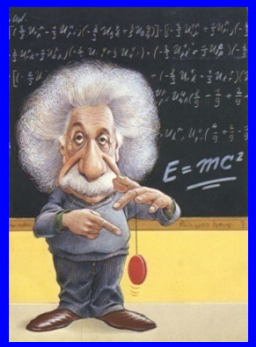
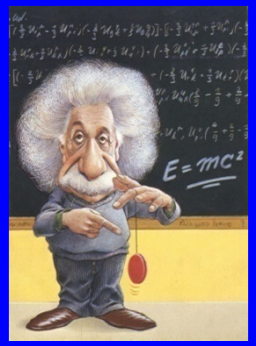


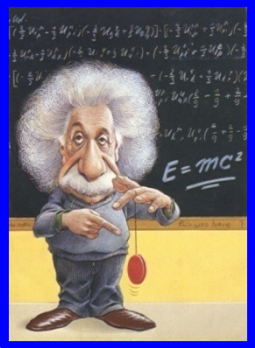
Preparing for Physical Sciences Exam



Format of Exam Papers

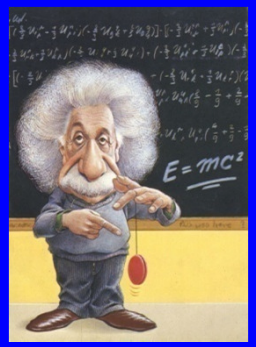
Paper 1 Physics: 3 hours	Marks	Paper 2 Chemistry 3 hours	Marks
SECTION A:		SECTION B:	
One Word Answers	5	One Word Answers	5
Multiple Choice	20 (10x2)	Multiple Choice	20 (10x2)
SECTION A: Longer questions that assess al themes	125	SECTION B: Longer questions that assess al themes	125
Total	150	Total	150

Cognitive levels



The final exam paper will adhere to the following weightings of the cognitive levels:

Cognitive level description	Weighting %	
	Paper 1	Paper 2
Recall (knowledge)	15	15
Comprehension	30	40
Analysis, Application	45	35
Evaluation, Synthesis	10	10

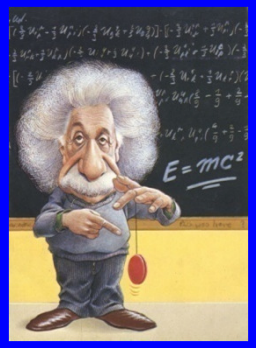


A: Knowledge

-involves recall of specific facts or other information.

Skills demonstrated:

- observation and recall of information
- State Law's
- knowledge of major ideas
- mastery of subject matter

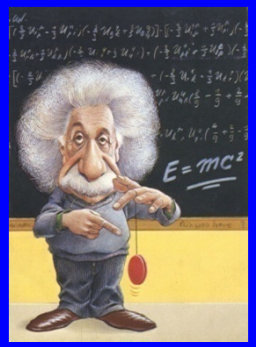


B: Comprehension

- This is the first level of understanding. A statement must not only be recalled but its meaning must be understood.

Skills demonstrated:

- understanding information
- grasp meaning
- translate knowledge into new context
- interpret facts, compare, contrast
- order, group, infer causes
- predict consequences



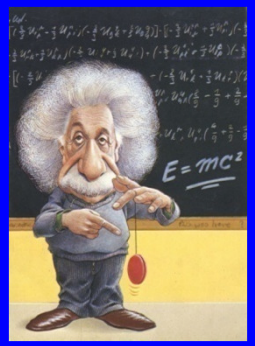
C: Analysis and Application

- Refers to the ability to use information in new situations.

Skills demonstrated:

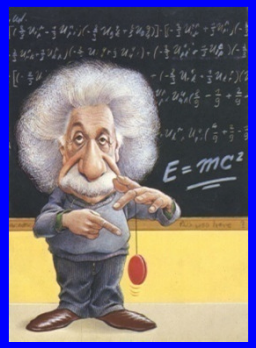
- use information
- use methods, concepts, theories in new situations
- solve problems using required skills or knowledge

D: Evaluation and Synthesis



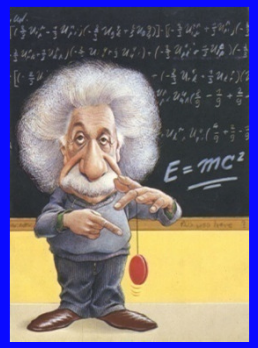
Skills demonstrated:

- seeing patterns
- organization of parts
- recognition of hidden meanings
- identification of components
- use old ideas to create new ones
- generalize from given facts
- relate knowledge from several areas
- predict, draw conclusions
- make choices based on reasoned argument



Weighting of the Learning Outcomes

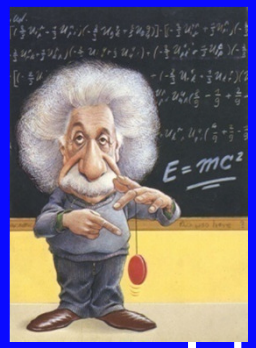
Learning Outcome		Paper 1	Paper 2
LO1	Practical Scientific inquiry and problem solving skills	35 - 40%	30 - 40%
LO2	Conducting and applying scientific knowledge	45 - 55%	50 - 60%
LO3	The nature of science and its relationship to technology, society and the environment	5 -15%	5 - 15%



