KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

POLITEKNIK MALAYSIA
KUCHING SARAWAK

Portal Rasmi Politeknik Kuching Sarawak

ENGINEERING SCIENCE:

Exam Success Workbook

Name:

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We Deliver With Passion

Department of Mathematics, Science and Computer

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PUBLISHED BY:
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MINISTRY OF HIGHER EDUCATION
KM22, JALAN MATANG,
93050 KUCHING, SARAWAK.

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e ISBN 978-629-7638-42-3

PREFACE

Greetings,

Grateful for the support and guidance that have allowed us to complete the *Engineering Science: Exam Success Workbook* within the set time frame. This workbook serves as an introduction to Engineering Science for diploma students, emphasizing aspects that expose students to basic topics deemed appropriate for discussion and problem-solving in groups or in class, as well as being studied more deeply after each topic.

Various challenges and obstacles had to be faced before producing a workbook that is solid in terms of its content delivery. This book explains various fundamental principles and applications found in the field. It also delves deeper into the key scenarios and problems encountered in the field of Engineering Science. Moreover, this workbook aims to strengthen students' skills in solving problems based on given situations related to relevant physics concepts in the field of engineering. It provides students with opportunities to review the topics they have learned by working through the exercises provided. The questions in this workbook are designed to resemble final exam questions, helping students prepare for their final examinations. This workbook contains only reinforcement questions to help students get accustomed to the format of final exam questions.

We hope this workbook will greatly benefit students by enhancing their understanding of fundamental Engineering Science concepts, improving their problem-solving skills, and preparing them for their final examinations. We believe there are still many weaknesses and shortcomings in this workbook. We are open-heartedly accepting any constructive feedback and comments on this workbook.

Thank you.

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ABSTRACT

The *Engineering Science: Exam Success Workbook* is crafted to serve as a reinforcement resource for Diploma students who pursuing DBS10042 Engineering Science. Its primary objective is to assist students in cementing their grasp of core engineering science principles and improving their problem-solving abilities by practicing questions modelled after final exam formats. The workbook includes a variety of reinforcement questions that reflect the type of challenges students will face in their final exams, and it does not include any additional notes, focusing solely on practice. Through the exercises provided, students can review and apply the topics covered in their coursework, thereby better equipping themselves for their final assessments. Feedback and suggestions for enhancing the quality and usefulness of this educational tool are greatly appreciated.

CONTENTS

ENGINEERING SCIENCE course introduces the physical concepts required in engineering disciplines. Students will learn the knowledge of fundamental physics in order to identify and solve engineering physics problems. Students will be able to perform experiments and activities to mastery physics concepts.

FORMULAE

$g = 9.81\ m/s^2$

$w = mg$

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$s = \frac{1}{2}(u + v)\ t$

$v^2 = u^2 + 2as$

$F = ma$

$F_g = mg$

$F = mg \sin\theta$

$\rho = \frac{m}{V}$

$\rho_{relative} = \frac{\rho_{subtance}}{\rho_{water}}$

$M = F \times d$

$E_p = mgh$

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

$Efficiency = \frac{P_{output}}{P_{input}} \times 100\%$

$Efficiency = \frac{E_{output}}{E_{input}} \times 100\%$

$Efficiency = \frac{W_{output}}{W_{input}} \times 100\%$

$\rho_{water} = 1000\ kg/m^3$

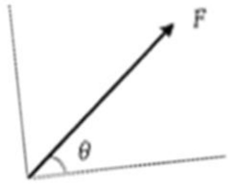
$W = F \times d$

$W = mgh$

$W = Fd \cos\theta$

$F_x = F \cos\theta$

$F_y = F \sin\theta$



$$F_R = \sqrt{\left(\sum F_x\right)^2 + \left(\sum F_y\right)^2}$$

$$\theta = \tan^{-1}\left(\frac{F_y}{F_x}\right)$$

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

$P = F \times v$

$P = \rho g h$

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

$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$A_1 h_1 = A_2 h_2$

$F_B = \rho V g$

$Q = mc\Delta\theta$

$Q = mL$

$C_{water} = 4200\ J/kg°C$

CHAPTER 1: PHYSICAL QUANTITIES AND MEASUREMENT

1. Define derived quantity and state **ONE (1)** example of derived quantity.

2. Define base quantity and give **ONE (1)** example of base quantity.

3. Define scalar quantity and vector quantity

4. Define **TWO (2)** types of errors. Give an example for each type of errors.

5. i. Define physical quantities. Give **ONE (1)** function of numerical values & units

   ii. What is the symbol and SI unit for time?

6. Convert 160 km/h to m/s

7. Convert 340 ms^{-1} to kmh^{-1}

8. Convert 670 km/h^2 to m/s^2

9. Convert 25 ms^{-1} to mm/min

10. Convert the velocity of 50 kmh^{-1} to ms^{-1}

11. Convert 8568 kg/m^3 to g/cm^3

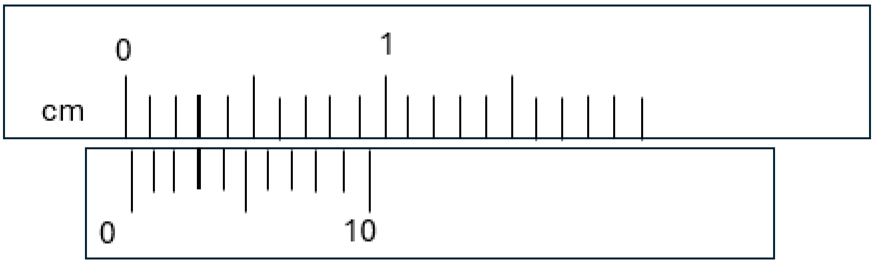
12. Convert the unit of 458 gcm^{-3} to kgm^{-3}

13. Change the value of 18 gm^{-3} to kgm^{-3}

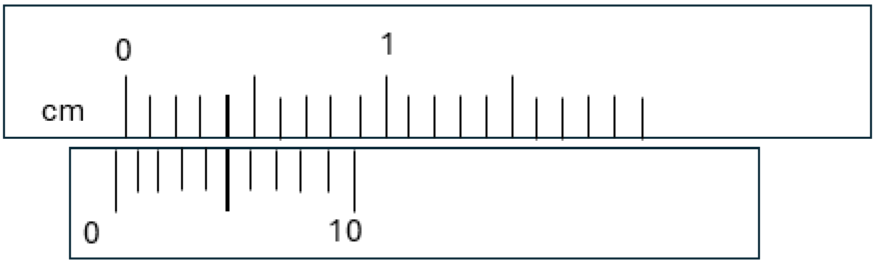
14. Convert 200 kg/m^3 to g/cm^3

15. Convert the unit of 13600 kg/m^3 to g/cm^3 and write the answer in standard scientific notation.

16. The following vernier callipers have their jaws closed firmly. However, the readings are not exactly zero. Determine the zero error and whether it's positive or negative.

