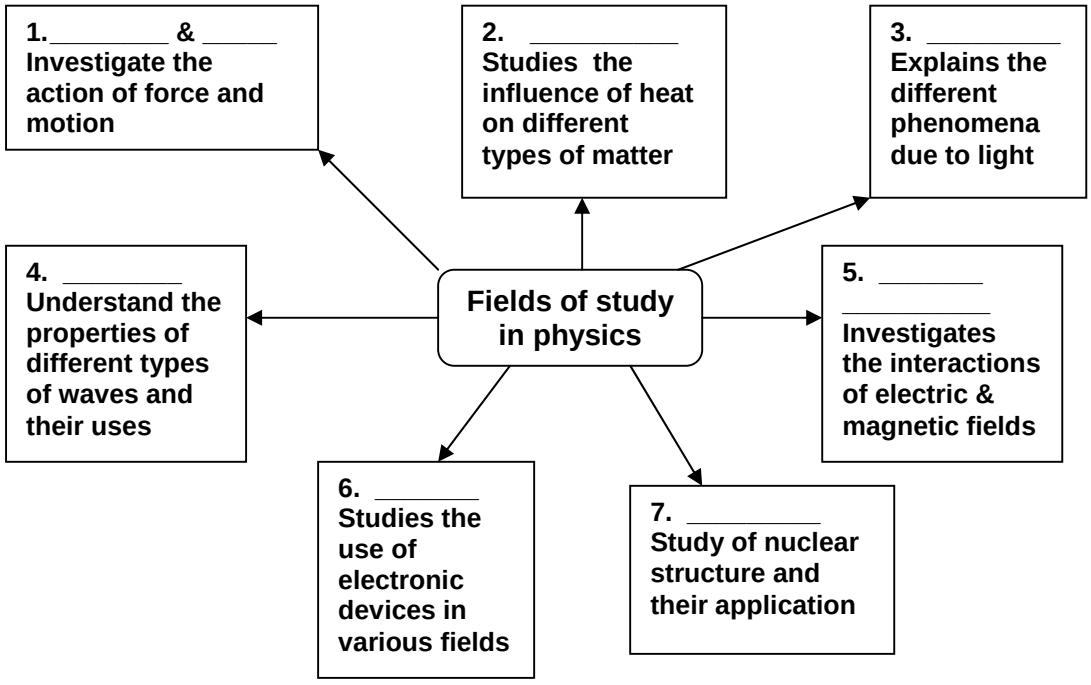
1.1 Understanding Physics

What is Physics?

Study of _____ phenomena and the properties of _____

Recognise the physics in every-day objects & in natural phenomena



Phenomena & Occurrence Around us	Field of study in physics
1. Car racing	
2. cooking in the kitchen	
3. rainbow in the sky	
4. Shadow on the ground	
5. Nuclear bomb	
6. Light bulb lights up during night	
7. communicating using mobile phone	
8. Memory chip in a computer	

1.2 Base Quantities & Derived Quantities

In learning physics, we need to carry out investigations. We gather information through observations and taking measurement. We measure many types of physical quantities

Physical Quantities is a physical characteristic that can be _____.

The value of the measurement consists of a numerical _____ and a _____

Examples : _____

All physical quantities can be classified into two groups :

1._____ 2. _____

What are base quantities?

Base quantities are quantities that cannot be _____ in terms of other base quantities.

List of 5 basic physical quantities and their units.

Base quantity	Symbol	S.I. Unit	Symbol for S.I. Unit
Length			
Mass			
Time			
Current			
Temperature			

What are derived quantities?

Derived quantity is one which obtained by _____ base quantities by multiplication, division or both these operations. Its unit is derived from a similar combination of the base units.

Determine the derived unit for the following derived quantities.

Derived quantity	Formula	Derived unit	Name of derived unit
area	area = length x width		
volume	volume = length x width x height		
density	$density = \frac{mass}{volume}$		

Derived quantity	Formula	Derived unit	Name of derived unit
velocity	$velocity = \frac{displacement}{time}$		
momentum	**momentum = mass x velocity**		
Acceleration	$acceleration = \frac{change\ in\ velocity}{time}$		
Force	**force = mass x acceleration**		
pressure	$pressure = \frac{force}{area}$		
weight	**weight = mass x gravitational acceleration**		
work	**work = force x displacement**		
power	$power = \frac{work}{time}$		
kinetic energy	$K.E = \frac{1}{2} \times mass \times velocity^2$		
potential energy	**P.E = mass x gravitational acceleration x height**		
charge	**charge = current x time**		
voltage	$\text{voltage} = \frac{\text{work}}{\text{charge}}$		
resistance	$resistance = \frac{voltage}{current}$		

Note that the physical quantities such as width, thickness, height, distance, displacement, perimeter, radius and diameter are equivalent to length.

<u>Exersise 1</u>

The extension of an elastic spring is directly proportional to the stretching force acting on it. It can be shown by the following formula:

$F \propto x$
$F = kx$ where F = the force (unit N)
k = spring constant
x = the extension (unit m)

Determine the value of the spring constant k.

Express quantities using standard form

The values of measurements which is either very large of very small are written in Standard Form so as to be neater, brief and easier to read.

Standard form = A x 10^n , 1 < A < 10 and n = integer

Exercise 2

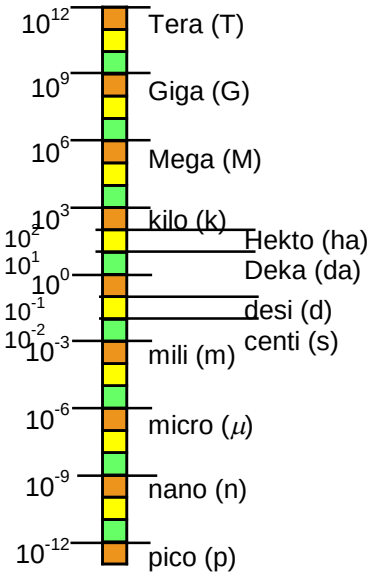
Write the following quantities in standard form :

a. **Radius of the earth = 6 370 000 m =……**
b. **Mass of an electron = 0.000 000 000 000 000 000 000 000 000 911 kg =……..**
c. **Size of a particle = 0.000 03 m = ……**
d. **Diameter of an atom = 0.000 000 072 m = ……..**
e. **Wavelength of light = 0.000 000 55 m = ……..**

Express quantities using prefixes

Prefix is used to simplify the expression of very big or very small numerical values of physical quantities.

The list of prefixes :



Prefix	Value	Standard form	Symbol
Tera	**1 000 000 000 000**		
Giga	**1 000 000 000**		
Mega	**1 000 000**		
Kilo	**1 000**		
Hekto	**100**		
Deka	**10**		
Deci	**0.1**		
Centi	**0.01**		
Mili	**0.001**		
Micro	**0.000 001**		
Nano	**0.000 000 001**		
Piko	**0.000 000 000 001**		

3. Complete the table below

1 Tm = _____ m	**1 m = _____ Tm**
1 Gm = _____ m	**1 m = _____ Gm**
1 Mm = _____ m	**1 m = _____ Mm**
1 km = _____ m	**1 m = _____ km**
1 hm = _____ m	**1 m = _____ hm**
1 cm = _____ m	**1 m = _____ cm**
1 mm = _____ m	**1 m = _____ mm**
1 μm = _____ m	**1 m = _____ μm**
1 nm = _____ m	**1 m = _____ nm**
1 pm = _____ m	**1 m = _____ pm**

4. Convert the measurement into SI unit and in standard form:

a. **Radio Melaka Frequency of radio wave = 102.3 MHz = _____**
b. **Diameter of the earth = 12 800 km = _____**
c. **Distance between the moon and the earth = 383 000 km = _____**
d. **Mass of the earth = 6 000 000 000 000 000 000 000 000 0000 g = _____**
e. **The height of Petronas Twin Towers is 452 000 mm = _____**
f. **The wavelength of a visible light is 0.00042 mm = _____**

4. Convert each of the following measurements into metre, m

(a) 2.98 Tm =

(b) 2.98 km =

(c) 2.98 μm =

(d) 2.98 x 10^{-1} Gm =

(e) 2.98 x 10^{-3} Mm =

(f) 2.98 x 10^{7} nm

(g) 2.98 x 10^{4} μm =

5. Convert

(a) **4 m^2 into the units of cm^2**

(b) 30 cm^2 into the units of m^2

(c) 2.5 m^2 to unit of mm^2

(d) 500 mm^2 into the units of m^2

(e) 200 m^3 into the units of mm^3

(f) 11.5 cm^3 into the units of m^3

(g) 72 km h^{-1} into the units of ms^{-1}

(h) 5 g cm^{-3} into the units of kg m^{-3}

6. **The table above shows the measurement of length for four different objects.**

Readings
7.2×10^5 µm , 7.2×10^{-2} cm 7.2×10^3 mm and 7.2×10^{-6} km

(a) Which reading is the longest ?

(b) Which reading is the shortest?

(c) Arrange the readings according descending order.

(d) Which reading is more than 1 metre?

(e) A cube of sides 7.2×10^3 mm . State the volume of the cube in unit of m^3

7. The pressure exerted by a box on a surface is 500 N cm^{-2}. What is the pressure in units of Pa? (1 Pa = 1 N m^{-2})

TUTORIAL 1.2

1. **Which of the following physical quantities is <u>not</u> a base quantity? (2006)**
   - **A. Weight**
   - **B. Time**
   - **C. Temperature**
   - **D. Electric current**

2. **Which physical quantity has the correct S.I unit? (2003)**

	Physical quantity	S.I unit
A	Temperature	Celcius
B	Time	Minute
C	Mass	Newton
D	Length	Metre

3. **30 miliseconds is equivalent to .(2003)**
   - **A. 3×10^{-6} seconds**
   - **B. 3×10^{-5} seconds**
   - **C. 3×10^{-4} seconds**
   - **D. 3×10^{-3} seconds**
   - **E. 3×10^{-2} seconds**

4. **Which of the following frequencies is the same as 106.8 MHz? (2004)**
   - **A. 1.068×10^{-4} Hz**
   - **B. 1.068×10^{-1} Hz**
   - **C. 1.068×10^{2} Hz**
   - **D. 1.068×10^{6} Hz**
   - **E. 1.068×10^{8} Hz**

5. **The product of 2.4×10^{-2} and 5.0×10^{-4} is**
   - **A 1.2×10^{6} B 1.2×10^{5}**
   - **C 1.2×10^{-5} D 1.2×10^{-7}**
   - **E 1.2×10^{-8}**

6. **What is 0.0455 kg expressed in standard form?**
   - **A 0.455×10^{-1} kg**
   - **B 4.55×10^{-2} kg**
   - **C 45.5×10^{-3} kg**
   - **D 455×10^{-4} kg**

7. **The prefixes according to their value in ascending order are**
   - **A Giga,mega,kilo,centi**
   - **B Mikro,mili,centi,kilo**
   - **C Mega,giga,kilo,centi**
   - **D Centi,giga,mikro,mili**

8. **Which one of the following measurements is different?**
   - **A 2.3×10^{2} m**
   - **B 2.3×10^{4} cm**
   - **C 2.3×10^{6} mm**

9. **Which one of the following measurements is smallest ?**
   - **A 1.5×10^{2} kg**
   - **B 1.5×10^{7} g**
   - **C 1.5×10^{12} µ g**

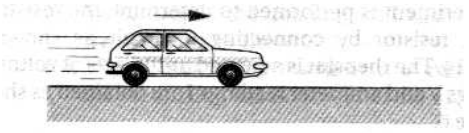
10. **The volume of a metal sphere is 12 cm^3. This volume in units of m^3 is**
    - **A 1.2×10^{-2} B 1.2×10^{-3}**
    - **C 1.2×10^{-5} D 1.2×10^{-7}**
    - **E 1.2×10^{-9}**

11. **The velocity of a car is 108 km h^{-1}. What is the velocity in units of ms^{-1} ?**
    - **A 20 B 30**
    - **C 50 D 60**
    - **E 90**

12. **The acceleration of a trolley is 2000 cm s^{-2}. This acceleration in S.I. unit is**
    - **A 0.002 B 0.02**
    - **C 0.2 D 2**
    - **E 20**

13. **Which one of the following prefixes is less then 1?**
    - **A Mega**
    - **B Desi**
    - **C Kilo**

14. **A car moves with an average speed of 75 km h^{-1} from town P to town Q in 2 hours as shown in Figure 1. By using this information, you may calculate the distance between the two towns.**



P **Q**

Figure 1

(a) (i) Based on the statements given, state two basic quantities and their respective SI units.