LO 1 – AS 12.1.1

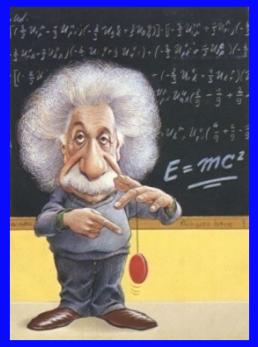
Investigative Question

- Marks are given for the two variables (dependent, independent) and the relationship between them in question form
- Hypothesis
- Marks are given for the two variables (dependent, independent) and the relationship between them in a statement



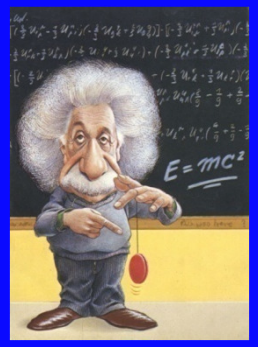
LO 1 – AS 12.1.1

- List apparatus
- Method – Sequence steps (need for more than one trial, safety precautions, appropriate control)
- Method for recording results



LO 1 – AS 12.1.2

- **Graphs**
  - Draw accurate graphs
  - Interpret graphs
  - Draw sketch graphs
- **Results**
- **Conclusions**

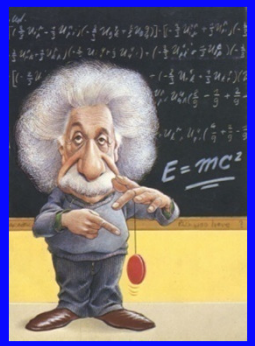


LO 1 – AS 12.1.3

- Calculations
- Descriptions

LO 1 – AS 12.1.4

- Explain/describe/argue the validity of a statement/event using scientific principles

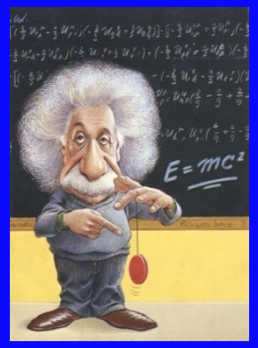


LO 2 – AS 12.2.1

- Recalling and stating of prescribed knowledge/definitions

LO 2 – AS 12.2.2

- Give relationships between scientific concepts e.g. the relationship between diffraction and the width of the slit



LO 2 – AS 12.2.3

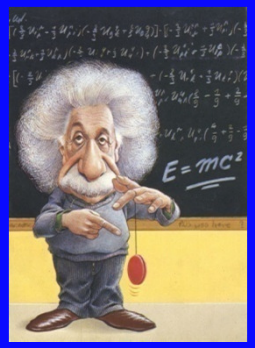
- **Calculations:**

  Application of knowledge to solve one-step calculations

- **Descriptions**

  Use scientific knowledge in different contexts e.g. explain how a cricketer can apply impulse during batting or catching of a cricket ball

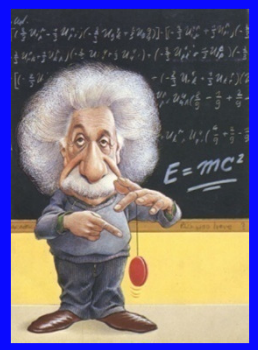
LO 3 – AS 12.3.1

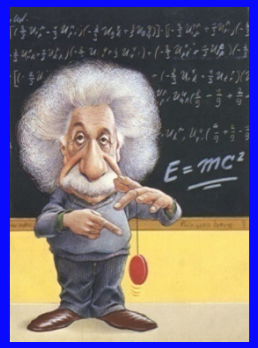


- Given a case study, compare the advantages and limitations of indigenous knowledge of past cultures to present scientific knowledge, for example,
- the extraction of metals from their ores (as part of electrochemical reactions)
- the use of the inclined plane as a simple machine in comparison to cranes and other machines today, etc.

LO 3 – AS 12.3.1 continue

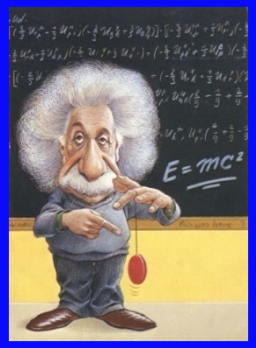
- Given a case study, discuss (describe) the changing nature of science i.e. as new knowledge develops, old ideas are replaced with new ideas. For example,
- the development of chemical pigments made the extraction of pigments from natural materials unnecessary





LO 3 – AS 12.3.2

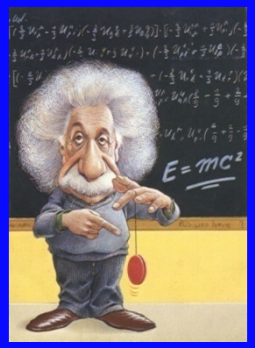
- Given a case study, discuss/argue the impact of scientific applications on the life of humans. For example,
- the advantages and disadvantages of the use of X-rays on human development
- the advantages and disadvantages of the Haber process on human development.