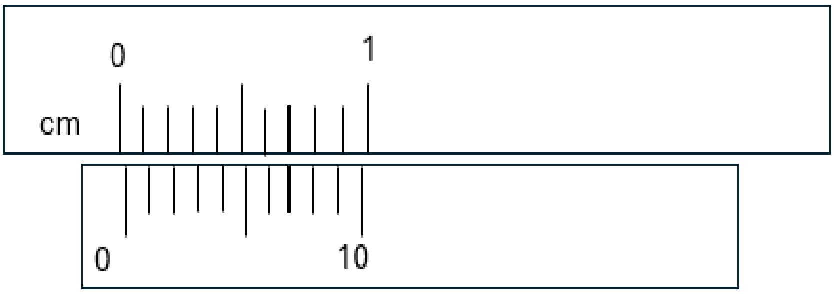


Zero error = ____________ cm



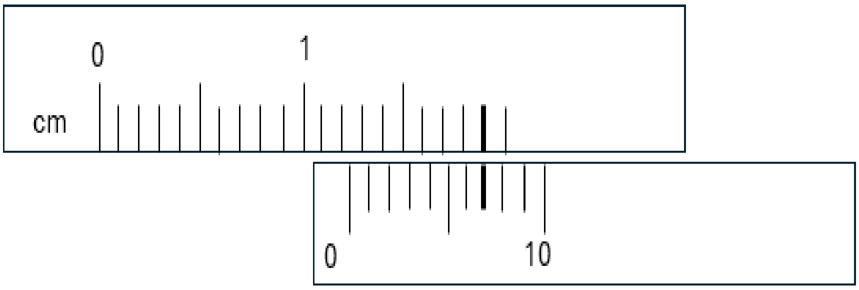
Zero error = ____________ cm

17. The following callipers have no zero errors. Determine the actual readings on each calliper



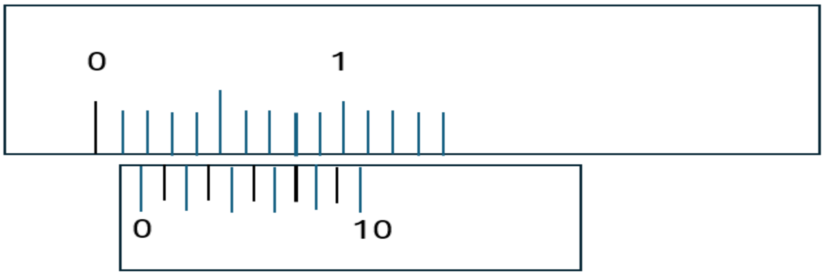
The actual reading = ____________________ cm

18. The following callipers have no zero errors. Determine the actual readings on each calliper



The actual reading = ____________________ cm

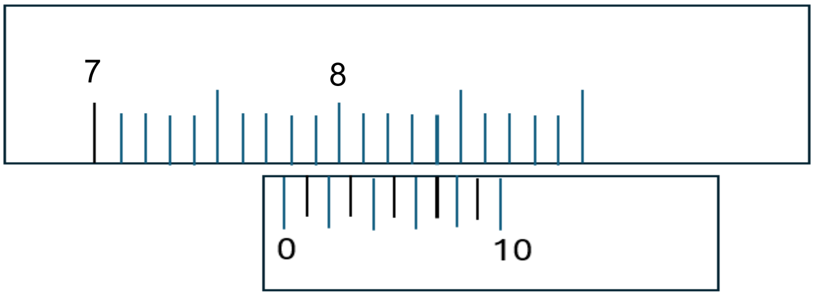
19. The following vernier callipers have zero errors as indicated in each case. Determine the actual reading



Zero error = - 0.02 cm

Actual reading = ________________ cm

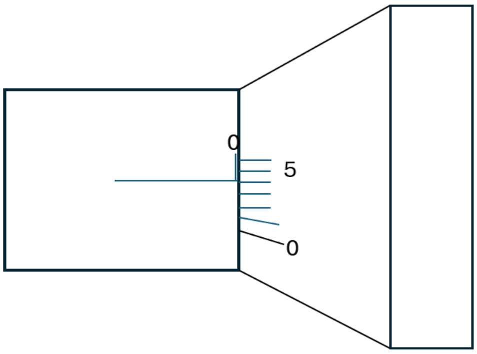
20. The following vernier callipers have zero errors as indicated in each case. Determine the actual reading.



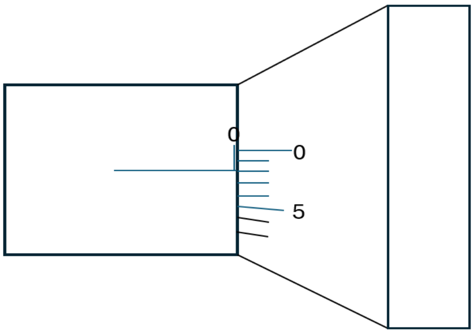
Zero error = + 0.05 cm

Actual reading = _______________ cm

21. The following micrometer screw gauges have their jaws closed firmly. However, the readings are not exactly zero. Determine the <u>zero error</u> and whether it's positive or negative.

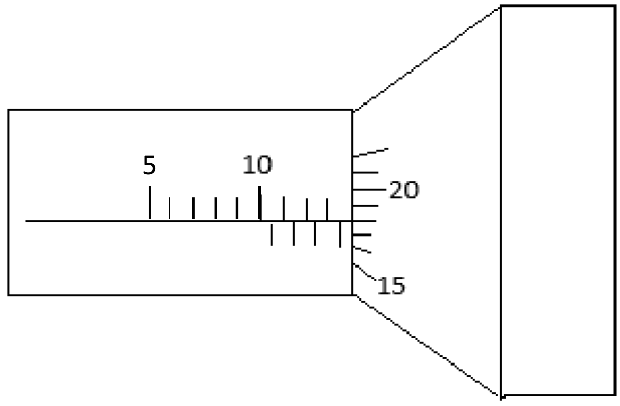


Zero error = _____________ mm



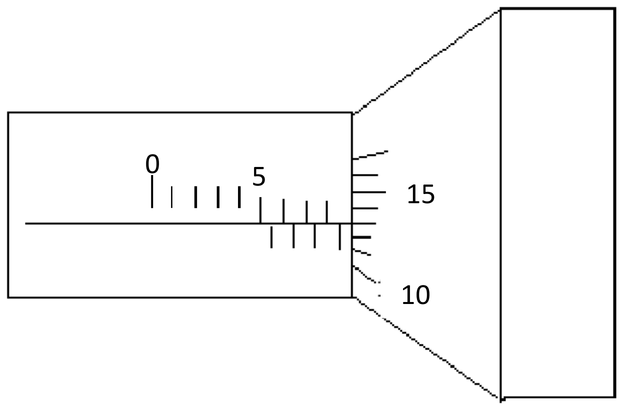
Zero error = _____________ mm

22. The following micrometer screw gauges have no zero errors. Determine the actual readings on each gauge.



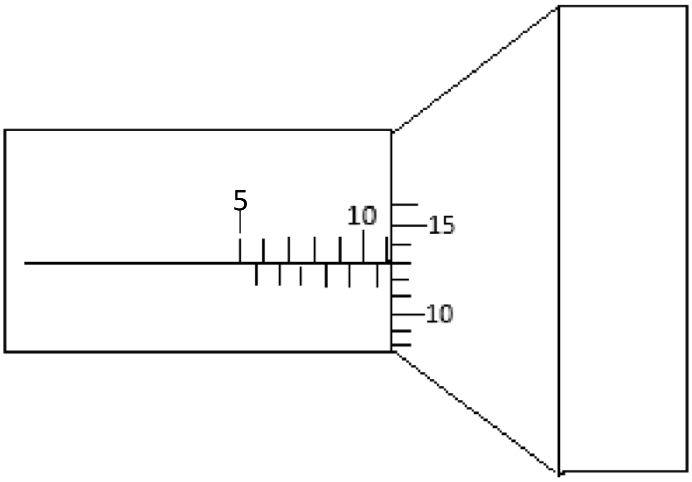
The actual reading = ___________________ mm