_____

_____

(ii) State a derived quantity and its SI unit.

_____

(b) Convert the value 75 km/hr to SI unit.

1.3 Scalar and Vector Quantities

Define Scalar & Vector quantities

Scalar quantities are quantities that have magnitude but no direction.

Vector quantities are quantities that have magnitude and direction.

Study the following description of events carefully and then decide which events require magnitude, direction or both to specify them.

Description of events	Magnitude	Direction
1. Walk 500 m and you'll find the shop		
2. Walk 500 m left from the junction and you'll find the shop.		
3. The temperature in the room is 25 ^{0}C		
4. The location of Ayer Hitam is 60 km to the north-west of Johor Bahru		
5. The power of the electric bulb is 80 W		
6. A car is travelling at 80 km/hr from Johor Bahru to Kuala Lumpur		

Give examples of scalar and vector quantities

Scalar Quantities	Vector Quantities

Given the formula: Acceleration = $\frac{\text{Final velocity – Initial velocity}}{\text{Time taken}}$

From the above formula:

Scalar quantities : _____

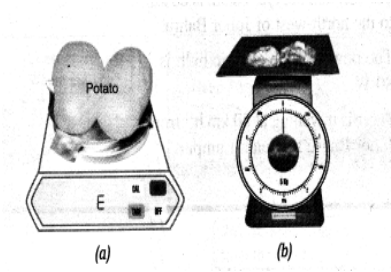
Vector quantities : _____

1.4 Measurements

Measure physical quantities using appropriate instruments

Two potatoes are put on the digital balance but the balance does not show any reading. Instead, it shows "E".

"E" stands for error.
The digital balances indicates "E" because the potatoes are too _____ and their weight is beyond the maximum capacity of the balance.



When dried mushrooms are place on an ordinary weighing scale, the pointer shows "0", Why?

The weighing scale shows zero reading because the dried mushrooms are too _____ for the scale to response.

When we measure a physical quantity, we need to consider its magnitude and then choose a suitable instrument. The magnitude of the quantity should not exceed the maximum capacity of the instrument, and the instrument must be sensitive enough to detect and give meaningful measurement of the quantity.

Activity 1

Carry out Hands-on Activity 1.1 on page 1 of the practical book and record your observation in the table.

Physical Quantities	Instrument	Readings
The length of the laboratory table		
The length of a book		
The diameter of beaker		
The diameter of a copper wire		
The volume of water in a beaker		
The volume of water in a spoon		
The time for 10 pulses of your heartbeat		
The time taken to walk around the laboratory twice		

1. **What criteria do you consider when you choose an instrument to measure a quantity?**

2. **Suggest a suitable instrument when measuring the following quantities.**
   - **(a) The mass of a wooden block**
   - **(b) The current that flows in a circuit**
   - **(c) The voltage of a battery**

Explain Accuracy, Consistency

Consistency **is the degree of uniformity of the measurements.**

OR

Consistency **is the degree of a measuring instrument to record consistent reading for each measurement by the same way.**

When we say the measurements are consistent, we mean that all the values of the measurements are close together.

Accuracy **is the degree of closeness of the measurements to the actual or accepted value.**

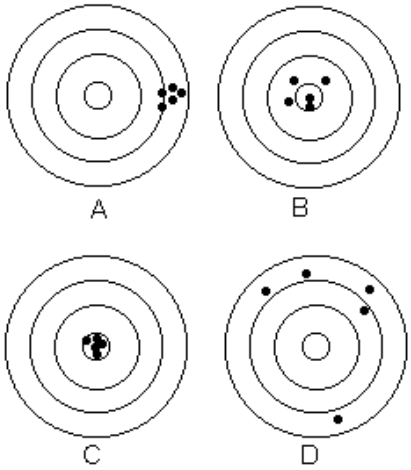
When we say the measurements are accurate, we are actually saying that the values of the measurements are close to the true or accepeted value.

Activity 2

The diagram shows the result for four shooters A, B , C and D in a tournament. Every shooters shot five times .

The table shows the conclusion . Write either high / low.

Shooter	Consistency	Accuracy
A		
B		
C		
D		



Explain Sensitivity

Sensitivity **of an instrument is the ability to detect a small change in the quantity to be measured.**

The smallest scale division on the measuring instruments shows the sensitivity of the instruments. Thus the more sensitive the measuring instruments the smaller the scale divisions.

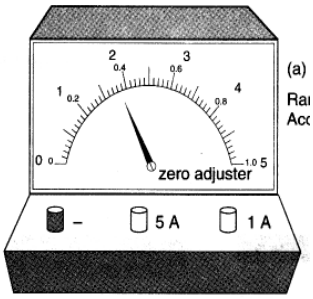
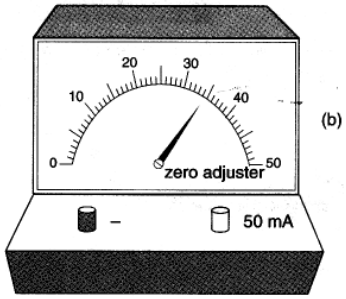
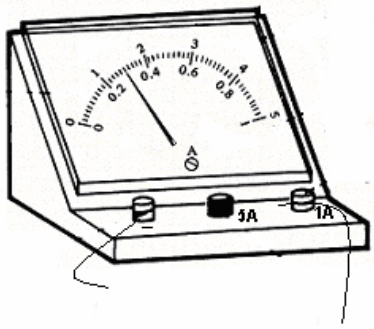
A vernier calipers is more sensitive than a ruler or a miliammeter is more sensitive than an ammeter. A sensitive instrument is not always an accurate instrument.

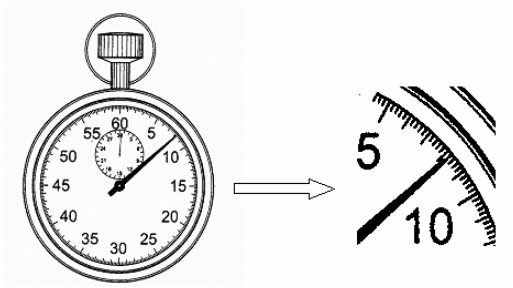
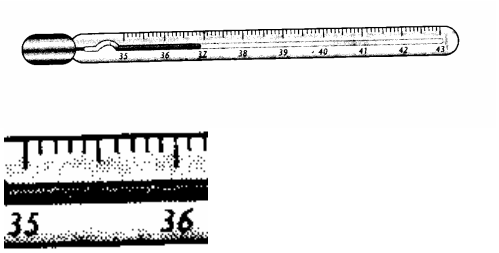
Carry out Hands-on Activity 1.2 on page 2 in the practical book.

The sensitivity of measuring instrument for length

Measuring instrument	Smallest division (cm)	Sensitivity low / moderate /high
Ruler		
Vernier Calipers		
Micrometer Screw gauge		

The sensitivity of different types of ammeter.

 **Double-scale ammeter** **Range : 0 – 1 A / 0 – 5 A**	 **Milliammeter** **Range : 0 – 50 mA**	 **Double scale ammeter** **Accuracy / sensitivity of upper scale : _____** **Accuracy / sensitivity of lower scale : _____** **Reading : _____**
What is the Accuracy / Sensitivity (smallest division)?	**What is the Accuracy / Sensitivity (smallest division)?**	
Which is more sensitive? Why?		

measuring time  **sensitivity : _____** **Reading : _____**	**Measurement Temperature**  **Sensitivity: _____.**

<u>Exercise 1</u>:
Minah, Mary and Malika were asked to measure the diameter of a test tube in the laboratory. The actual diameter of the test tube is 2.75 cm. Each of them measured the diameter three times at three different places on the test tube. Their measurements are shown in the table.

Student	Diameter , d / cm		
Mary	2.69	2.67	2.68
Malika	2.83	2.91	2.85
Minah	2.74	2.76	2.75

(a) What instrument was used to measure the diameter of the test tube? _____

(b) What instrument should we use to get more accurate readings?

_____

<u>Exercise 2</u>:
Group A and group B do an experiment to measure the period of a simple pendulum five times and the results are shown in the table.
State which group's measurements are more consistent and explain why.

Group A	Group B
Reading 1 = 14.01 s	Reading 1 = 14.37 s
Reading 2 = 13.15 s	Reading 2 = 14.15 s
Reading 3 = 14.36 s	Reading 3 = 14.36 s
Reading 4 = 12.99 s	Reading 4 = 14.29 s
Reading 5 = 15.34 s	Reading 5 = 14.34 s

Explain types of experimental error and use appropriate techniques to reduce errors

Any measurement of a physical quantity has <u>errors</u> or uncertainty.
There are two types of errors.
(a) Systematic errors (b) Random errors

<u>Systematic errors</u>

Systematic errors are errors in the measurement of a physical quantity due to instruments, the effects of surrounding conditions and physical constraints of the observer.

Sources of systematic errors are:

(i) <u>Zero errors</u> or <u>end errors</u>
Zero errors occurs when the instrument gives a non- zero reading when in fact the actual reading is zero.
It can be <u>corrected</u> by adjusting the zero adjuster on the instrument or by subtracting zero error from any reading taken from the instrument.

(ii) <u>Personal error</u> of the observer.
Physical constraints or limitations of the observer can cause systematic errors.
An example is the reaction time.

Systematic errors can be eliminated or reduced by improving the procedure of taking the measurements , using a different instrument or getting somebody else to make the measurements.

<u>Random errors</u>

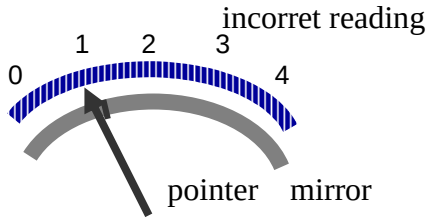
The main source of random error is due to the carelessness of the observer when making a measurement.