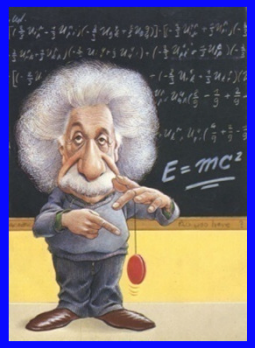
LO 3 – AS 12.3.2

- Argue/discuss the impact of scientific knowledge on human development based on prescribed content. For example,
- the impact (positive and negative) of the production of aluminium on the lives of South Africans

LO 3 – AS 12.3.2 Cont



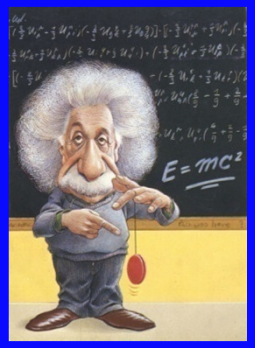
- NB: **When stating an impact of science on human development, listing of aspects is <u>not</u> sufficient.** For example, giving ‘fertilizers' as an answer to the impact of the Haber process on humans, is not sufficient. A complete answer will be ‘fertilizers to produce more food’.
- <u>Always state cause and effect</u>



Mark allocation per knowledge area Paper 1

- **See hand out given for detail**

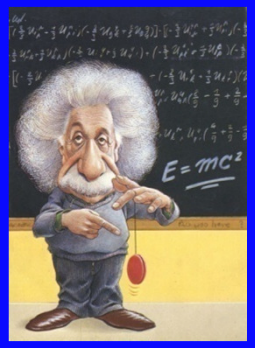
Knowledge Area	Marks
Mechanics (± 33%)	± 50
Waves, Sound and Light (± 20%)	± 25
Electricity and Magnetism (± 37%)	± 55
Matter and Materials (± 15%)	± 20



Mark allocation per knowledge area Paper 2

- **See hand out given for detail**

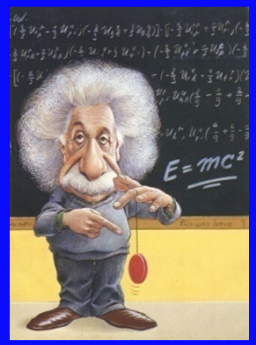
Knowledge Area	Marks
Matter and Materials (± 33%)	± 50
Chemical Change(± 50%)	± 75
Chemical Systems(± 17%)	± 25



Content to be assessed for the Grade 12 Final Examinations - 2012

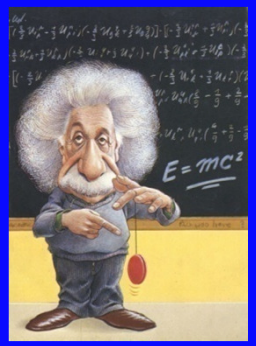
- Remember a textbook is not the curriculum.
- Use the document in the hand outs
- Use it as a tick list when studying
- Extract from the National department Exam guidelines

PRIOR KNOWLEDGE FROM GRADES 10 & 11



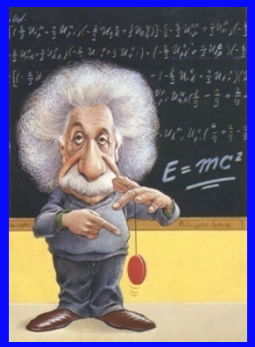
- All skills and application of knowledge learnt in Grades 10 and 11 are transferable and applicable to assessment in Grade 12.
- In particular, skills and knowledge from Grades 10 and 11 that may be assessed in Grade 12 include the following:

PRIOR KNOWLEDGE Cont.



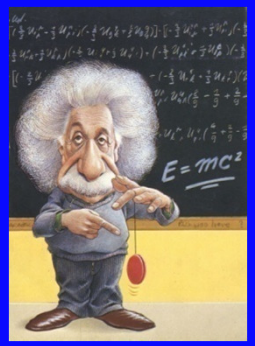
- The use of equations of motion in solving problems dealing with momentum,
- vertical projectile motion, work, energy and power
- The use of Newton's first and second laws of motion
- *Sound waves and properties of sound
- *Electromagnetism
- Stoichiometric calculations

PRIOR KNOWLEDGE Cont



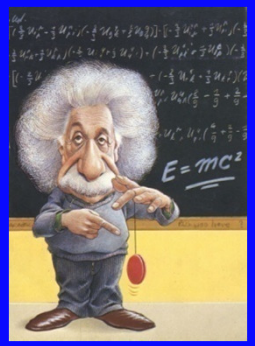
- Concentration calculations
- Balancing of chemical equations
- Use of oxidation numbers
- Identification and description of intermolecular forces (Van der Waal's forces and Hydrogen bonds)
- *Acids and bases

PRIOR KNOWLEDGE



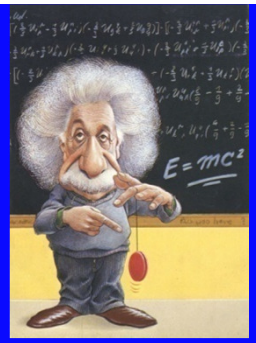
- **NB:** Although there will be no direct questions about these aspects, applications there-of can be assessed. For example, writing down the definition of Newton's first law is not expected, but its use to e.g. explain the need for safety belts, can be assessed. The formula $F_{net} = ma$ may form part of a calculation that is mainly about work or energy.

PRIOR KNOWLEDGE



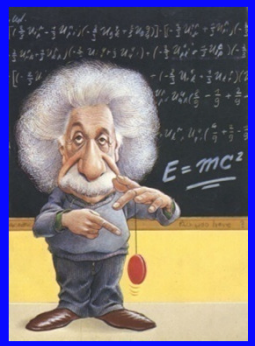
- A further example is concentration calculations and stoichiometry needed in K_c calculations

How do we mark



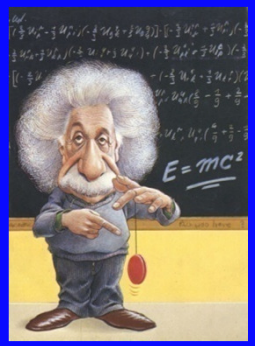
- **Definitions:** Two marks will be awarded for a correct definition. No marks will be awarded for an incorrect or partially correct definition.
- **Calculations**:
  - Marks will be awarded for: correct formula, correct substitution, correct answer with unit.
  - No marks will be awarded if an incorrect or inappropriate formula is used, even though there may be relevant symbols and applicable substitutions.

