Sun?

$$\left(\frac{T_A}{T_B}\right)^2 = \left(\frac{r_A}{r_B}\right)^3$$

$$\left(\frac{T_A}{T_B}\right)^3 = \left(\frac{r_A}{r_B}\right)^2$$

$$\left(\frac{T_A}{r_B}\right)^2 = \left(\frac{r_A}{T_B}\right)^3$$

$$\left(\frac{T_A}{r_A}\right)^2 = \left(\frac{T_B}{r_B}\right)^3$$

Two objects each with mass **m** at a distance **r** from each other. The gravitational **force between them** is **F**. If the masses of the objects are increased to be **3r**, what will be the gravitational force between the objects?

9F

F/9

3F

F/3

Neptune is nearly at (10^{13}m) from the sun, and Saturn is nearly at (10^{12}m) from the sun. Which of the following is the correct ratio of their periods?

OUR SOLAR SYSTEM

$$\frac{T_{Neptune}}{T_{Saturn}} = \sqrt{1000}$$

$$\frac{T_{Neptune}}{T_{Saturn}} = \sqrt{10}$$

$$\frac{T_{Neptune}}{T_{Saturn}} = 100$$

$$\frac{T_{Neptune}}{T_{Saturn}} = 10$$

A piece of iron is placed (**23 cm**) away from a piece of nickel that has a mass of (**46 kg**) .) . Given that the force of gravity between them is (**2.9 x 10** $^{-8}$ **N**), what is the mass of the piece of iron?

Kepler's third law states that …………
a. the orbits of the planets are elliptical.
b. the speed of a planet's orbit varies depending on which part of the ellipse it is occupying.
c. the square of the ratio of the periods of any two planets revolving around the Sun is equal to the cube of the ratio of their average distance from the sun.
d. objects attract other objects with a force that is directly proportional to the product of their masses, and inversely proportional to the square of the distance between them.

19 : (1) Calculate the orbital period of a satellite.

(2) Define pressure as the perpendicular component of a force on a surface divided by the area of the surface: $\left(P = \dfrac{F}{A}\right)$

ORBITAL SPEED AND PERIOD Assume that a satellite orbits Earth 225 km above its surface. Given that the mass of Earth is 5.97×10^{24} kg and the radius of Earth is 6.38×10^6 m, what are the satellite's orbital speed and period?
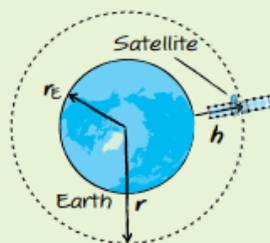
1 ANALYZE AND SKETCH THE PROBLEM

Sketch the situation showing the height of the satellite's orbit.

Known	Unknown
$h = 2.25\times10^5$ m	$v = ?$
$r_E = 6.38\times10^6$ m	$T = ?$
$m_E = 5.97\times10^{24}$ kg	
$G = 6.67\times10^{-11}$ N·m²/kg²	

Satellite
r_E
h
Earth r

2 SOLVE FOR ORBITAL SPEED AND PERIOD

Determine the orbital radius by adding the height of the satellite's orbit to Earth's radius.

$r = h + r_E$

$= 2.25\times10^5$ m $+ 6.38\times10^6$ m $= 6.60\times10^6$ m   Substitute $h = 2.25\times10^5$ m and $r_E = 6.38\times10^6$ m.

Solve for the speed.

$v = \sqrt{\dfrac{Gm_E}{r}}$

$= \sqrt{\dfrac{(6.67\times10^{-11}\,\text{N·m}^2/\text{kg}^2)(5.97\times10^{24}\,\text{kg})}{6.60\times10^6\,\text{m}}}$ Substitute $G = 6.67\times10^{-11}$ N·m²/kg², $m_E = 5.97\times10^{24}$ kg, and $r = 6.60\times10^6$ m.

$= 7.77\times10^3$ m/s

Solve for the period.

$T = 2\pi\sqrt{\dfrac{r^3}{Gm_E}}$

$= 2\pi\sqrt{\dfrac{(6.60\times10^6\,\text{m})^3}{(6.67\times10^{-11}\,\text{N·m/kg}^2)(5.97\times10^{24}\,\text{kg})}}$ Substitute $r = 6.60\times10^6$ m, $G = 6.67\times10^{-11}$ N·m²/kg², and $m_E = 5.97\times10^{24}$ kg.

$= 5.34\times10^3$ s

This is approximately 89 min, or 1.5 h.

Suppose that engineers are planning to place the International Space Station (ISS) into orbit at an altitude of 450 km above Earth's surface. What would be the orbital speed and period of the ISS?

Known: $h = 4.50\times10^5$ m
$r_E = 6.38\times10^6$ m
$m_E = 5.97\times10^{24}$ kg
$G = 6.67\times10^{-11}$ N·m²/kg²

Determine the orbital radius. Add the height of the satellite's orbit to Earth's radius.

$r = h + r_E$
$= 4.50\times10^5$ m $+ 6.38\times10^6$ m
$= 6.83\times10^6$ m

Solve for speed.

$v = \sqrt{\dfrac{Gm_E}{r}}$

$= \sqrt{\dfrac{(6.67\times10^{-11}\,\text{N·m}^2/\text{kg}^2)(5.97\times10^{24}\,\text{kg})}{6.83\times10^6\,\text{m}}}$

$= 7640$ m/s or 27,500 km/h

Solve for the period.