Examples of random errors are:
(i) <u>Parallax errors</u> – occur when the position of the eye is not perpendicular to the scale.
(ii) Different pressures are applied when closing the gap of the micrometer screw gauge when it is used to measure the diameter of a wire.
(iii) Changes in the temperature during an experiment.
(iv) Recording the wrong reading.
(v) Mistake in counting

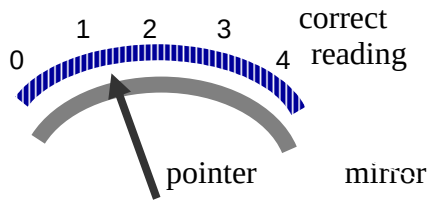
To eliminate or reduce random errors , repeated reading are taken.
<u>To avoid parallax errors</u>:
(a) The position of the eye must be perpendicular to the plane of the scale. To overcome parallax errors in instruments with a scale and pointer, e.g. an ammeter often have a mirror behind the pointer. The correct reading is obtained by making sure that the eye is exactly in front of the pointer, so that the reflection of the pointer in the mirror is behind it.

<u>Sample of measuring instruments</u> :

1 Ammeter : is used to measure _____

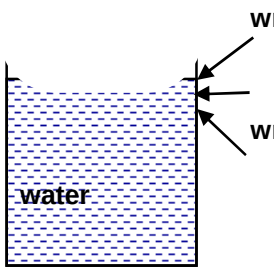


Pointer's image can be seen

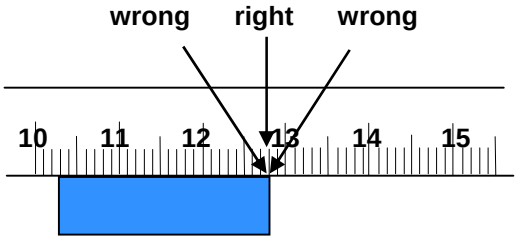


Pointer's image is behind the pointer

2.Measuring cylinder : is used to measure_____



3. Ruler : is used to measure _____



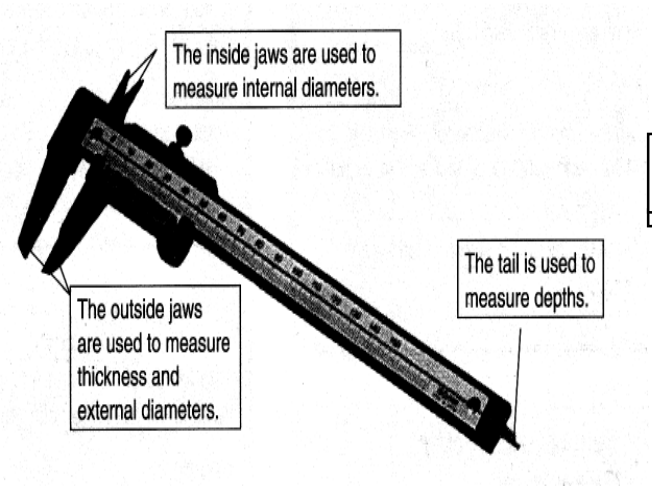
Reading = …… cm

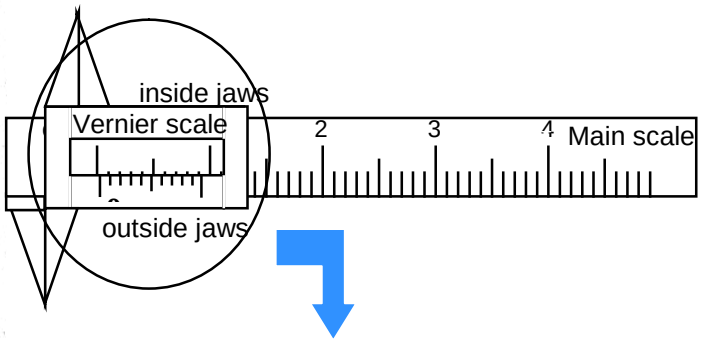
4. Vernier calliper

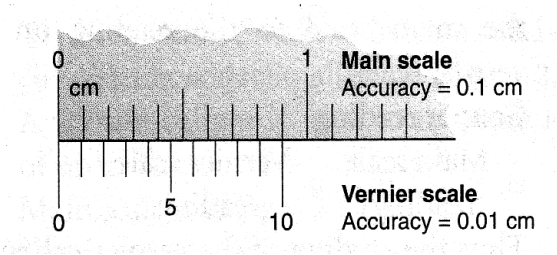
A venier calliper is used to measure :

a. _____ **b.** _____

A vernier calliper gives readings to an accuracy of _____ **cm.**







1 cm on main scale is divided into 10 divisions.

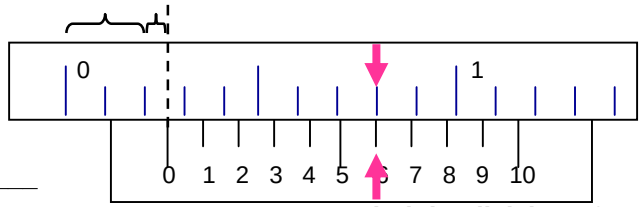
Length of 1 division on main scale = _____ **cm**

Length of vernier scale = _____ **cm**

Vernier scale is divided into 10 divisions

Length of 1 divisions on vernier scale = _____ **cm**

The differenct between the main scale and vernier scale is = _____ **cm**



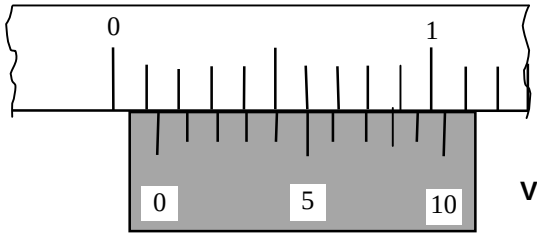
Main scale = _____

Vernier scale = _____

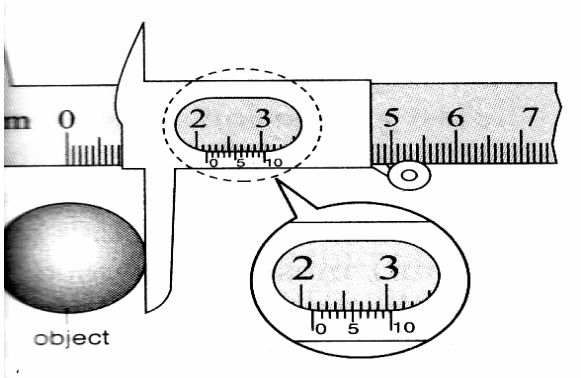
Final reading = _____

Find the division of vernier scale which is coincides with any part of the main scale

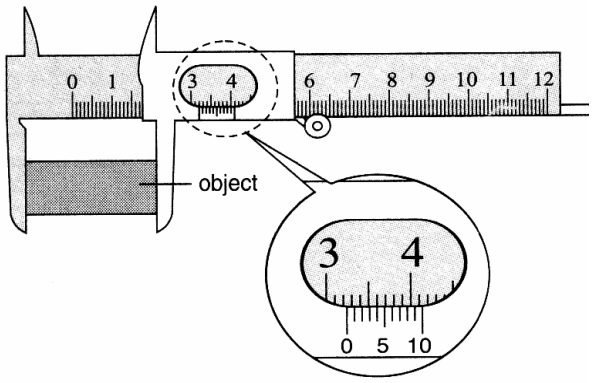
The diagram below shows a vernier calliper with reading.



Vernier calliper reading = _____ cm

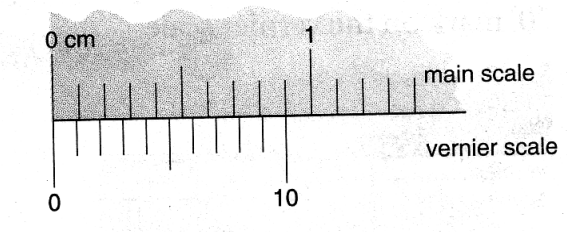


Vernier calliper reading = _____

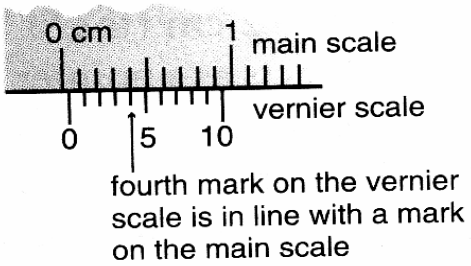


Vernier calliper reading = _____

<u>No Zero error:</u>



<u>Positive zero error:</u>



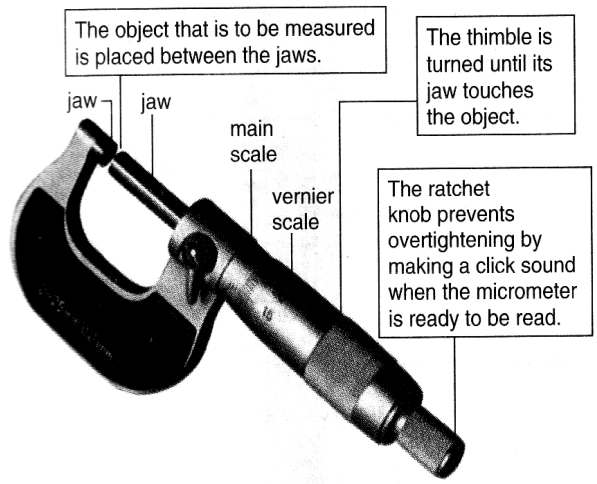
Zero error = _____ cm

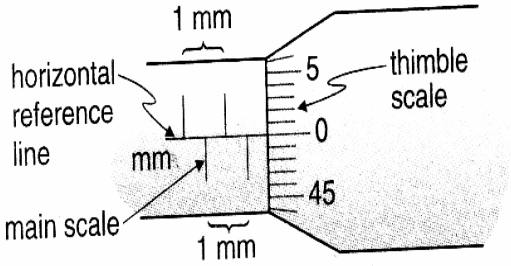
Correct reading = observed reading – zero error

5. Micrometer screw gauge.

A micrometer screw gauge is used to measure :

a. _____ **b.** _____

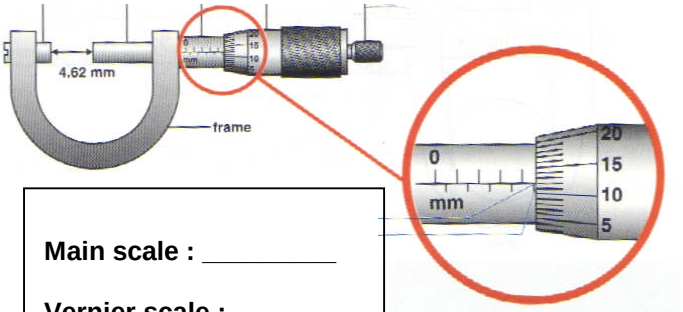




One complete turn of the thimble (50 division) moves the spindle by 0.50 mm.
Division of thimble
= _____

= _____

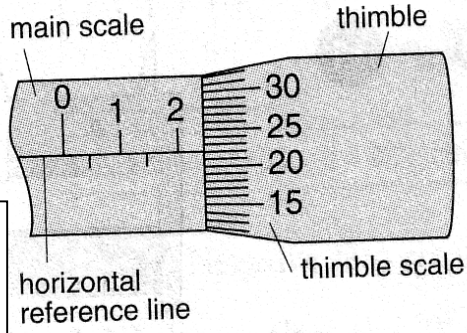
A accuracy of micrometer screw gauge = _____