23. The following micrometer screw gauges have no zero errors. Determine the actual readings on each gauge.



The actual reading = ___________________ mm

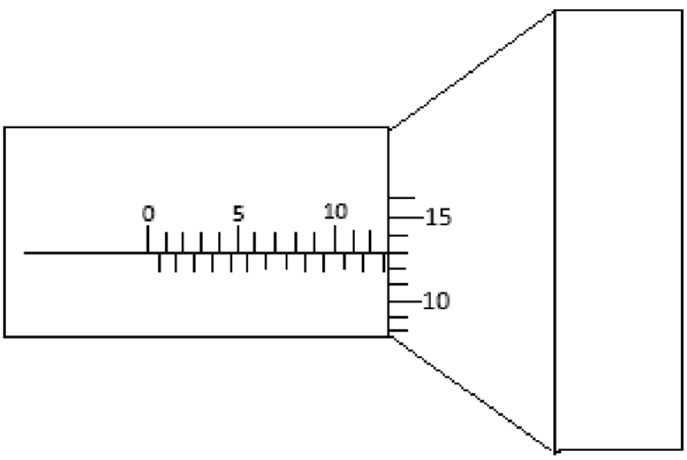
24. The following micrometer screw gauges have zero errors as indicated below. Determine the actual readings on the gauge.



Zero error = -0.05mm

The actual reading = ___________________ mm

25. The following micrometer screw gauges have zero errors as indicated below. Determine the actual readings on the gauge.



Zero error = +0.12 mm

Actual reading = ___________________ mm

CHAPTER 2: LINEAR MOTION

1. Describe **TWO (2)** differences between **speed** and **velocity**.

2. Define the term **acceleration** and state the **SI unit**.

3. State **TWO (2)** characteristics of **distance** and **displacement**.

4. Define the term **distance**, **displacement** and state their **SI unit**.

5. State **TWO (2)** examples for:

    i. Uniform motion.

    ii. Non-uniform motion.

6. A boat sailing through a river moved eastward for 5km, then cross the river by moving 3km southward. On reaching the other side it moved westward through 1km and reached the jetty. Find the distance covered and displacement of the boat in km.

7. A speedboat increases its speed uniformly from $20ms^{-1}$ to $30ms^{-1}$ in a distance of 0.2km. Calculate.

   i. Acceleration

   ii. Time for the boat to travel in distance of 0.2km.

8. An airplane travelling at 150m/s is accelerated uniformly at $25m/s^2$.

   i. What is the airplane's speed after 15s?

   ii. What distance has it travelled at that point of time?

9. A car started from a rest and accelerated at 10.23 m/s^2 for 5.5 seconds. Calculate the distance covered by the car.

10. An object starts moving with a velocity of 10m/s. After travelling a distance of 5m, it gets a velocity of 20m/s. Find its:

    i. Acceleration

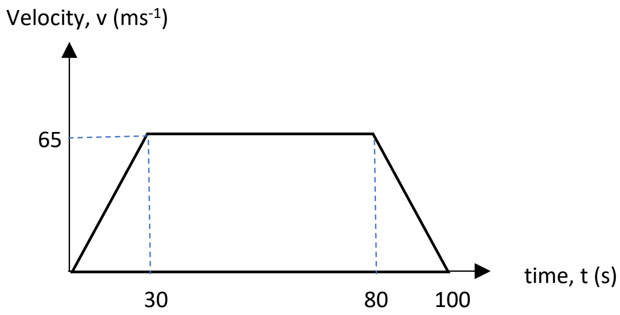
    ii. Time taken

11. A car which was moving at a velocity of $24ms^{-1}$ stopped after its brakes were applied. The distance from the brakes were applied to the instance when it stopped was 480m. Find:

    i. The deceleration of the car?

    ii. The time taken to stop the car?

12. Figure below shows a velocity-time graph for a car moving along a straight line. Calculate:



i. The acceleration of the car at the first 30 seconds?

ii. The deceleration of the car?

iii. The total distance travelled by the car?

v. The average velocity of the car?

13. A car moving at a velocity of 3.5 kmh^{-1} is stopped after its brakes are applied. The distance when the brakes are applied till it stopped is 250 m. Determine:

i. Sketch the velocity-time graph for the motion.

ii. The deceleration of the car.

iii. Time taken to stop the car.

14. A car starts from rest and accelerates at a constant acceleration of $10 m/s^2$ for 5 seconds. Then, the car travels at a constant velocity for 10 seconds. The brakes are then applied and the car stops in 8 seconds.

i. Sketch the velocity-time graph for the motion.

ii. Calculate the maximum velocity attained by the car.

iii. Calculate the total distance travelled by the car.

v. Calculate the average velocity of the car.

15. An object moves with velocity of 30m/s and then increases its velocity to 60m/s in 8 seconds. The object then moving with constant velocity for 10 seconds and stop in 7 seconds.

i. Sketch the velocity-time graph for the motion.

ii. Calculate the initial acceleration of the object.

iii. Calculate the total distance travelled by the object.

CHAPTER 3: FORCE

1. Define force and its unit.

2. Define the Newton's First Law ($\Sigma F=ma$)

3. State **TWO (2)** differences between weight and mass.

4. Match the following force with the description.

Force	
i.	Normal
ii.	Gravity
iii.	Applied
iv.	Friction

Description	
a.	Push or pull
b.	Perpendicular to a surface and opposes gravity
c.	Only opposes motion
d.	Result of the mass and related to distance between two objects.

5. Read each question carefully, and then **CIRCLE TRUE or FALSE**.

   i. Your mass on Earth is different than your mass on Mars. **(TRUE/FALSE)**

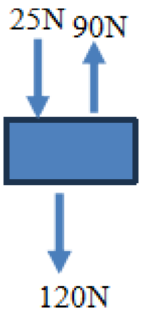
   ii. Force in equilibrium means that the sum of the external force acting on the object must NOT be zero. **(TRUE/FALSE)**

   iii. The Moment of a force is a measure of its tendency to cause a body to rotate about a specific point or axis, and its unit is Nm. **(TRUE/FALSE)**

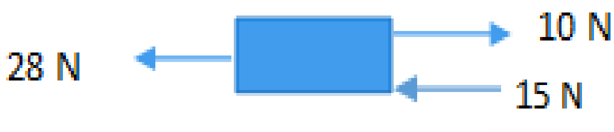
   iv. The principles of moment of force states that when a body is balanced, the total clockwise moment about a point equals the total anticlockwise moment about the same point**. (TRUE/FALSE)**

6. Find the net force and state its direction for each situation below.

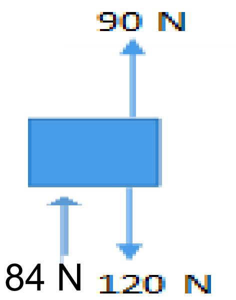
7. Find the net force and state its direction for each situation below.