How do we mark



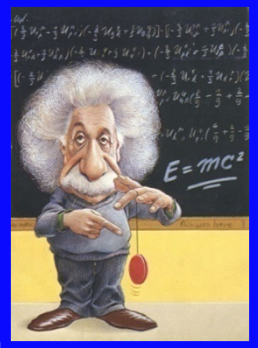
- When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
- Marks are only awarded for a formula if a calculation had been **attempted**. i.e. substitutions have been made or a numerical answer given

How do we mark



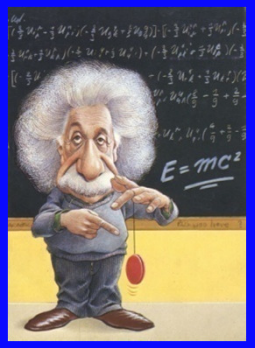
- Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
- No marks will be awarded if no formula is given, but correct substitutions <u>OMITTING ZERO SUBSTITUTIONS,</u> are given

How do we mark



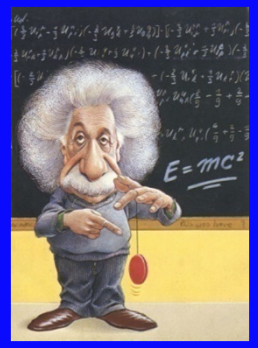
- All calculations, when not specified in the question, must be done to two decimal places
- Candidates will only be penalized once for the repeated use of an incorrect unit **within a question or sub-question**
- Units are only required in the final answer to a calculation

How do we mark



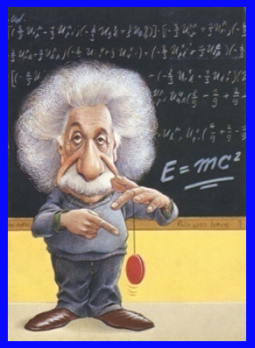
- Marks are only awarded for an answer, and not for a unit *per se*.
- SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this. (This instruction only applies to Paper 1.)

How do we mark



- Positive marking regarding calculations will be followed in the following cases:
- **Sub-question to sub-question:**
- **A multi-step question in a sub-question**:
- If a final answer to a calculation is correct, full marks will not automatically be awarded.

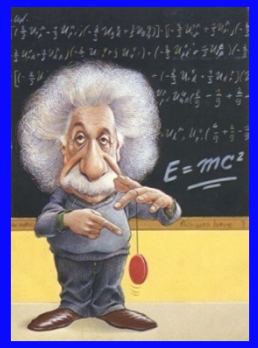
How do we mark



- Start all calculations with a formula from the data sheet – NO abbreviations
- (E_{OA} or E_{RA} is not accepted!) use:

$$E_{cell} = E_{oxidising\ agent} - E_{reducing\ agent}$$

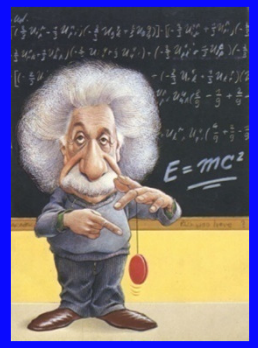
How do we mark



- K_c calculations:
- always write the K_c expression! Use the substances in the chemical equation and NOT $\frac{[\text{product}]}{[\text{reactant}]}$ or something general like $\frac{[C]^2[D]}{[AB]^3}$
- The expression must relate to the reaction,

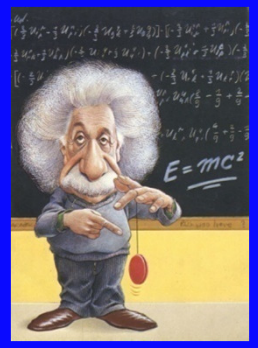
  eg: $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$

How do we mark



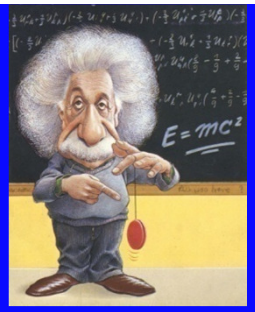
If learners use the table to solve K_c calculations, headings of rows and columns must be clearly indicated – many learners only put values into the table without any indication whether it is mole, concentration, etc. The table is not the only method for solving K_c problems! Only stating initial or equilibrium without the mole or concentration will result in no marks

How do we mark



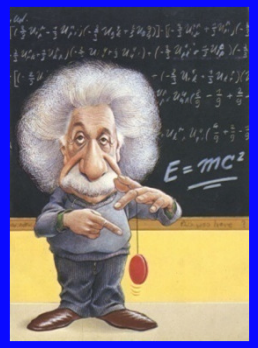
Stoichiometric calculations

- Marks are only given for the calculation of molar mass (M)
- if used in the formula: $n = \frac{m}{M}$
- Learners loose marks because they do not show / use the mol ratio.



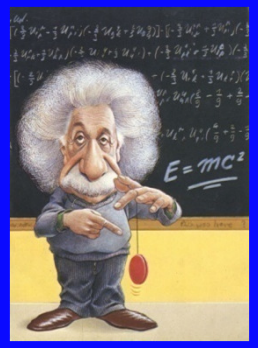
How do we mark

- If one answer or calculation is required, but two given by the candidate, only the first one will be marked
- If instructions regarding method of answering are not followed, e.g. the candidate does a calculation when the instruction was to ***solve by construction and measurement***, a candidate may forfeit all the marks for the specific question.