Main scale : _____

Vernier scale : _____

Total reading : _____

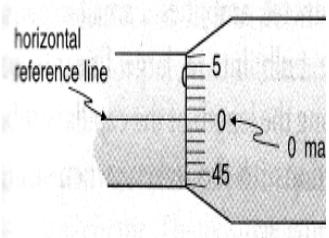


Main scale : _____

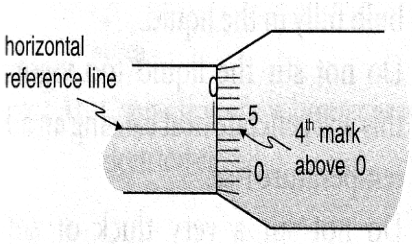
Vernier scale : _____

Total reading : _____

No zero error

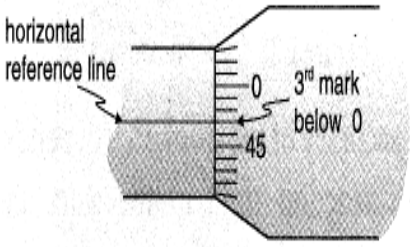


Positive zero error



Zero error = _____

Negative zero error

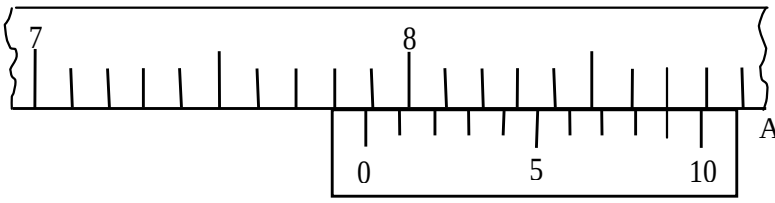


Zero error = _____

Exercise: Vernier Callipers And Micrometer Screw Gauge

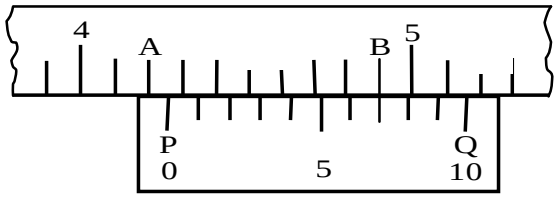
1. Write down the readings shown by the following

(a)



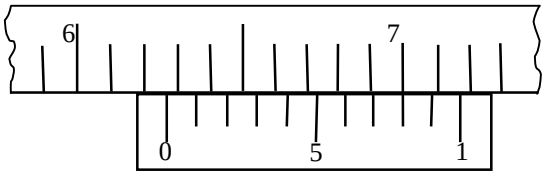
Answer: _____

(b)



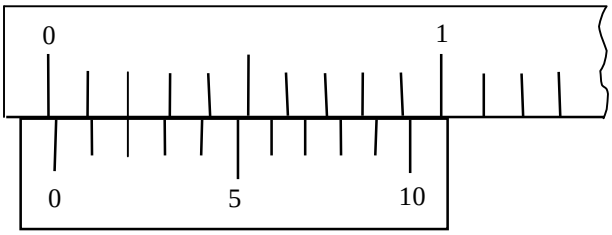
Answer:: _____

(c)



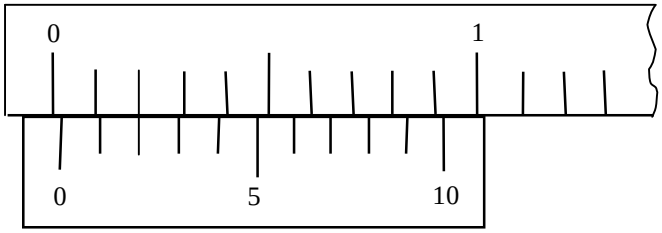
Answer:

(d)



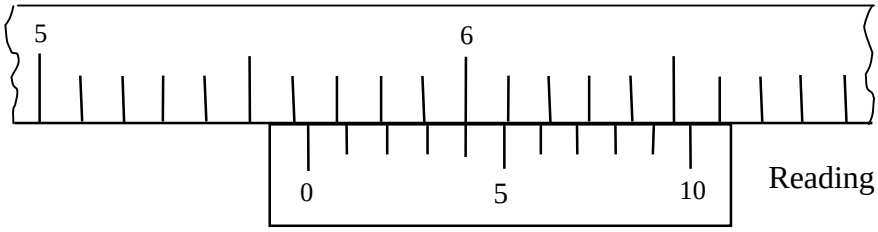
Answer:

2. (a) The following diagram shows the scale of a vernier calliper when the jaws are closed.



Zero error = _____ cm

(b). The following diagram shows the scale of the same vernier calliper when there are 40 pieces of cardboard between the jaws.

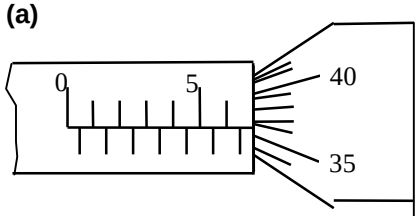


Reading shown = _____ cm

Corrected reading = _____ cm

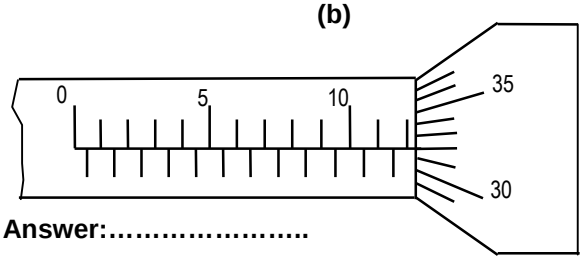
3. Write down the readings shown by the following micrometer screw gauges.

(a)



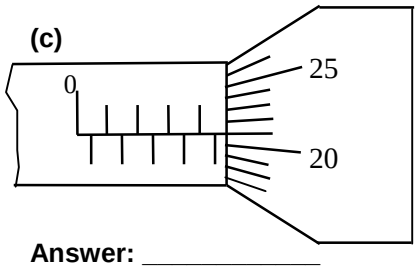
Answer: ……

(b)



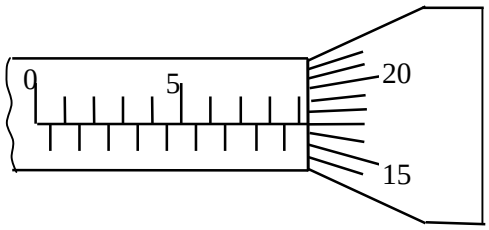
Answer:……

(c)



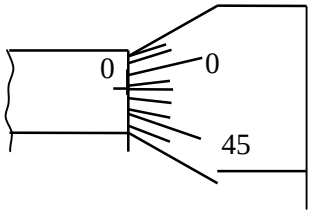
Answer: _____

(d)

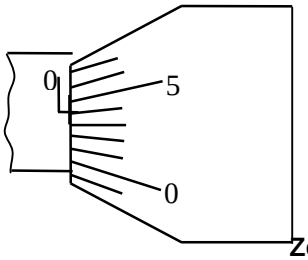


Answer: _____

4. (a) Determine the readings of the following micrometer screw gauges.

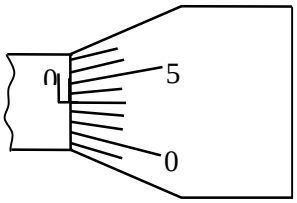


Zero error = _____

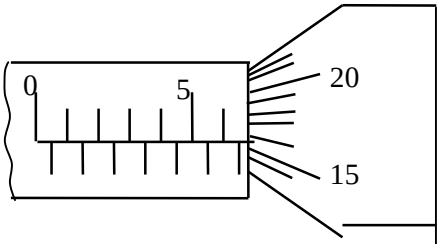


Zero error = _____

(b) Determine the readings of the following micrometer screw gauges.



Zero error = _____

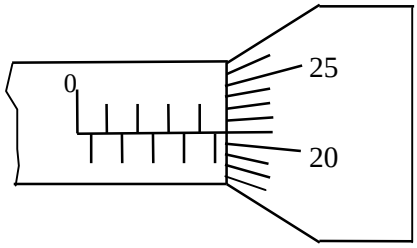


Reading shown = _____

Corrected reading = _____

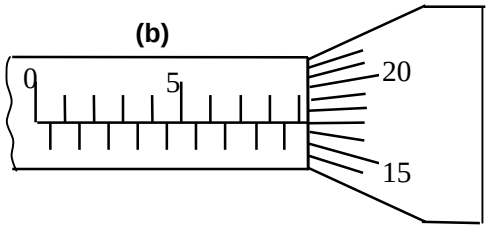
5. Write down the readings shown by the following micrometer screw gauges.

(a)



Answer: _____

(b)



Answer: _____

TUTORIAL 1.3

1. **The ability of an instrument gives consistent reading , when repeated readings are taken is called as**
   A accuracy B precision
   C sensitivity D error

2. **Which of the following should be the small value ,so that the precision becomes high?**
   A Actual value B Mean
   C Relative error D Relative deviation

3. **The ability of an instrument to detect a slight change that occurs in the measured quantity is called as**
   A precision B accuracy
   C sensitivity D error

4. **The accuracy of an instrument increases if**
   A the number of significant figures increases
   B the relative deviation relative increases
   C the relative error increases

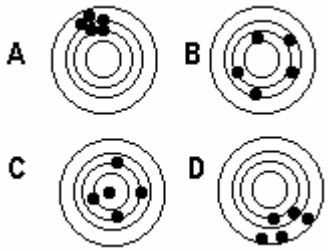
5. **Based on the table below, what are the measuring instruments J, K and L?**

Measuring instruments	Measurement
J	2.52 ±0.01 cm
K	15.2±0.1 cm
L	125.4±0.1 g

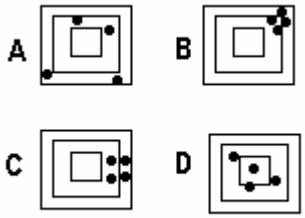
	J	K	L
A	Micrometer screw gauge	Vernier calipers	Spring balance
B	Micrometer Screw gauge	Vernier calipers	Triple beam balance
C	Vernier calipers	Metre ruler	Triple beam balance

6. **Which of the following is true?**
   A The parallax error is not effected to the accuracy
   B The accurate instrument is also the sensitive instrument
   C The accuracy increases when the measurement nearest to actual value.

7. **A, B, C and D show the shooting marks on a target. Which marks can explain the concept of precision of a measurement? (2005)**



8. **Which of the following is most likely to show an accurate shooting but not so presicely?**



9. **The following table shows the readings measured by using different measuring instruments X, Y dan Z.**

Measuring instrument	Reading / mm
X	2.38
Y	52
Z	6.5

Which of the following is true?

	X	Y	Z
A	Ruler	Vernier calipers	mikrometer screw gauge
B	Vernier calipers	Mikrometer screw gauge	Measuring tape
C	Measuring Tape	Ruler	Vernier calipers
D	Mikrometer Screw gauge	Ruler	Vernier Calipers

10. **Table shows readings of the thickness of a book measured by four different students. Which of the students recorded the true readings.**

	Student	Ruler / cm	Vernier calipers / cm	Mikrometer screw gauge /cm
A	W	2.17	2.2	2.174
B	X	2.174	2.2	2.17
C	Y	2.17	2.174	2.2
D	Z	2.2	2.17	2.174

11. Which comparison is correct about the sensitivity of the vernier calipers and the metre rule when measuring the thickness of a wire? (2004)

	Vernier calipers	Metre rule
A	Low sensitivity	Low sensitivity
B	Low sensitivity	High sensitivity
C	High sensitivity	Low sensitivity
D	High sensitivity	High sensitivity

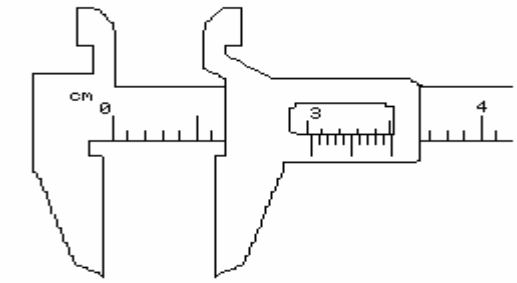
12. Which of the following accuracy of the measuring instruments is true?