8. Find the net force and state its direction for the situation below



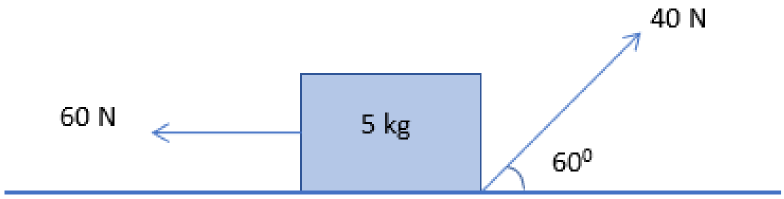
9. Find the net force and state its direction for the situation below



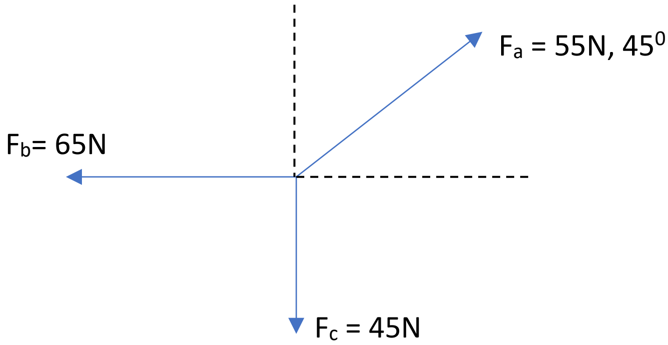
10. Find the net force and state its direction for the situation below

11. A 5 kg box sits on a flat frictionless surface. Two forces of 60N and 40N are applied to the box as shown above. Calculate:

Horizontal component for the forces.
Vertical component for the forces.



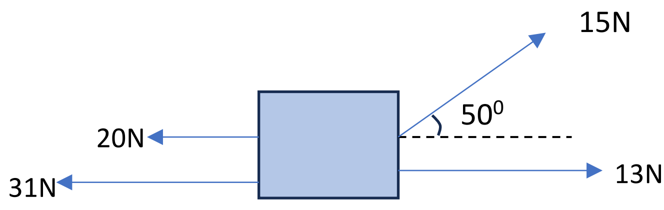
12. According to figure below, resolve each force to x-axis and y-axis



F_a	F_b	F_c
$F_x =$	$F_x =$	$F_x =$
$F_y =$	$F_y =$	$F_y =$

13. Figure below shows forces acting on an object. Calculate the resultant force (**F$_R$**) and the direction (**θ**) of the resultant force acting on the object.

$$\vec{F_R} = \sqrt{F_x^2 + F_y^2} \qquad \theta = tan^{-1}\frac{F_y}{F_x}$$



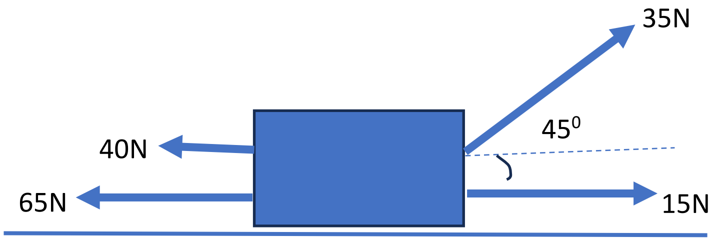
F$_R$ =

θ =

F(N)	θ (⁰)	F$_x$ = F cos θ	Fy = F sin θ
Total			

14. Figure below shows forces acting on an object. Calculate the resultant force (**F$_R$**) and the direction (**θ**) of the resultant force acting on the object.

$$\vec{F_R} = \sqrt{F_x^2 + F_y^2} \qquad \theta = tan^{-1}\frac{F_y}{F_x}$$



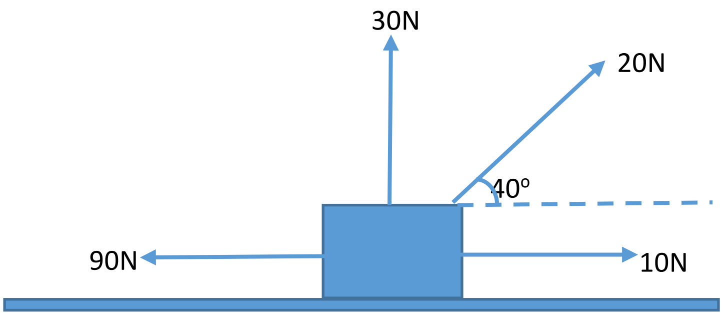
F$_R$ =

θ =

F(N)	θ (⁰)	F$_x$ = F cos θ	Fy = F sin θ
Total			

15. Figure below shows forces acting on an object. Calculate the resultant force (**F**$_R$) and the direction (**θ**) of the resultant force acting on the object.