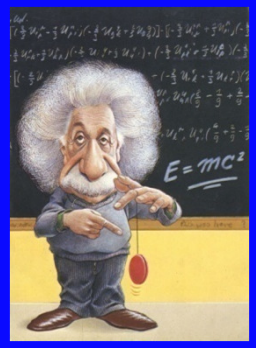
How do we mark

- When a chemical **FORMULA** is asked, and the **NAME** is given as answer, only one of the two marks will be awarded. The same rule applies when the **NAME** is asked and the **FORMULA** is given
- If one answer or calculation is required, but two given, only the first one will be marked, irrespective of which one is correcct



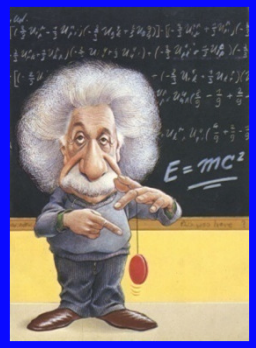
How do we mark

- When redox half-reactions are to be written, the correct arrow should be used. If the equation
- $H_2S \rightarrow S + 2\,H^+ + 2e^-$ (2/2)
- $S + 2H^+ + 2e^- \rightleftharpoons H_2S$ (0/2)



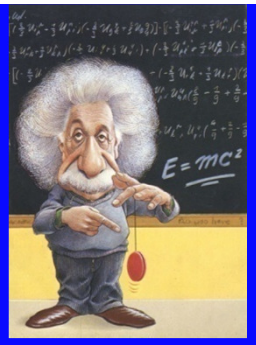
How do we mark

- When candidates are required to give an explanation involving the relative strength of oxidising and reducing agents, the following is unacceptable:
- Stating the position of a substance on table 4 only (e.g. Cu is above Mg).
- Using relative reactivity only (e.g. Mg is more reactive than Cu).



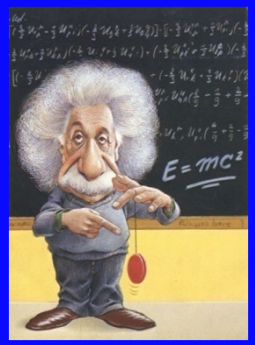
How do we mark

- The correct answer would for instance be:
- Mg is a stronger reducing agent than Cu, and therefore Mg will be able to reduce Cu^{2+} ions to Cu. The answer can also be given in terms of the relative strength as electron acceptors and donors.



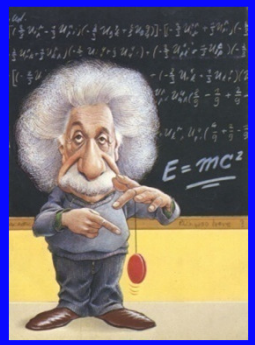
How do we mark

- The error carrying principle does not apply to chemical equations or half reactions. For example, if a learner writes the wrong oxidation/reduction half-reaction in the sub-question and carries the answer to another sub-question (balancing of equations or calculation of) then the learner is not credited for this substitution.



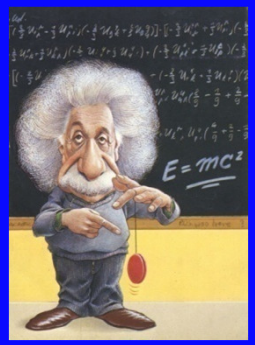
How do we mark

- When a calculation of the cell potential of a galvanic cell is expected, marks will only be awarded for the formula if one of the formulae indicated on the data sheet (Table 2) is used. The use of any other formula using abbreviations etc. will carry no marks.



How do we mark

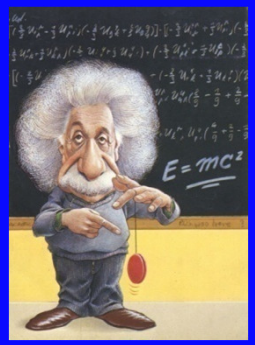
- In the structural formula of an organic molecule all hydrogen atoms must be shown. Marks will be deducted if hydrogen atoms are omitted –see comment later



How do we mark

Structural formulae

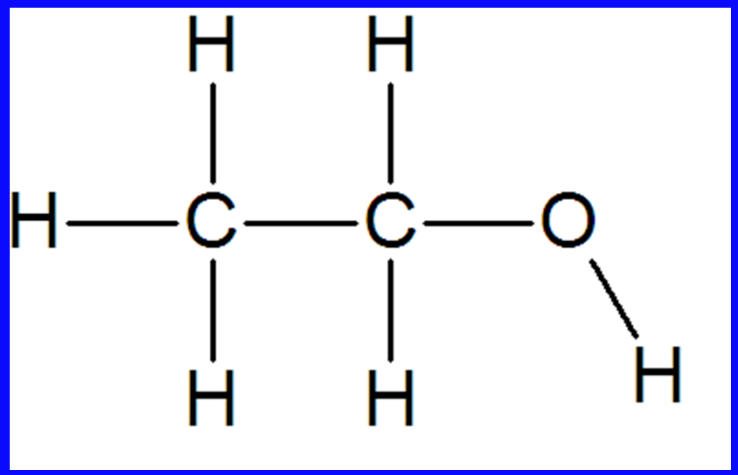
The structural formula of a compound shows which atoms are attached to which within the molecule. Atoms are represented by chemical symbols and lines are used to represent the bonds that hold the atoms together. A structural formula does not represent the geometry of the molecule.