	Measuring instruments	Accuracy
A	Ruler	1 mm
B	Vernier calipers	0.001 cm
C	Mikrometer screw gauge	0.1 mm

13. The focal length of a convex lens is 12 cm. If the focal length is measured by using a ruler, the reading recorded ought to be

A 11.9 cm B 12.0 cm
C 12.00 cm D 12.1 cm

14. The following diagram shows a vernier calipers.



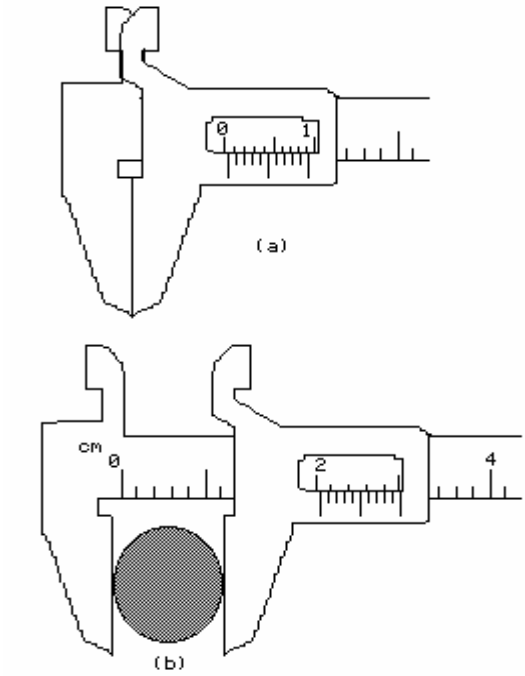
What is the reading of the vernier calipers ?

A 3.17 cm B 3.08 cm
C 2.18 cm C 2.07 cm

15. The thickness of a paper is measured by using a micrometer screw gauge should be recorded as

A 2 mm B 2.1 mm
C 2.14 mm D 2.142 mm

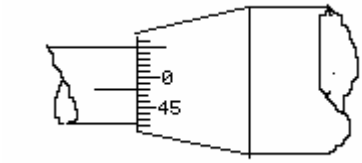
16. Figure(a) shows the existence of zero error of a vernier calipers. Figure(b) shows the reading of the vernier calipers for diameter of metal sphere.



The actual reading of diameter of the metal sphere is

A 2.02 cm B 2.04 cm
C 2.06 cm D 2.08 cm

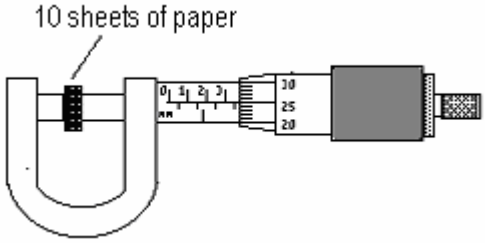
17. Diagram shows a micrometer screw gauge reading when it is closed at its gap.



The subsequent readings must be corrected by

A adding 0.02 mm
B subtracting 0.02 mm
C adding 0.03 mm
D subtracting 0.03 mm

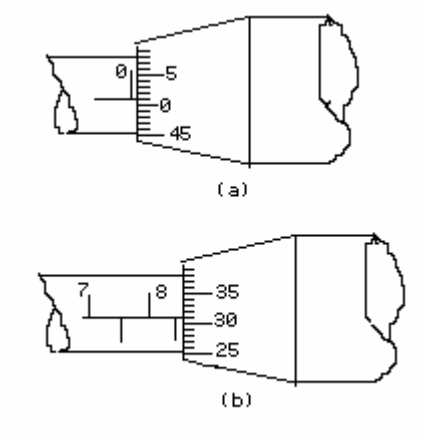
18.



Based on the diagram above, the thickness of a sheet of paper is

A 3.25 cm B 3.75 cm
C 0.325 cm D 0.0375 cm

19. Figure(a) shows the existence of zero error of a micrometer screw gauge. Figure(b) shows the reading of the micrometer screw gauge for diameter of metal wire.



The actual reading of diameter of the metal wire is

A 8.30 mm B 8.32 mm
C 8.80 mm D 8.82 mm

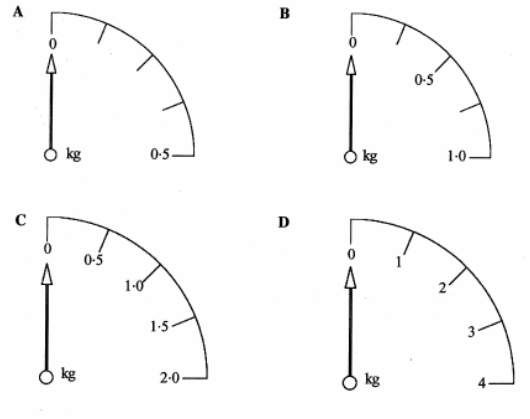
20. Which of the following will increase the sensitivity of a mercury-in-glass thermometer/

	Glass stem wall	Capillary tube	Size of bore
A	thick	wide	big
B	thin	narrow	big
C	thick	wide	small
D	thin	narrow	small

21. The current flows through a metal conductor is between 0.01 A to 0.05 A. Which ammeter is most suitable to use?

A Ammeter range 0-1A
B Ammeter range 0-5A
C Ammeter range 0-10 mA
D Ammeter range 0-50 mA

22. A,B, C and D show parts of four different balance scales. Which balance is the most sensitive? (2007)



Structure Question

1. Figure 2.1 and Figure 2.2 show two methods used by a student to measure the width of a piece of paper.

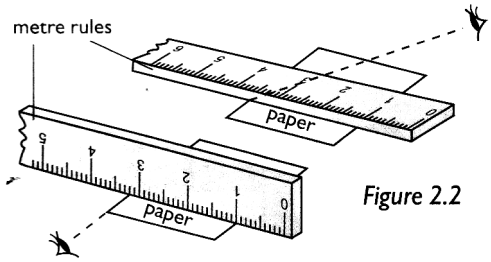


Figure 2.2

Figure 2.1

(a) State the SI unit of the width of the paper.

_____

(b) Why are the measurements not taken from the zero marks?

_____

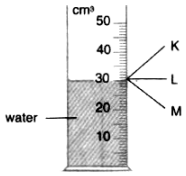
(c) Which method gives a more accurate measurement?

_____

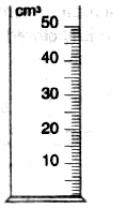
(d) Name the error made when the method shown in Figure 2.2 is used.

_____

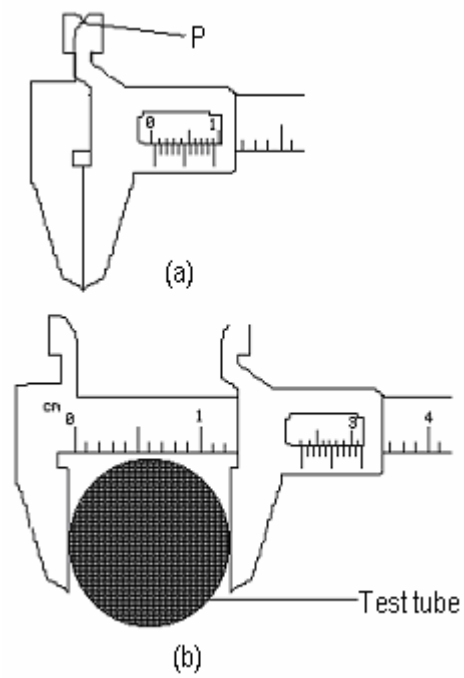
2. Figure 3 shows the meniscus of water in a measuring cylinder K, L, and M are three eye positions while measuring the volume of the water.



(a) (i) Which of the eye positions is correct while taking the reading of the volume of water?



(b) The water in the measuring cylinder is replaced with 30 cm^3 of mercury.In Figure 4, draw the meniscus of the mercury in the measuring cylinder.



3. Figure(a) shows the jaws of a vernier calipers without tigh any object. Figure(b) shows the jaws of the vernier calipers tigh a test tube.

(a) What is the function of P?

_____

(b) What is the smallest division on the vernier scale?

_____

(c) State the diameter of the test tube in metre.

_____

4.

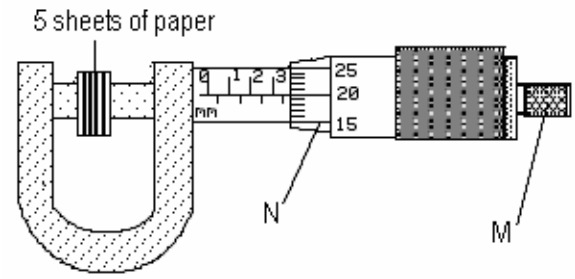


Diagram above shows the reading of a mikrometer screw gauge for the thickness of 5 sheets of paper.

(a) What is the number of revolution of the N scale .

(b) Determine the thickness of a sheet of the paper in cm.

(c) Give the name and the function of M.

_____

_____

(d) State a precaution to be taken while taking measurements by using the micrometer screw gauge.

_____

_____

5.

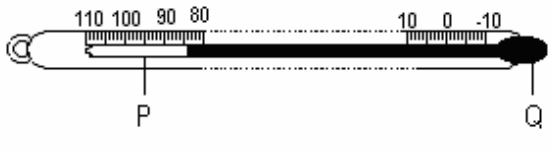


Diagram above shows a thermometer.

(a) Name component

(i) P: _____

(ii) Q : _____

(b) State the accuracy of the thermometer.

_____

(c) What is the reading of the thermometer?

_____

(d) Why does the glass stem wall of the thermometer is thin?

_____

(e) How should you do to increase the accuracy of the thermometer.

_____

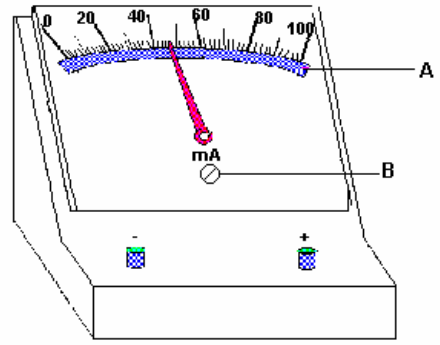
(f) Why does the thermometer use mercury?

_____

_____

(g) Draw a dotted line to show the correct position of eye in the above diagram while measuring the temperature of a substance.

6. Diagram shows a miliammeter.



(a) Give the name and the function of component of

(i) A : _____

_____

(ii) B : _____

_____

(b) State the accuracy of the ammeter

(c) State the reading of the ammeter.

(d) State two precautions to be taken while taking measurements by using the ammeter.