$$\vec{F_R} = \sqrt{F_x^2 + F_y^2} \qquad \theta = tan^{-1}\frac{F_y}{F_x}$$

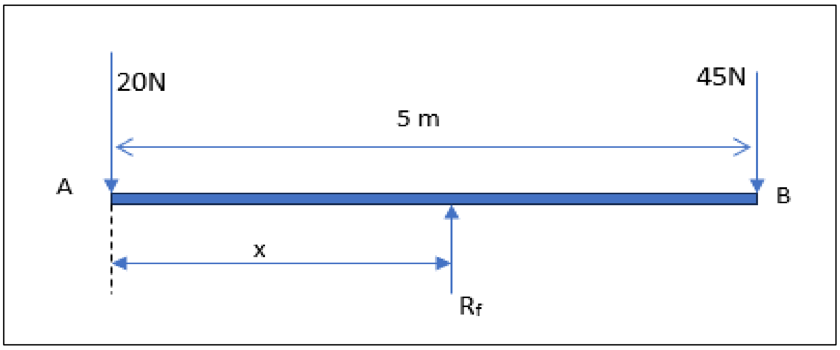


F_R =

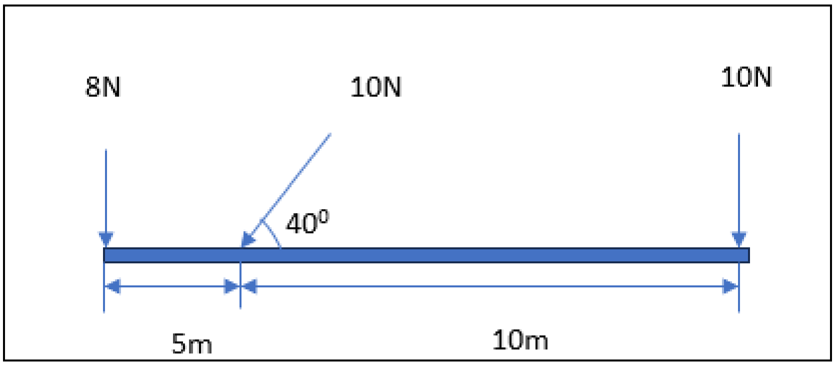
θ =

F(N)	θ (^{0})	$F_x = F\cos\theta$	$F_y = F\sin\theta$
Total			

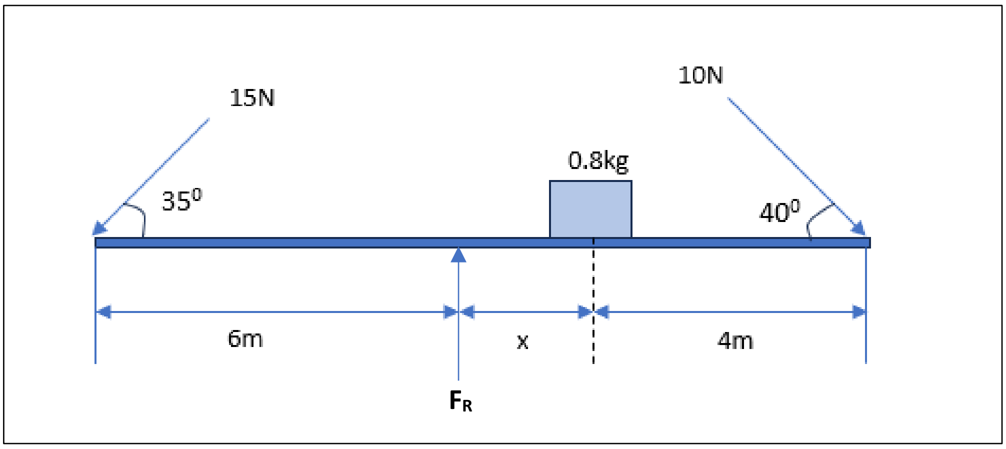
16. Determine the centre of gravity for the system as shown below, by assuming the object is in equilibrium. Use Moment Method Principle.



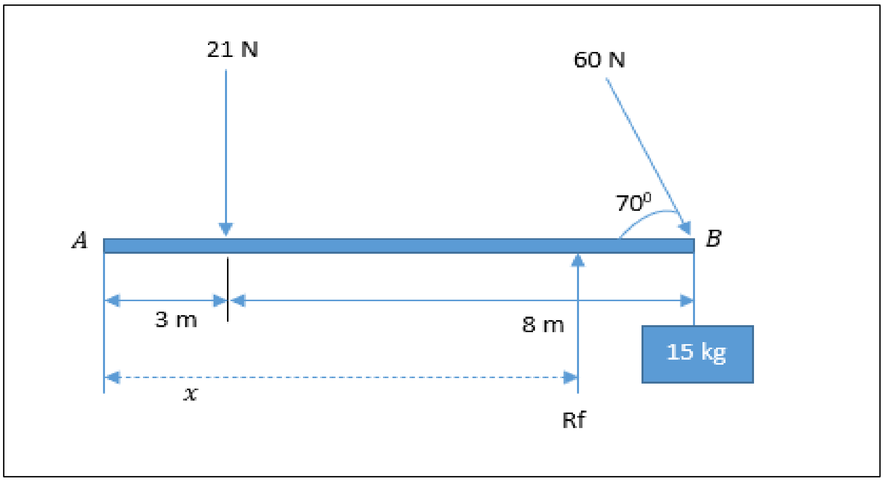
17. Determine the centre of gravity for the condition given in figure below. Assume the object is in equilibrium. Use Resultant Moment Method to solve it.



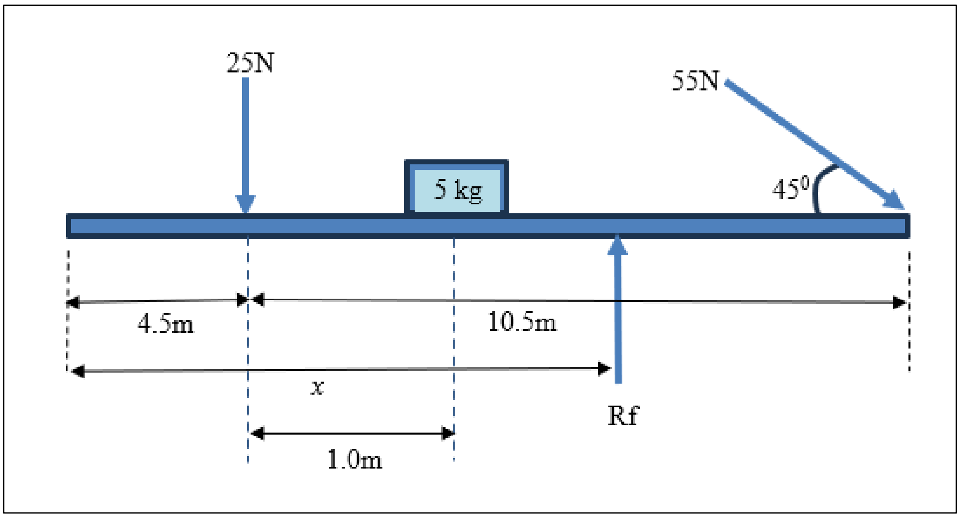
18. below shows a loaded beam. Find the resultant force (**F_R**) and the **value of x** if the beam is equilibrium. Given g = 10 ms^{-2}.



19. Calculate the **value of** x and reaction **force** $\mathbf{R_f}$ for the condition given in Figure below. Assume the object is in equilibrium



20. Calculate the **value of x** and **resultant force** $\mathbf{R_f}$ for the condition given in figure below. Assume the object is in equilibrium



CHAPTER 4: WORK, ENERGY AND POWER

1. Define **renewable energy** and **non-renewable energy**.

2. State **THREE (3)** principles of conservation of energy.

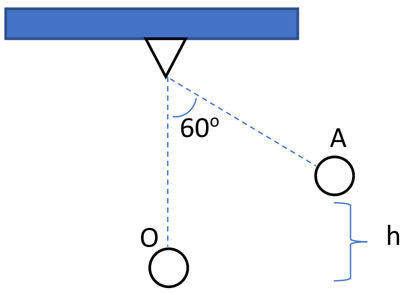
3. State **TWO (2) examples** of energy sources for each renewable energy and non-renewable energy.

4. Define **Energy** and state the **SI unit**.

5. Define **work** and state the **SI unit**.

6. A crate of mass 50kg is pushed along a floor with a force of 20N for a distance of 5m. Calculate the work done.

7. A pendulum bob is suspended on the ceiling by string as shown in figure below. The length of the string is 0.5m and the mass of the pendulum bob is 0.15kg. It is pulled aside to an angle of 60° and starts to swing. ($g = 9.81m/s^2$).



i. Find the initial height h at point A. (measured from the lowest position of the bob)

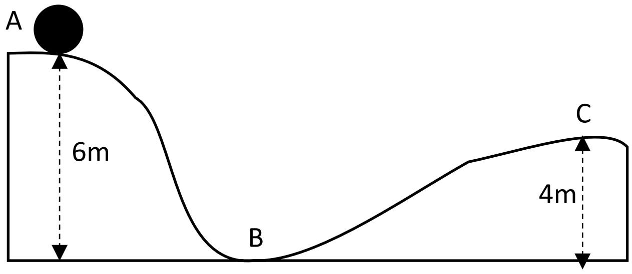
ii. Calculate the corresponding potential energy at point A. (Assume the potential energy at point O is 0)

iii. Find the kinetic energy of the bob when it is swings to the lowest position.

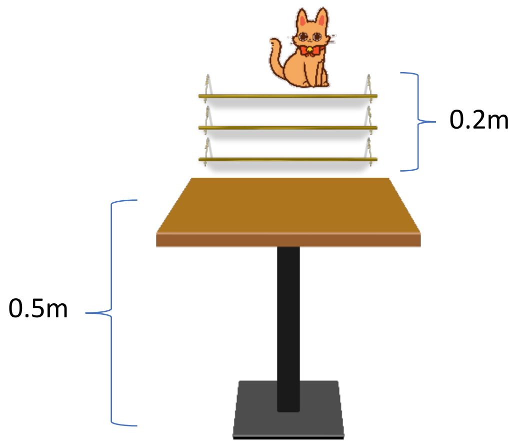
iv. Calculate the velocity of the bob at the lowest position.

v. Can the bob reach to a height of 0.3m (measured from the lowest position of the bob) when it swings to the left-hand side? Explain briefly.