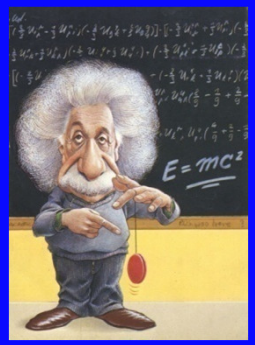


How do we mark

Example:

Structural formula of ethanol (the O-H can be straight)





How do we mark

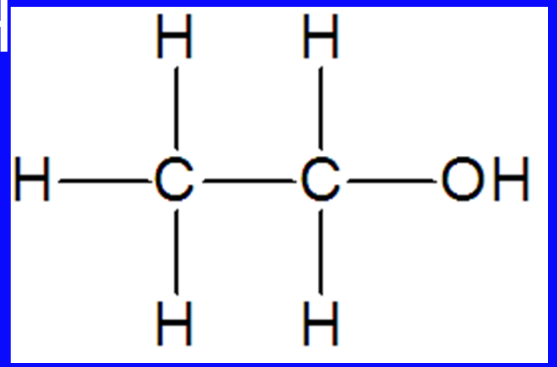
Condensed structural formula

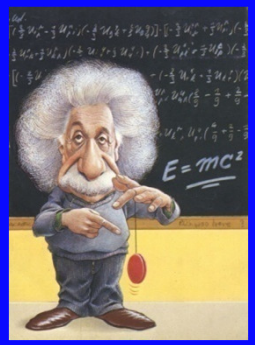
This notation represents the way that the atoms are bonded in a molecule but does not indicate <u>all the bonds</u>.

Example:

Condensed structural formula for ethanol

CH_3CH_2OH <u>or</u> $CH_3 – CH_2 –OH$





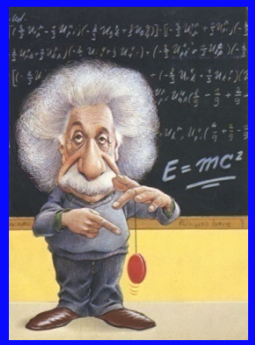
How do we mark

Molecular formula

A chemical formula that indicates the types of atoms and the correct number of atoms in a molecule.

Example:

Molecular formula for ethanol C_2H_6O

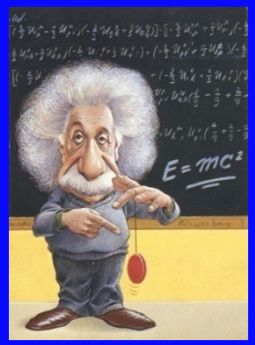


How do we mark

- When an IUPAC name is asked, and the candidate omits the hyphen (e.g. instead of 1 –pentene the candidate writes 1 pentene), marks will be forfeited.
- E.g 1,3-dimethylpentane

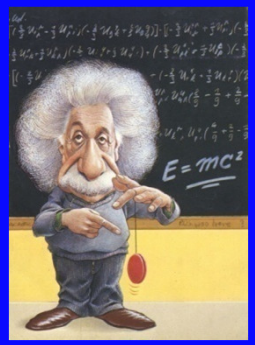
Cannot be written as

1,3-dimethyl pentane



TIPS

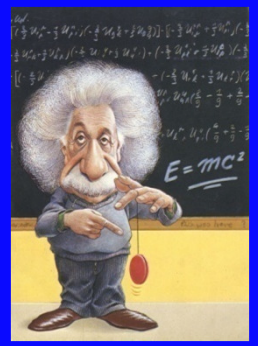
- Do not waste time on a question – carry on – come back
- Use the 10 minute reading time to sort out in your mind which questions you will start with.
- Check data sheets specially which reduction table you use. Tear the other off and put under chair



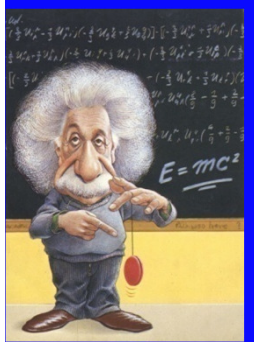
Use Past Papers

- If you have access to the Internet you can obtain these papers by logging on to www.education.gov.za. Click on Assessment and then choose Examinations then national Senior Certificate Previous exam papers and then go to Non-Languages and then Physical Sciences.

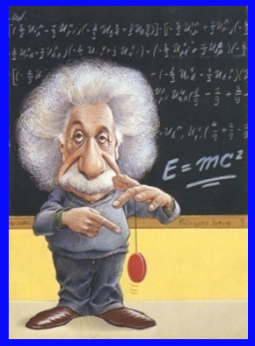
- **Extract from "Mathematical methods in the Physical Sciences" by Mary Boas One point ….that cannot be emphasized enough: to use mathematics effectively in applications, you need not just knowledge, but *skills*. Skill can only be obtained through practice.**



- **You can obtain a certain *superficial knowledge* of mathematics (or science) by listening to lecturers, but you cannot obtain skills this way.**
  How many students have I heard say: "it looks so easy when you do it", or "I understand it but I can't do the problems!". Such statements show lack of practice and consequent lack of skill. The only way to develop the skill necessary ….. is to practice by solving many problems.