_____

_____

7. Diagram (a) shows the scale of a micrometer screw gauge before being used to measure an object. Diagram (b) shows the scale of an ammeter without any current flowing through it.

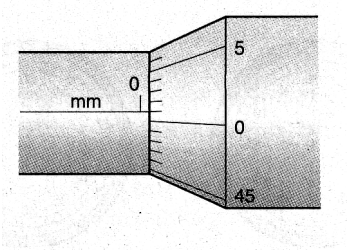


Diagram (a)

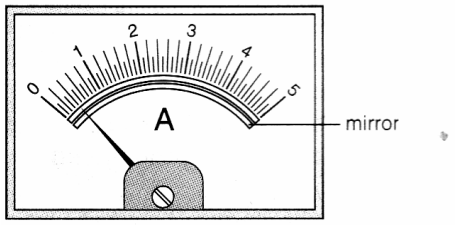


Diagram (b)

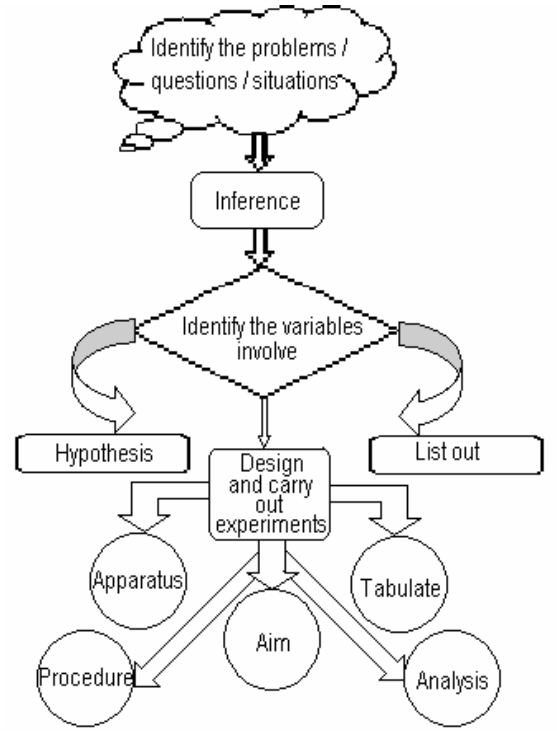
(a) What is meant by sensitivity?

(b) Observe Diagram (a) and (b), and compare the readings shown by the two instruments. Relate the readings shown by the two instruments so that a conclusion can be drawn based on a related concept of physics.

[5 marks]

1.5 Scientific Investigation

When physicists observe a particular physical phenomenon they will as questions as to how or why it happens . Ahypothesis will be put forth and experiments or scientific investigations will be carried out to prove or disprove the hypothesis. If the experiments bear out the hypothesis, the hypothesis may come to regarded as theory or law of nature. If the don't the hypothesis will be rejected or modified.
In any experiment , the report on the experiment will be based on these guidelines and follows a sequence as shown in the following flow chart:



<u>Inference</u>
Early assessment that is carried out to answer the questions raised.

The inference should be written as :
…….depend on……
Or
The ……..changes as the ……..changes

<u>Hypothesis</u>
A general statement about the relationship between a manipulated variable and a responding variable.

The hypothesis should be written as :
The greater the……., the greater the…….Or The bigger the……., the smaller the…..

<u>Manipulated variable</u>
The quantity whose values we deliberately choose to change or a primary variable which causes other secondary variable to change.

<u>Responding variable</u>
The quantity whose value depend on the manipulated variable or a secondary variable which changes in response to the change in the manipulated variable.

<u>Fixed variable</u>
The quantity whose value is kept constant throughout the experiment.

<u>Aim</u>
A statement to show the investigation of the variables involve.
The aim of the experiment should be written as:
To investigate the relationship between ……..and ……..

<u>Apparatus</u>
List the apparatus and materials used so that at least a set of data for manipulated and responding variables can be determined.
State the arrangement of the apparatus that can function by drawing a labeling diagram .

Procedure

State the method of controlling the manipulated variables
State the method of measuring the responding variables
Repeat the experiments at least four times.

Tabulating the data

Record the data in the following table

Manipulated variable/unit Velocity, v/ ms^{-1}	Responding variable/ unit Time, t / s

The data shown in the table must be consistent in the number of decimal places in accordance with the respective measuring instruments.
For example,

Length, l / cm	Time , t /s
0	12.8
2	25.6
4	39.4
6	52.2
8	75.0

If the data too small or too big use the standard form number.
For example

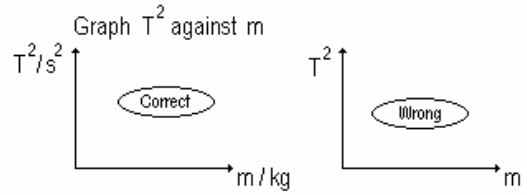
Temperature θ /^oC	10	20	30	40	50
Density, ρ / kg m^{-3} x 10^4	9.7	8.5	7.3	6.6	5.1

Analyzing the data

Plot a graph of (Responding variable) against (Manipulated variable)

How to plot the graph ?

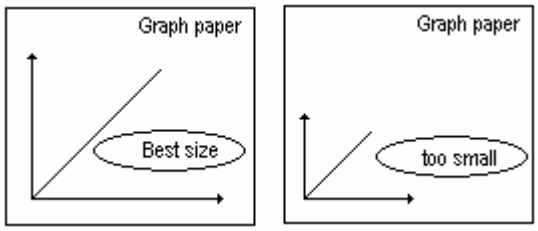
The title of the graph must be shown.
The axes of the graph must be labeled with the unit used.
For example:



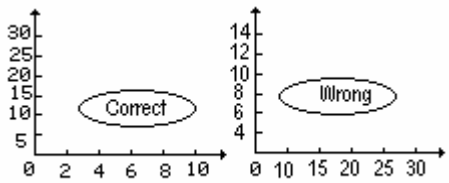
The scale chosen must be easy to use.
Scales such 1:1 , 1:2 , 1:5 ,1:10 ,1:100 are proffered in plotting a graph.
Odd scales such as 1:3 , 1:4, 1: 6, 1:7, 1: 30 should be avoided in plotting a graph.

Make sure the area covered by the plotted points must not be less than 50% of the area of the graph paper.

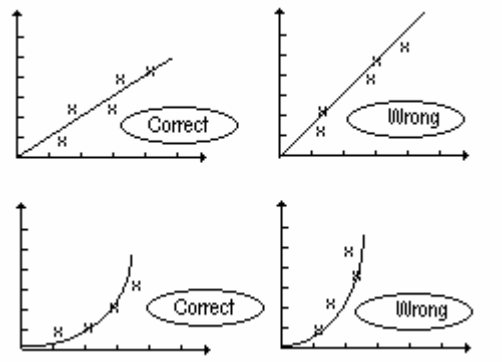
For example:



The scale on the axes must be uniform and clearly marked with value.
For example:



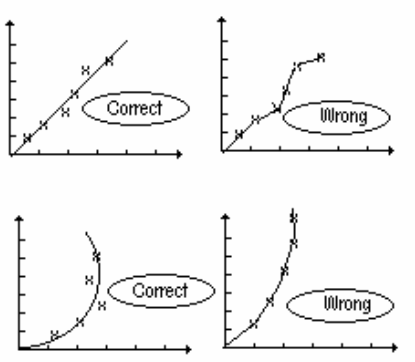
The best straight line or the best curve graph must be drawn.
The best straight line or the best curve graph is the line that passes through most of the points plotted such that it is balanced by the number of points above and below the line.
The line also must smooth.



All the points are marked with a symbol such as a cross or circle and the centre of the cross must accurately positioned.

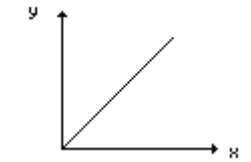
(×) or ⊙

It is not advisable to plot graph by joining point to point because the graph obtained is not smooth.

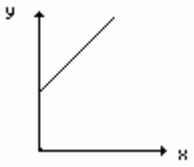


How to analyze the data ?

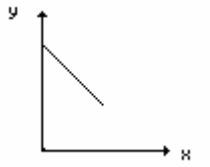
(a) Determine the relationship between two variables.



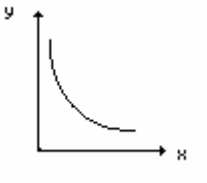
y is directly proportional to x.
or $y \propto x$
or $y = mx$
m = gradient



y increases linearly with x
or $y = mx + c$
m = gradient
c = intercept on axis-y

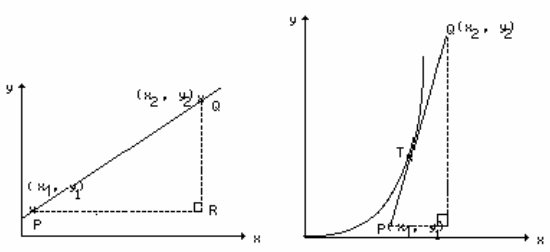


y decreases linearly with x
or $y = -mx + c$
m = gradient
c = intercept on axis-y



y is inversely proportional to x
or $y \propto \frac{1}{x}$ or $y = \frac{k}{x}$
k = constant

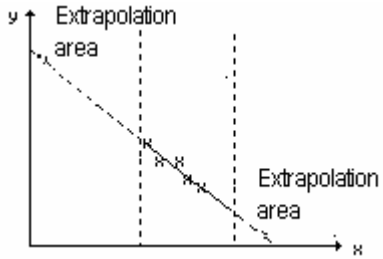
(b)Determine the gradient of the graph
Example



Draw a sufficiently large triangle to calculate the gradient of the graph.
State value of the gradient with correct unit.
The gradient of the graph is

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{QR}{QR}$$

(c) Determine the certain values from the graph.
Certain important values can be obtained from the graph plotted by drawing a horizontal line or by extrapolating the graph.

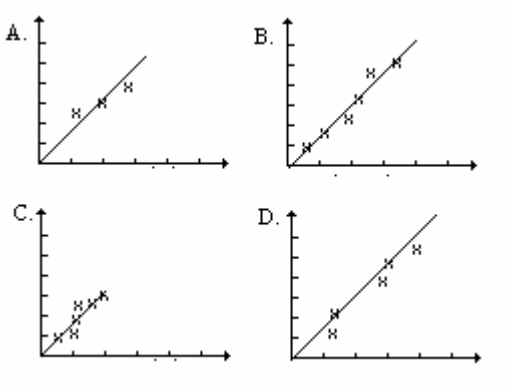


(d) State the precautions should be taken

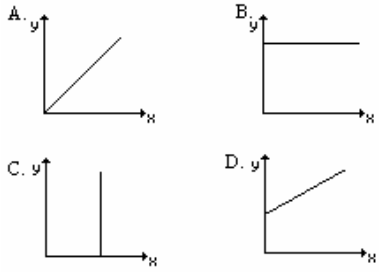
Carry out Experiment 1.1 on page 4 of the practical book and write a report.

TUTORIAL 1.3

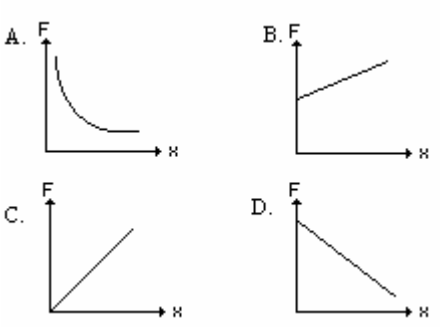
1. Which of the following is the best graph ?