$T = 2\pi\sqrt{\dfrac{r^3}{Gm_E}}$

$= 2\pi\sqrt{\dfrac{(6.83\times10^6\,\text{m})^3}{(6.67\times10^{-11}\,\text{N·m}^2/\text{kg}^2)(5.97\times10^{24}\,\text{kg})}}$

$= 5620$ s

This is approximately 94 min.

Neptune's Orbital Period Neptune orbits the Sun at an average distance given in **Figure 9**, which allows gases, such as methane, to condense and form an atmosphere. If the mass of the Sun is 1.99×10^{30} kg, calculate the period of Neptune's orbit.

Sun

$r = 4.496 \times 10^{12}$ m

Neptune   (Not to scale)
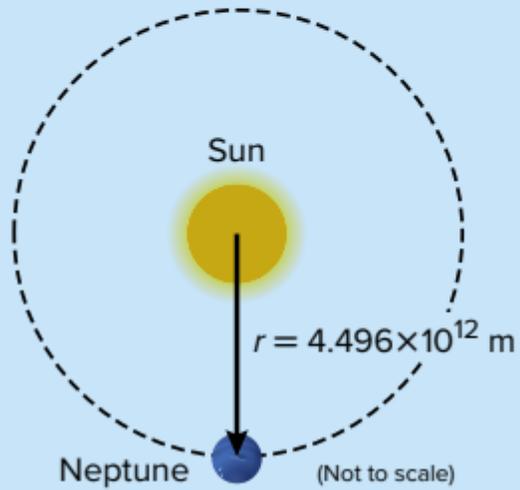
6.02×10^4 days

CALCULATING PRESSURE A child weighs 364 N and sits on a three-legged stool, which weighs 41 N. The bottoms of the stool's legs touch the ground over a total area of 19.3 cm².

a. What is the average pressure that the child and the stool exert on the ground?

b. How does the pressure change when the child leans over so that only two legs of the stool touch the floor?

1 ANALYZE AND SKETCH THE PROBLEM

- Sketch the child and the stool, labeling the total force that they exert on the ground.
- List the variables, including the force that the child and the stool exert on the ground and the areas for parts **a** and **b.**

Known

$F_{g\,child} = 364$ N

$F_{g\,stool} = 41$ N

$A_a = 19.3$ cm²

$A_b = \frac{2}{3} \times 19.3$ cm²

$= 12.9$ cm²

$F_{g\,total} = F_{g\,child} + F_{g\,stool}$

$= 364\text{ N} + 41\text{ N}$

$= 405$ N

Unknown

$P_a = ?$

$P_b = ?$

$F_g = 405$ N

2 SOLVE FOR THE UNKNOWN

Find each pressure.

$$P = \frac{F}{A}$$

a. $P_a = \left(\dfrac{405\text{ N}}{19.3\text{ cm}^2}\right)\left(\dfrac{(100\text{ cm})^2}{(1\text{ m})^2}\right)$ Substitute $F = F_{g\,total} = 405$ N, $A = A_a = 19.3$ cm².

$= 2.10 \times 10^2$ kPa

b. $P_b = \left(\dfrac{405\text{ N}}{12.9\text{ cm}^2}\right)\left(\dfrac{(100\text{ cm})^2}{(1\text{ m})^2}\right)$ Substitute $F = F_{g\,total} = 405$ N, $A = A_b = 12.9$ cm².

$= 3.14 \times 10^2$ kPa

A lead brick, 5.0 cm × 10.0 cm × 20.0 cm, rests on the ground on its smallest face. Lead has a density of 11.8 g/cm³. What pressure does the brick exert on the ground? **23 kPa**

The figure below shows a student's thump pressing a drawing pin with a force of (15N) into a piece of wood. The cross-sectional area of the tip of the pin is (0.01cm²). What is the **pressure** of the tip of the drawing pin on the wood?
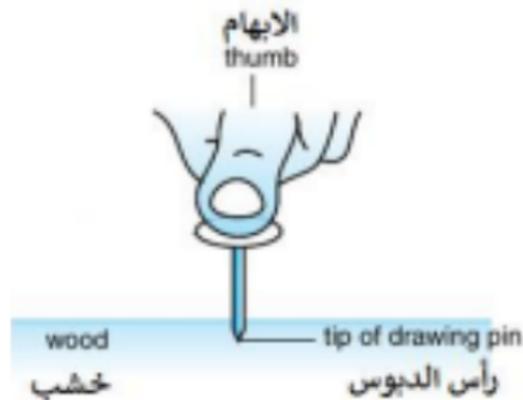
وضح الشكل أدناه أصبع الإبهام لطالب يضغط على دبوس بقوة (15 N على قطعة من الخشب. تبلغ مساحة المقطع العرضي لرأس الدبوس (0.01)cm²، ما مقدار الضغط الذي يسلطه رأس الدبوس على قطعة الخشب؟

1.1.5 × 10⁷ Pa

1.1.5 × 10³ Pa

1.6.7 × 10⁴ Pa

1.6.7 × 10⁸ Pa

الابهام
thumb

wood
tip of drawing pin

خشب
رأس الدبوس

Which of the following is **not correct unit** of pressure?

kPa

N/m²

N/m

Pa

19- Mercury orbits the Sun with an orbital radius of ($5.8 × 10^{10}$ m). Given that the mass of the Sun is ($2.0 × 10^{30}$ kg), and the mass of Mercury is ($3.3 × 10^{23}$ kg).
- Calculate the period of Mercury's orbit.

_____

_____

_____

- Calculate the gravitational force between Mercury and the Sun.

_____

_____

_____

- Calculate the orbital velocity of Mercury around the Sun.

_____

_____

_____

Hope this worksheet be useful for u and good Luck ☺