8. Figure below shows 4kg object is moving downwards from point A. Determine the speed of the object at point B and point C?



9. A cat of mass 5kg is placed on a shelf which is 0.2m above a table. If the table top is 0.5m above the floor as shown in figure below, find the potential energy of the cat with reference to:



i. The table top

ii. The floor

10. A steel ball of mass 2 kg is released from a height of 8 m from the ground. On hitting the ground, the ball rebounds to a height of 6 m. Find:

i. The kinetic energy of the ball as it reaches the ground.

ii. The velocity of the ball on reaching the ground?

iii. After reaching 6 m, the ball falls and bounces again. Assume that the energy loss in each bounce is the same, find the height reached by the ball after the second bounce?

11. A bird sitting on a tree branch with height of h. Say that the mass of the bird is 0.5kg and the height of the tree branch is 2m. Calculate the gravitational potential energy possessed by the bird at the moment.

12. A 50g flying bullet has the same kinetic energy as a 2000kg locomotive which travelling at $7.2kmhr^{-1}$. Calculate the velocity of the bullet.

13. A pitcher throws baseball of mass 145g with a speed of $20ms^{-1}$. What is its kinetic energy?

14. A tractor was pulled by another tractor as far as 15m from point A to point B. amount of force needed to pull the tractor was 4000N. It took 3 minutes for the tractor to reach point B from point A. Calculate the power done.

15. A man has pulled a cart through 12m in 10 seconds by applying a force of 250N. Calculate:

    i. The work done by the man?

ii. The power of the man?

16. A 50000W motor is used to lifts a 5000kg load to a height of 14 m in 20s. Find the efficiency of the motor?

17. An electric motor with input power of 1500W can lift a load of mass 50kg to a height of 20m in 10s. Find the efficiency of the motor?

18. A petrol engine has a work output of 78000J per minutes. What the power input if the efficiency of the engine is 30%?

19. The motor in a toy crane can lift 450g weight through a height of 50cm in 5 seconds. If the batteries of the toy crane supply 0.5W of power to the motor. Calculate:

i. The work done by the toy crane.

ii. The efficiency of the motor.

20. A load with a weight of 1300N is raised up to a height of 12 m when a force, F, is applied over a distance of 6m. If the efficiency of the pulley is 55%, Calculate:

i. The work done by the pulley.

ii. The value of the force, F.

CHAPTER 5: SOLID AND FLUID

1. List **TWO (2)** characteristics of each solid, liquid and gas.

2. Define density and state its SI unit.

3. Define pressure and state its SI unit.

4. State the definition of Archimedes Principle.

5. Define Buoyant Force and its SI unit.

6. Calculate the density and relative density of a block with the following measurements: (Given ρ_{water} =1000 kg/m^3.

Length = 20 cm	Width = 8 cm
Height = 25 cm	Mass = 7500 g

7. A shipping container with dimension 5.9m x 2.4m x 3.1m has a mass of 29015kg. Calculate the density and relative density of the shipping container. (Given ρ_{water} =1.0 g/cm^3.

8. 80N force was imposed at one cubic container with a dimension of 10cm x 20cm x 30cm as shown below. The container was filled with 4.8kg of oil. Calculate

   i. The density of oil.

   ii. The relative density of oil.

9. Calculate the density of a metal block in dice shape if its length is 0.2m and its mass is 86g.

10. A metal block with density of 750 kg/m3 is located on a floor. The weight of the metal is 1500N. Calculate:

    i. Mass of the metal block

    ii. Volume of the metal block

iii. Relative density of the metal block.

11. A wood cutter uses a saw with a cross-sectional area of 0.8 cm^2 to cut a pieces of wood. Calculate the pressure exerted by the saw if the force applied on the saw is 25N.

12. A box full of apples with 200N weight is placed on the table. The height and width of the box is 0.2m and 0.05m each. Calculate the pressure between the box and the table top.

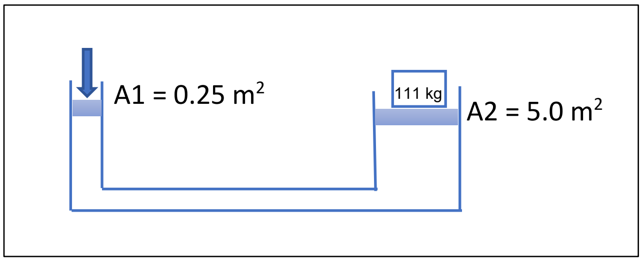
13. Calculate the pressure retained by a diver in the sea at the depth of 75m. (sea water density= 1030kg/m^3)

14. In a hydraulic system, the large piston P has cross-sectional area of 150cm^2 and the small piston, R has a cross-sectional area of 30cm^2. If a mass of 30kg was applied to the small piston, calculate:

    i. Force at a large piston, P

    ii. Displacement of piston P in meter (m) if the piston R moves 50cm downward.

15. Figure below shows a hydraulic lift with a force F1 acting on a circular piston with an area of $0.25m^2$. The pressure generated is transmitted through a liquid to a second piston with an area of $5.0m^2$.



i. Calculate the downward force on Piston A.

ii. If the distance moved at Piston A is 0.7m, calculate the distance moved by Piston B.

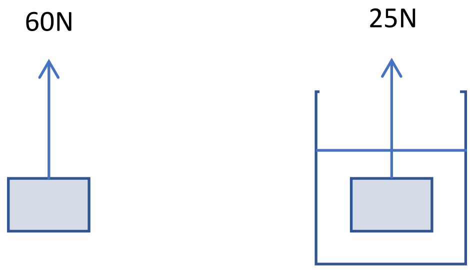
16. A hydraulic lift in a Proton Service has two pistons. The smaller piston has a cross-sectional area, A_1 which is $0.06m^2$. The bigger piston has cross-sectional are, A_2 which is $2.4m^2$. If the maximum mass, F_1 can be applied on the small piston is 1177.2N, calculate the maximum weight of the Proton car that can be lifted up by the bigger piston. ($g=9.81ms^{-2}$)

17. A stone with the volume of $1.28 \times 10^{-5}m^3$ weighs 0.36N in air. Given the density of the liquid is 8.0×10^2 kgm^{-3}, calculate:

i. Buoyant force

ii. Apparent weight of the stone

18. The figure below shows a load suspended in air and then immersed into water. Based on the spring balance readings, calculate the density of the load. (Given density of water = 1000 kg/m^3 and g = 9.81 m/s^2)



19. i. An object of volume 1.0m^3 floats in water with 20% of its volume is above the water surface. How much does it weight in air?

ii. The volume of another object is 5m^3. Find the buoyant force which act on the object if it is placed in the air. (Density of the air=1.3kgm^{-3})

20. A stone when weighed in the air is 6.9N. When completely immersed in water however, weighed in water is 4.3N. Find the density of the stone. (Density of water= 1000kg/m^3 and g=9.81)

CHAPTER 6: TEMPERATURE AND HEAT

1. Define **heat** and state its **SI unit.**

2. Define **temperature** and state its **SI unit**.

3. State the **definition** and **SI unit** for the terms below:

   i. Heat Capacity

   ii. Specific heat capacity

4. Describe **THREE (3)** method of heat transfer with **an example** for each method.

5. How much heat energy is required to raise the temperature of a 3kg sheet of glass from 24°C to 36°C? [specific heat capacity of glass 840J/kg°C]

6. The initial temperature of 150g of ethanol was 22°C. What will be the final temperature of the ethanol if 3240J was needed to raise the temperature of the ethanol? [specific heat capacity of ethanol = 2.44J/g°C].