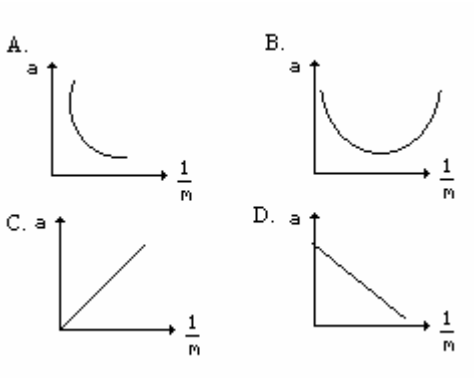
2. Which of the following graphs show that y increases linearly with x?

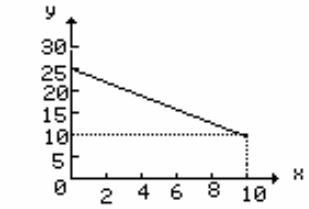


3. Hooke's law states that applied force *F* is directly proportional to the extension *x* of spring if its elastic limit is not exceeded. Which of the following graphs shows the Hooke's Law?



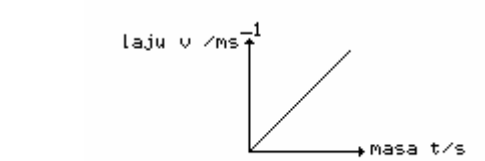
4. The acceleration, a of an object is inversely proportional to the mass, m of the object under constant force.
Which of the following graphs describes the relationship between a and m .





5. Based on the graph above, what is the gradient of the graph?

A - 1.5 **B - 0.7**
C 0.7 **D 1.0**
E 1.5



6. What is the unit of the gradient of the graph above?

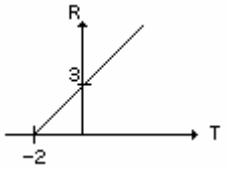
A m **B $m^2 s$**
C ms^2 **D ms^{-2}**

7. A student plot a graph for a physical quantity , Q on axis-y against a physical quantity ,R on axis –x
The relationship between Q and R is given by as Q - aR = b , where a and b are constants. The gradient of the graph is

A $\frac{a}{b}$ **B $\frac{R}{Q}$**

C b **D a**

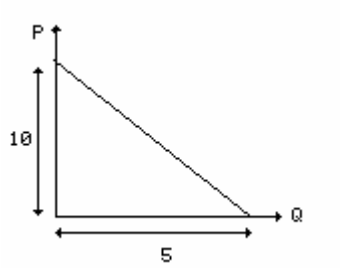
8. The resistance R and temperature T for an electric conductor is given as R = r + aT with r as the resistance at 0^oC and a as a constant.
A graph of R against T is shown .



What is the resistance ,R of the conductor at a temperature 60°C ?

A 35
B 47
C 86
D 93
E 180

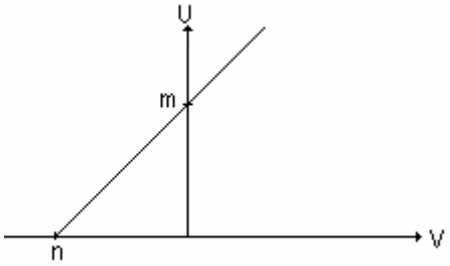
9.



The equation of the graph above is

A P = 10Q + 5 B P = 2Q + 10
C P = -2Q + 10 D P = 5Q – 10

10. The following figure shows a graph U versus V.



Which of the following shows the correct relationship between U and V?

A $U = \frac{m}{n} V + m$

B $U = -\frac{m}{n} V + m$

C $U = \frac{m}{n} V + n$

D $U = -\frac{n}{M} V + m$

11. A student carries out an experiment to find out the relationship between the change in length , *y* , of a spring and mass, *m* , of the load on the spring. The arrangement of the apparatus for the experiment is shown in Figure 1 . The length of the spring when a load is placed on the piston is *l* .

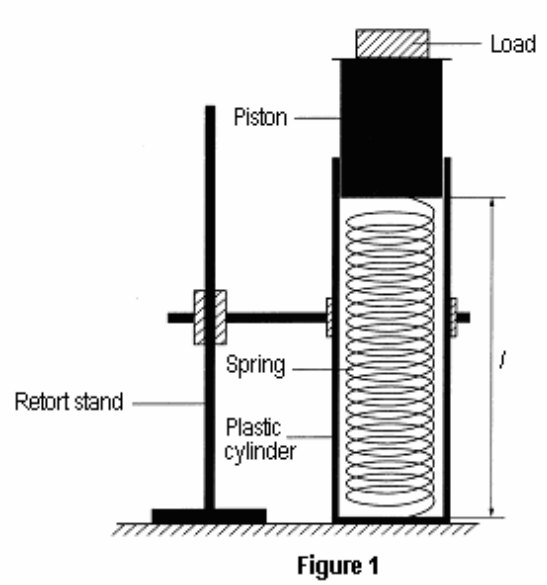
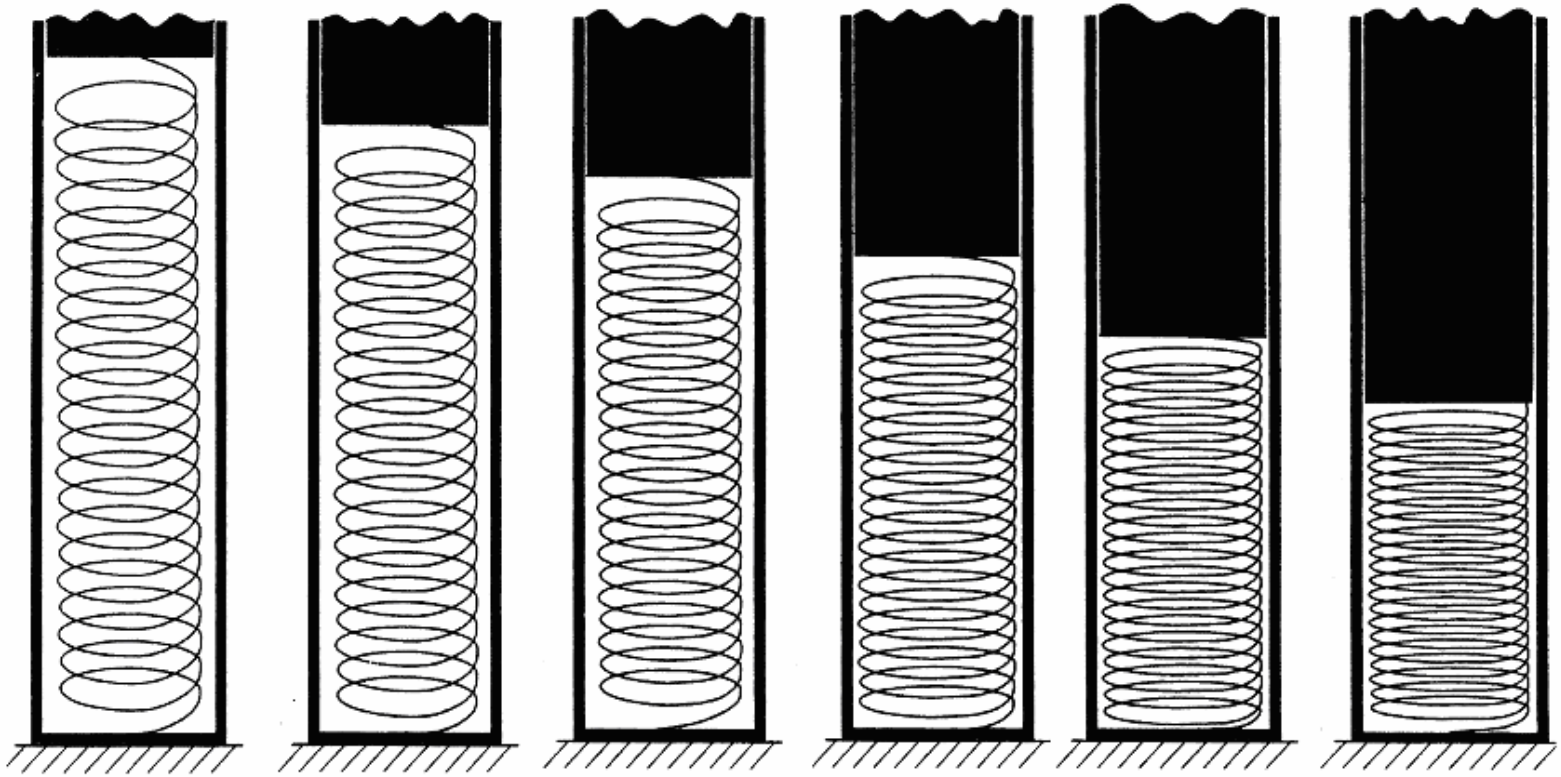


Figure 1

At the beginning of the experiment there is no load. The length of the spring is l_o . The actual length of l_o is shown in Figure 2.
The experiment is repeated by using load with mass , *m* , equal to 0.5 kg , 1.0 kg , 1.5 kg , 2.0 kg and 2.5 kg. The actual lengths of the spring when the different masses are used are shown in Figure 3, Figure 4 , Figure 5 , Figure 6 and Figure 7.

The diagrams shows the actual lengths of the spring



No load
m = 0.0 kg
Figure 2

m = 0.5 kg
Figure 3

m = 1.0 kg
Figure 4

m = 1.5 kg
Figure 5

m = 2.0 kg
Figure 6

m = 2.5 kg
Figure 7

(a) Based on the aim and the procedure of the experiment state the:

(i) manipulated variable

_____

(ii) responding variable

_____

(iii) constant variable

_____

(b) Measure the length of the spring in Figure 2.

l_o = _____

Measure the lengths *l* of the spring in Figure 3 , Figure 4 , Figure 5 , Figure 6 and Figure 7 when different load are used.

In each case, calculate the change in length, *y* , of the spring where;

$y = (l_o - l)$

Tabulate your results for *m* ,*l* and *y* in the space below.