- **Always study with pencil and paper at hand. Don't just read through a solved problem – try to do it yourself! Then solve some similar ones.**
- **But this means practice, practice, practice! The only way to learn to solve problems *is* to solve problems.**



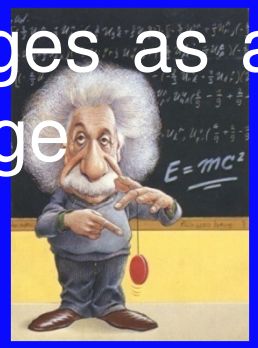
1. Practical investigations

1.1 Identify variables

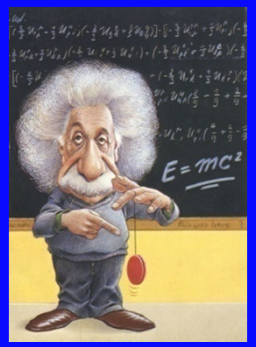
In Q 7.3 & 5.4 Nov 2009 the learners could not identify or explain the concept of controlled variable (that which has to be kept constant in order for the test to be fair). Also Q 7.3.4 Febr / March 2010.

Independent variable: The one that changes under your control.

Dependent variable: The variable that changes as a result of the change of the independent change.



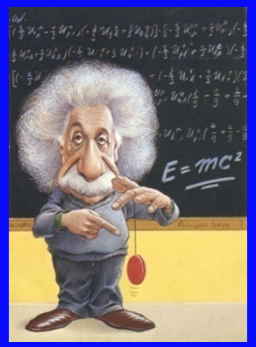
1.2 Investigative question



The following marking rubric is used in the NSC exam:

Criteria for investigative question	**Mark**
Refers to **relationship** between **dependent** and **independent variables**	√√
Is stated as a **question**, not an aim	

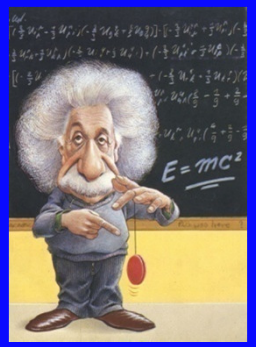
1.3 Hypothesis



The following marking rubric is used in the NSC exam.

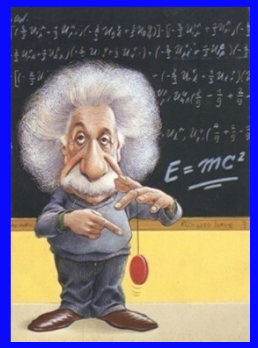
Criteria for hypothesis	**Mark**
Refers to **relationship** between **dependent** and **independent variables** .	√√
Statement that can be proved correct or incorrect – **prediction based on (prior) knowledge.**	

1.4 Relationships



- Proportional to
- Directly proportional to
- Inversely proportional to (NOT: indirectly!!)
- Exponential relationship
- Linear relationship

1.5 Graphs

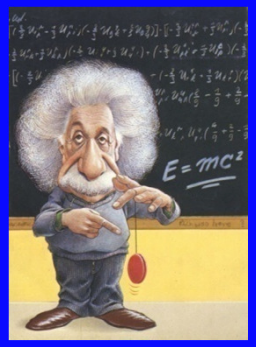


Questions regarding conclusions from graphs: always refer to the gradient of the graph.

In Physics the following checklist below was used for the drawing of a graph in Q 14 March 2010.

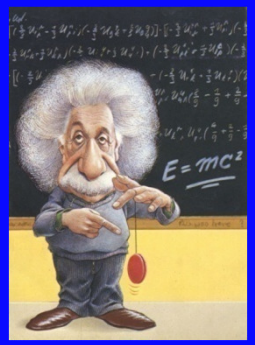
Checklist	**Marks**
Criteria for graph	
Relevant heading	√
Axes labelled correctly with units	√
Appropriate scale	√
Plotting all points	√
Line of best fit	√

1.6 Conclusion from results



This is the answer to the investigative Question –refer to the relationship between the variables

1.7 Explain trends



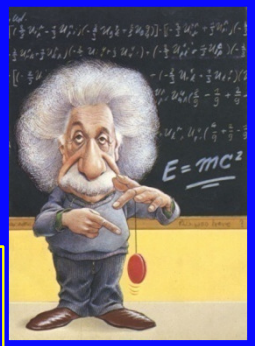
Be very specific! Do not give a general rule/statement – use the compounds referred to in the question and apply the facts/principles to the specific compound (e.g. carboxylic acids....)

WORK ENERGY THEOREM

The netto work done on an object is equal to the change of the kinetic energy of the objects.

The netto work done on an object is equal to the change of the kinetic energy of the objects.

$$W_{net} = \Delta K = E_{kf} - E_{ki}$$



but $W_{net} = F_{net}\,\Delta x \cos\theta$

therefore $F_{net}\,\Delta x \cos\theta = \Delta K = E_{kf} - E_{ki} = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

Also for $W_{net} = \Sigma W$ (of each individual force exerted on the system)

IF THERE ARE NO FRICTIONAL FORCES

Use the law of conservation of mechanical energy:

Mechanical energy (i) = Mechanical energy (f)

$$(U + K)_i = (U + K)_f$$

...OR...