7. The fluid Y has released 1.42×10^4 Joule of heat. The mass of the fluid was 0.7kg and has been cooled from 70°C to 30°C. Calculate the specific heat capacity for the Fluid Y.

8. A water heater at 30°C needed 20 kJ of heat quantity to heat the water to achieve 80°C. Calculate the mass of the water. (The specific heat capacity of water=4200$Jkg^{-1}°C^{-1}$)

9. Calculate the amount of heat required to melt 0.1kg of aluminium. (Specific latent heat of aluminium is 397000Jkg^{-1})

10. How much heat energy must be absorbed by 560g of ice at -10°C to convert it to water at 40°C? (Specific latent heat of fusion of water = 334000J/kg, specific heat capacity of ice = 2100J/kg°C)

11. How much heat energy is needed to melt a silver of 0.5kg at 20°C? (Melting point of silver = 960.8°C, specific heat capacity of silver = 235Jkg^{-1}°C^{-1}, specific latent heat of fusion of silver = 8.82 x 10^4J/kg)

12. When 0.7kg water of 15°C is mixed with certain amount of water of 90°C, the temperature of the final mixture is 65°C. Find the original mass of the 90°C water. (Specific heat capacity of water = 4200 Jkg^{-1}°C^{-1})

13. A piece of stone of mass 600 g at 26°C is placed in a beaker containing 1.2kg of water at 48°C. if the temperature of the water drops to 45°C, calculate the specific heat capacity of the stone. (Specific heat capacity of water= 4200Jkg^{-1}°C^{-1})

14. A cup of water A at 90°C with mass of 120g is poured into a bowl. Another cup of water B at 30°C is poured into the same bowl. If the mixture reaches a final temperature of 65°C:

    i. Calculate the heat released by water A.

    ii. Determine the mass of water B.
    (Specific heat capacity of the water is $4200 Jkg^{-1 o}C^{-1}$)

15. 300g of metal at 90°C is added to 200g of water at 10°C. What is the specific heat capacity of the metal if the final temperature of the mixture is 30°C? (Specific heat capacity of water is 4200J/kg°C)

16. Given that 450g of water 26°C is added to 250g of water at 100°C. Determine the final temperature of mixture. (C_{water}= 4200 $Jkg^{-1 o}C^{-1}$).

17. A 50g silver spoon at 20°C is used to mix coffee at 90°C. After a few moments the spoon and coffee achieved 89°C If mass of the coffee is 200g. (Specific heat capacity for silver spoon = 0.23 kJ $kg^{-1o}C^{-1}$)

   i. Calculate the thermal absorbed by spoon

   ii. Determine the specific heat capacity for coffee

18. A girl poured 220g of coffee at 75°C and 12 g of milk at 10°C into a ceramic cup of mass 110g which has a specific heat capacity of 1100 J/kg°C at temperature 27°C. What is the final temperature of the coffee when thermal equilibrium is reached? Assume that there is no heat loss to the surroundings and that the specific heat capacities of coffee and milk are the same as that of water which is 4200J/kg°C.

19. 200g of hot water at 80°C is mixed with 100g of cold water at 20°C. What is the final temperature of the water? (Specific heat capacity of water= 4200 J/kg°C)

20. An iron block with mass of 4.5kg was heated until it reached the temperature of 660°C. Then the iron block was immediately soaked in 4kg of oil with temperature of 230°C. Both the oil and iron temperature then settled at 295°C. Given the specific heat capacity of iron is 0.12 $kJkg^{-1}{}^{o}C^{-1}$. Calculate:

i. The quantity of heat transferred from the iron to the oil.

ii. The specific heat capacity of the oil.

Answer

Chapter 1: Physical Quantities and Measurement

2.
- Physical quantity derived from combination of based quantity through multiplication, division or both operations.
- Density @ volume @ velocity

3.
- Physical quantity that cannot be derived from other physical quantities.
- length @ mass @ time.

4.
- Scalar quantity is a quantity that has magnitude only.
- Vector quantities that possess both magnitude and direction.

5.
- Systematic error – zero error
- Random error – parallax error

6.
- Physical Quantities is a quantity that is measurable. Numerical Values & Units give quantities meaning.
- *t* and second

7. $44.44ms^{-1}$

8. 1,224km/h

9. $0.052m/s^2$

10. 1500000 @ 1.5×10^6mm/min

11. $13.89ms^{-1}$

12. $8.568g/cm^3$

13. 458000 @ $4.58 \times 10^5kg/m^3$

14. 18000 @ $1.8 \times 10^4kg/m^3$

15. $0.2g/cm^3$

16. $1.36 \times 10g/cm^3$

17. i. +0.03cm
 ii. -0.05cm

18. 0.07cm

19. 1.27 cm

20. 0.19cm

21. 7.72m

22. i. +0.04mm
 ii. -0.02mm

23. 13.68mm

24. 8.63mm

25. 11.18mm

26. 12.51mm

Chapter 2: Linear Motion

1.

Term	Speed (m/s)	Velocity (m/s)
Definition	The rate of change of distance with time	The rate of change of displacement with time, or speed in a specified direction
Quantity	Scalar	Vector

2.
- Rate of change of velocity
- m/s^2

3. Distance
 - Total length path
 - Scalar Quantity

 Displacement
 - Distance measured in straight line, in specific direction between two points.
 - Vector Quantity

4. Distance
 - Total length path
 - meter, m

 Displacement
 - Distance measured in straight line, in specific direction between two points.
 - meter, m

5. Uniform motion
 - A car going along the road with constant speed
 - A train going along the tracks at steady speed

 Non-uniform motion
 - Roller coaster ride
 - Snake crawling

6. Distance = 9km, Displacement = 5km

7. $1.25ms^{-2}$, 8s

8. $525ms^{-1}$, 5062.5m

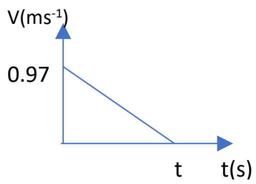
9. 154.73m

10. $30ms^{-2}$, 0.33s

11. $-0.6ms^{-2}$, 40s

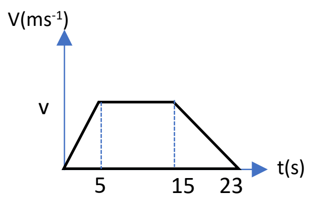
12. $2.17ms^{-2}$, $-3.25ms^{-2}$, 4875m, $48.75ms^{-1}$

13. i.



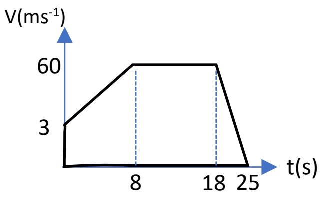
ii. $1.88 \times 10ms^{-2}$
iii. 515.46s

14. i.



ii. $50ms^{-1}$
iii. 825m
iv. $35.87ms^{-1}$

15. i.



ii. $3.75ms^{-2}$
iii. 1170m

Chapter 3: Force

1.
- Push or pull needed to start an object moving or more accurately to make things change their motion.
- Unit of force is Newton (N) or $kgms^{-2}$.