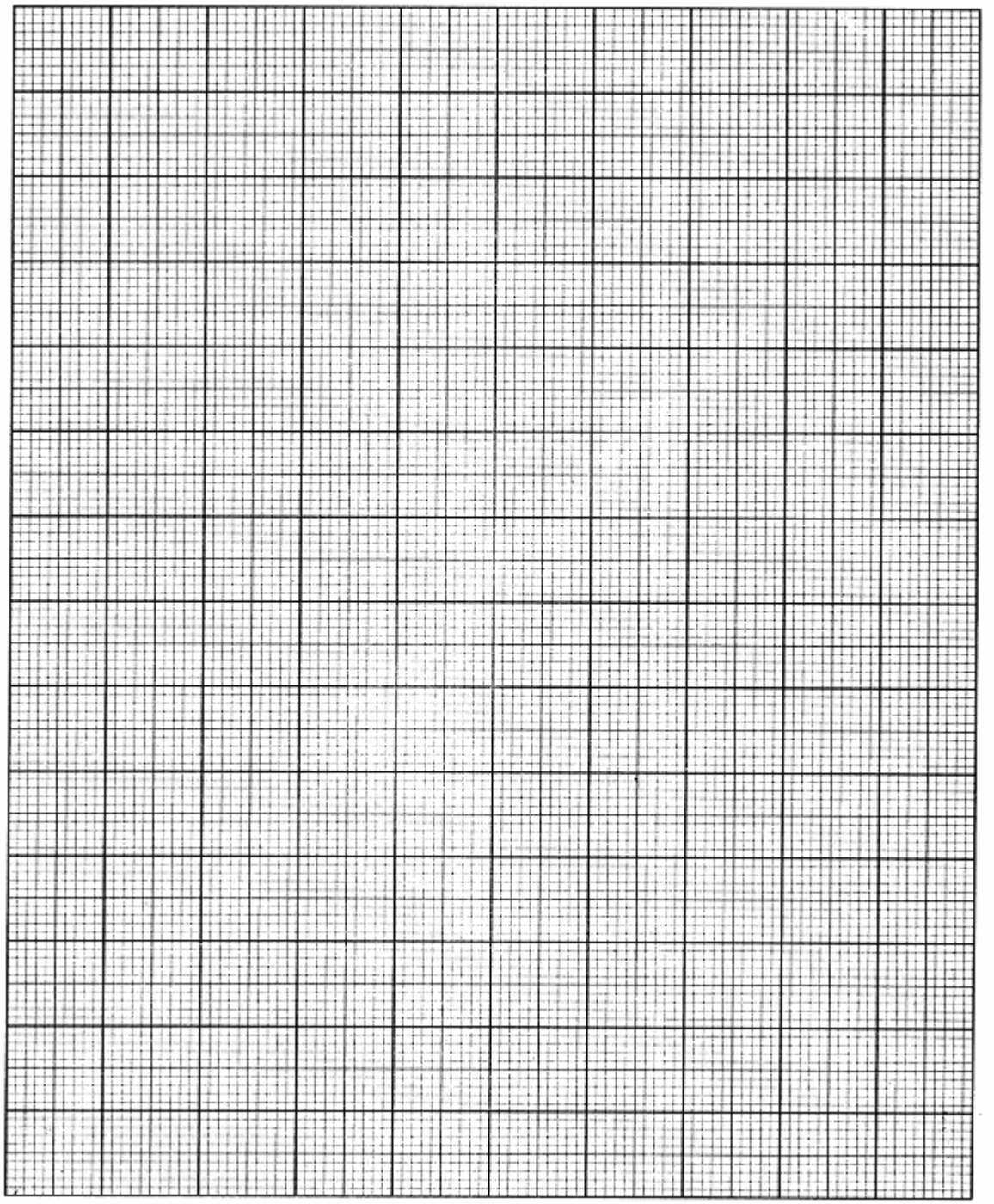
(c) On the graph paper , plot a graph of *y* against *m*.

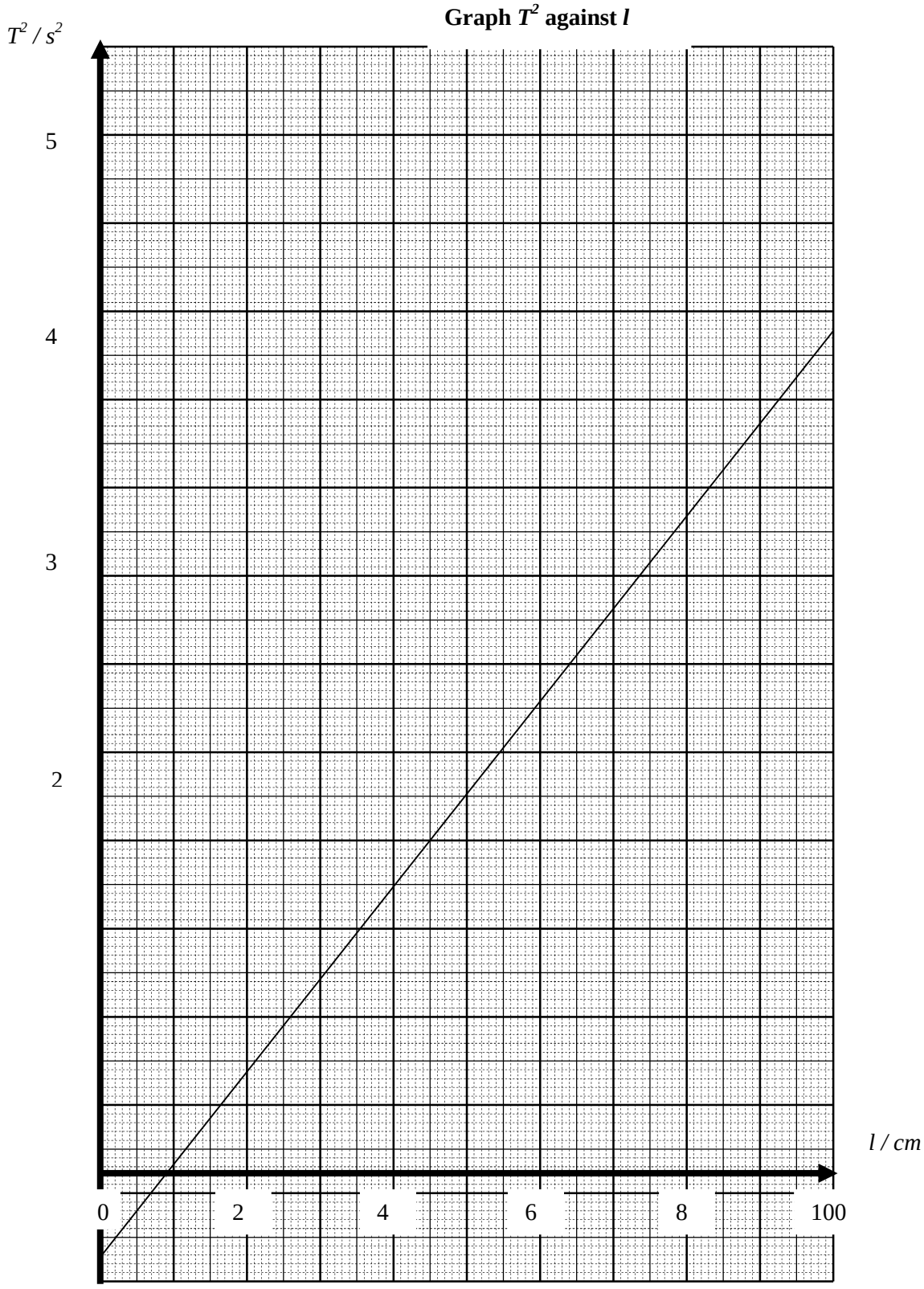
(d) Based on your graph, state the relationship between *y* and *m* .

_____

_____

Graph of y against m





12. A student carries out an experiment to investigate the relationship between the length of a simple oscillating pendulum ,*l* , with its period, *T*.

The experiment is repeated using different lengths, *l*, and their corresponding periods, *T*, are recorded. A graph of T^2 against *l* , is then plotted as shown above.

(a) Based on the graph,

(i) State the relationship between T^2 with *l*.

_____

_____

(ii) Calculate period, *T*, when the length *l* = 45 cm.

(Show your working)

(iii) Calculate the gradient of the graph.

(b) Using the value of the gradient obtained from (a)(iii) and the equation,

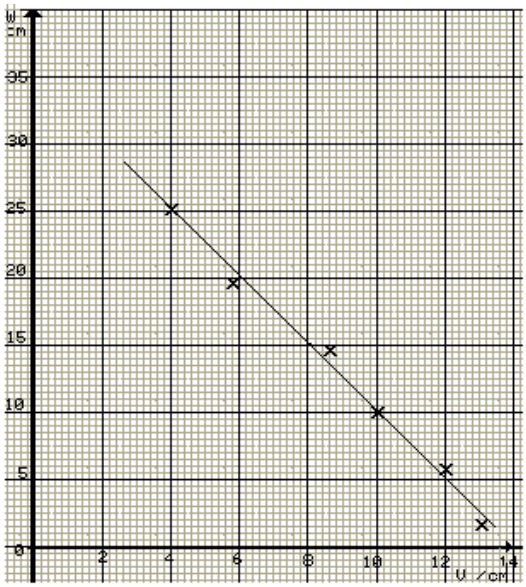
$$T = 4\pi^2 \frac{l}{g}$$

calculate the acceleration due to gravity , g.

(c) State one precaution for this experiment.

_____

_____



13. The graph above represents graph W against V , where W and V are the distances on a wooden rod.

(a) Based on the graph state the:

(i) manipulated variable

_____

(ii) responding variable

_____

(b) Calculate the gradient of the graph.

(c) Determine the intercept on

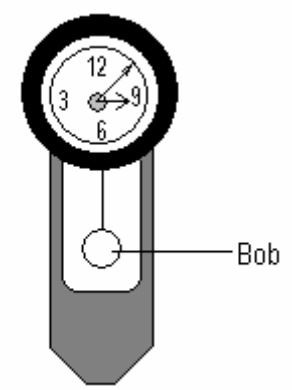
(i) axis- W

(ii) axis-V

(d) State the equation of the line

_____

22 Pak Ali has a pendulum clock as shown in the diagram below.



Every day it was observed that the clock was slow about 2 minutes. Pak Ali raised the position of the bob to correct the clock.

Based on the observations:

(a) State one suitable inference that can be made.

(b) State one appropriate hypothesis for an investigation.

(c) With the use of apparatus such as pendulum bob , string and other apparatus, describe an experimental framework to test your hypothesis.

In your description, state clearly the following:

(i) Aim of the experiment

(ii) Variables in the experiment

(iii) List of apparatus and materials

(iv) Arrangement of the apparatus

(v) The procedure of the experiment which include the method of controlling the manipulated variable and the method of measuring the responding variable

(vi) Way you would tabulate the data

(vii) Way you would analysis the data

23. Diagram 1 and Diagram 2 show two babies sleeping in their spring cradles.The two cradles are extended with the same displacement and released so that they move up and down.

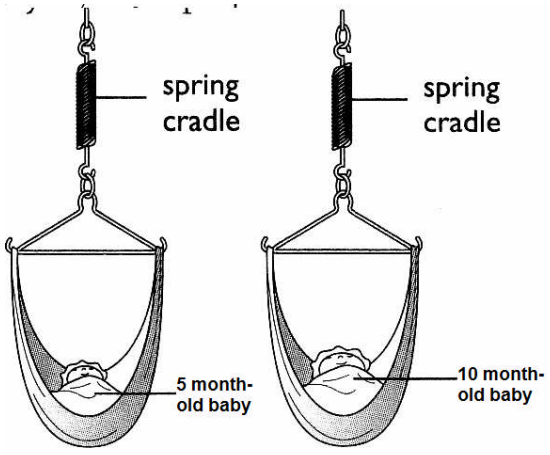


Diagram 1 **Diagram 2**

At the beginning, the up and down movement are the same for both cradles. But at the end, the cradle shown in Diagram 1 stops earlier than the cradle shown in Diagram 2.

Using the information

(a) Make one suitable inference.

(b) State one appropriate hypothesis for an investigation.

(c) With the use of apparatus such as spring and other apparatus, describe an experimental framework to test your hypothesis.

In your description, state clearly the following:

(i) Aim of the experiment

(ii) Variables in the experiment

(iii) List of apparatus and materials

(iv) Arrangement of the apparatus

(v) The procedure of the experiment which include the method of controlling the manipulated variable and the method of measuring the responding variable

(vi) Way you would tabulate the data

(vii) Way you would analysis the data