2. Newton's First Law ($\Sigma F=ma$)
- An object at rest will continue to be at rest, until an external force act on it.
- An object will not change its motion unless acted on by an unbalanced force.
- An object moving with a certain velocity will move in the same direction with the same velocity if the total force acting on it is zero, or no external force acts on it.

3. Mass
- The mass of an object is the same verywhere.
- Mass is base quantity.

Weight
- Weight varies according to location.
- Weight is derived quantity.

* Any answer which is suitable will do.

4. Normal force → b
Gravity force → d
Applied force → a
Friction force → c

5. i. FALSE
ii. FALSE
iii. TRUE
iv. TRUE

6. -136N (left)

7. -55N (downward)

8. -33N (left)

9. 54N (upward)

10. 64N (right)

11. i. -40N (ke kiri)
ii. -14.41N (ke bawah)

12.

F_a	F_b	F_c
F_x = Fcosθ = 55cos45⁰ = 38.89N	= Fcosθ = 65cos180⁰ = -65N	= Fcosθ = 45cos270⁰ = 0N
F_y = Fsinθ = 55sin45⁰ = 38.89N	= Fsinθ = 65sin180⁰ = 0N	= Fsinθ = 45sin270⁰ = -45N

13.

F(N)	θ (⁰)	$F_x = F\cos\theta$ (N)	$F_y = F\sin\theta$ (N)
15	50	9.64	11.49
13	0	13	0
20	180	-20	0
31	180	-31	0
Total		-28.36	11.49

$\vec{F_R}$ =30.6N, θ=-22.06⁰

The direction is = 180⁰ – 22.06⁰ = 157.94⁰

14.

F(N)	θ (⁰)	$F_x = F\cos\theta$ (N)	$F_y = F\sin\theta$ (N)
15	0	15	0
35	45	24.75	24.75
40	180	-40	0
65	180	-65	0
Total		-65.25	24.75

$\vec{F_R}$= 69.79 N
ϴ = -20.77°
The direction is = 180⁰ – 20.77⁰ = 159.23⁰

15.

F(N)	θ (⁰)	$F_x = F\cos\theta$ (N)	$F_y = F\sin\theta$ (N)
20	40	15.32	12.86
30	90	0	30
90	180	-90	0
10	0	10	0
Total		- 64.68	42.86

$\vec{F_R}$= 77.59 N
ϴ = -33.53°
The direction is = 180 - 33.53 = 146.47 °

16. x = 3.4615 m

17. x = 7.4564 m

18. x = 1.79m, F_R=23.03N

19. x = 10.25 m, F_R= 224.53N

20. Reaction Force, R_f = 112.94 N, $x = 8.54m$

Chapter 4: Work, Energy and Power

1.
- Renewable energy is energy produced using natural resources that are constantly replaced and never run out.
- A non-renewable energy is one that either does not regenerate or does not regenerate

2. Principle of conservation of energy stated that:
- Energy cannot be created or destroyed.
- Energy can be transformed from one form to another.
- Total energy in a system is always constant.

quickly enough to serve some human purpose in a sustainable way.

3.
   - Renewable energy: solar, wind, hydropower, biomass and geothermal.
   - Non-renewable energy: fossil fuels, such as coal, oil and natural gas.

4.
   - Energy is defined as capacity to do work.
   - SI unit for energy is Joule (J).

5.
   - Work is defined as force acting upon an object to cause a displacement in the direction of the applied force.
   - SI unit of work is Joule (J) or Nm.

6. 100J
7. 0.25m, 0.37J, 0.37J, 2.21ms-1,
   No, it cannot reach 0.3m on the other side because it is larger than initial height.
8. 10.85ms^{-1}, 6.26ms^{-1}
9. 9.81J, 34.34J
10. 156.96J, 12.53ms^{-1}, 4m
11. 9.81J
12. 400ms^{-1}
13. 29J
14. 333.33W
15. 3000J, 300W
16. 68.67%
17. 65.4%
18. 4333.33W
19. 0.225J, 9%
20. 15600N, 4727.27N

Chapter 5: Solid and Fluid

1. Solid
   - The volume is fixed
   - Vibration only

   Liquid
   - The volume is fixed
   - Vibration and rotation only

   Gases
   - The volume can change
   - Vibration, rotation and translation

   Or any related answer will be accepted

2.
   - Density is defined as the measurement in relative to "heaviness" of an object with a constant volume.
   - Density is the amount of mass (in grams) per unit of volume (in cubic centimeters).

   SI Unit : kg/m^3

3.
   - Pressure involves the concept of force and surface area
   - Pressure is defined as force per unit area.

   SI unit: Nm-^{2} @ Pa

4. Archimedes' Principle indicates that the upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces.
5. Upward buoyant force that is exerted on a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces.
   SI Unit: N
6. 1.875
7. 0.661
8. i. 800 kg/m^3
   ii. 0.8
9. 52.75kg/m^3
10. i. 152.9kg
    ii. 0.204m^3
    iii. 0.75
11. 312500 / 312.5k / 3.125 x 10^5 Pa @ Nm^{-2}
12. 20000 /20k / 2.0 x 10^4 Pa@ Nm^{-2}
13. 757822.5Pa
14. i. 1471.5 N
    ii. 0.1m
15. i. 54.45 N
    ii. 0.035 m
16. 47088N
17. i. 0.1 N
    ii. 0.26 N
18. 1715.25 @ 1.7153 x 10^3 kgm^{-3}
19. i. 7848 N
    ii. 63.77N
20. 2641.51kg/m^3

Chapter 6: Temperature and Heat

1. Heat is defined as the thermal energy transferred from one object to another due to their temperature difference.
   SI Unit:Joule, J.
2. Temperature is defined as degree of hotness and coldness of an object.
   SI Unit: Kelvin, K or Celsius, ^{o}C.
3. i. Heat Capacity is the amount of heat needed to raise 1^{o}C of temperature of substance.
   Unit: J / ^{o}C
   ii. Specific Heat Capacity is defined as the heat energy (Q) required to raise 1oC temperature (θ) of 1 kg mass (m) of substance.
   Unit: J / kg^{o}C
4. **Conduction** - Heat transferred from a hot object to cold object when there is physical contact between them. Touching Stove and being burned
   Convection - Heat is transferred via fluids (gas or liquid) from hot area to cold area. Hot air balloon
   Ray and Radiation - Heat transferred through radiation or ray. Microwave oven.

5. 30240J
6. 30.85°C
7. 507.14 $Jkg^{-1}°C^{-1}$
8. 0.095kg @ 95 g
9. 10.75 kg/m^3
10. 292880J
11. 154644J
12. 1.4kg
13. 1326.3$Jkg^{-1}°C$
14. 12.6kJ, 86g
15. 933.33$Jkg^{-1}°C^{-1}$
16. 52.43°C
17. 793.5J, 3967.5$Jkg^{-1}°C^{-1}$
18. 66.7°C
19. 60°C
20. 197100J, 758.0769 $Jkg^{-1}°C^{-1}$

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e ISBN 978-629-7638-42-3
9 786297 638423