Use the work energy principle

$$W_{net} = \Delta K$$
$$= E_{kf} - E_{ki}$$
$$= \tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_i^2$$

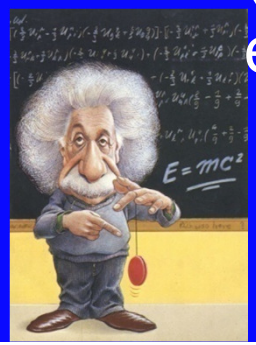
IF THERE ARE FRICTIONAL FORCES

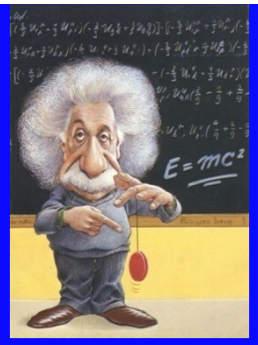
Use the work energy principle:

$$W_{net} = \Delta K$$
$$= E_{kf} - E_{ki}$$
$$= \tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_i^2$$

REMEMBER:

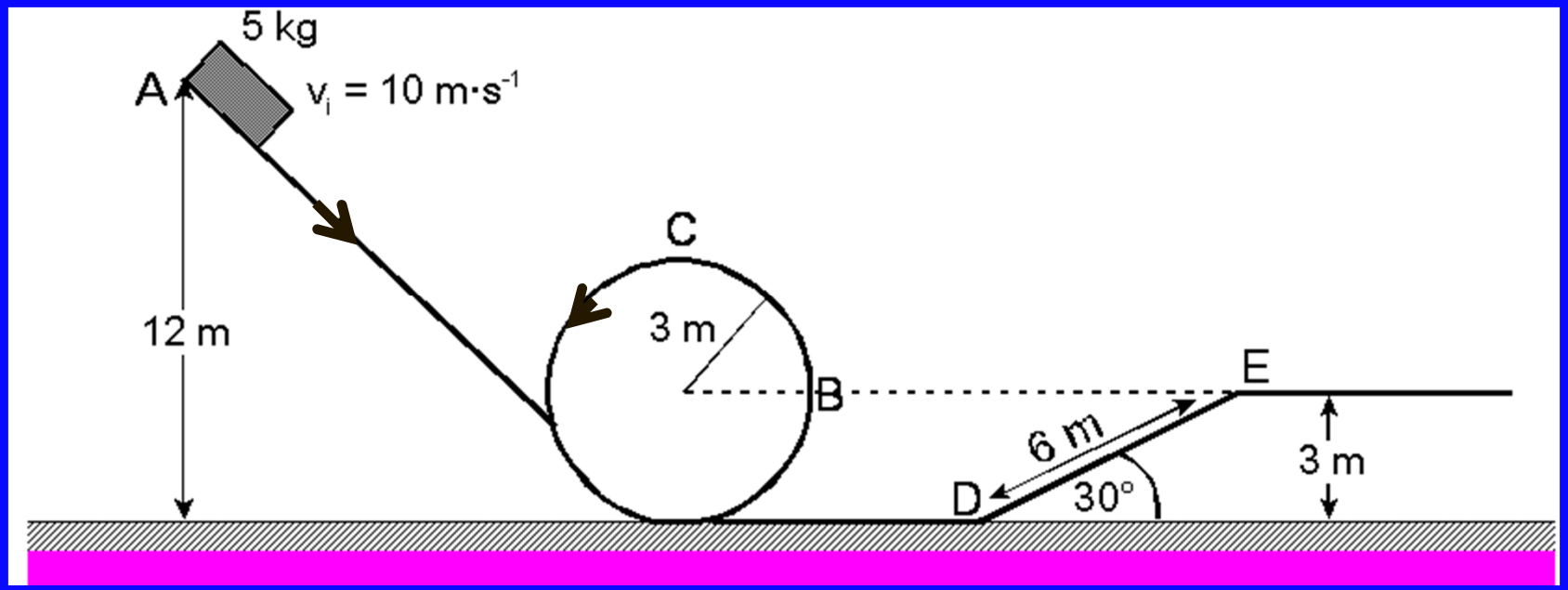
$W_{net} = \Sigma W$
(of each individual force exerted on the system)

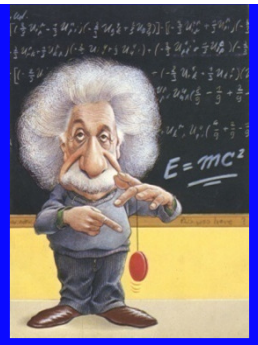




EXAMPLE

A 5 kg crate moves at a speed of 10 $m \cdot s^{-1}$ at point A. The crate moves further along the slide as in the sketch until it has moved passed E. All parts of the slide is frictionless except part DE. Make use of energy methods when doing calculations.





1.1 Calculate the speed of the block at point B.

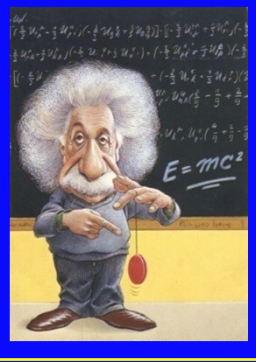
1.2 Calculate the speed of the block at point C.

1.3 Calculate the speed of the block at point D.

1.4 Draw a free body diagram of ALL the forces on the block as it moves up the plane.

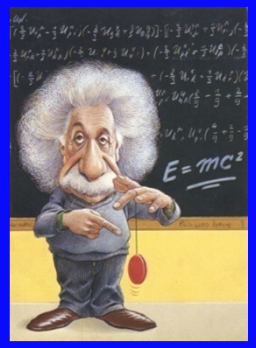
1.5 The crate reaches the top of the slope (point E) with a speed of 15,38 $m \cdot s^{-1}$ where after it moves further at this speed over the horizontal surface.

1.5.1 Calculate the work done on the crate by the gravitational force.



1.5.2 Calculate the work done on the crate by the frictional force.

1.5.3 The size of the friction that is exerted on the crate.



ANSWERS

1.1 Calculate the speed of the block at point B.

There is no friction: Use the law of conservation of mechanical energy.

Mechanical energy (A)= Mechanical energy (B)

$$(U + K)_A = (U + K)_B$$

$$mgh_A + + \tfrac{1}{2}mv_A^2 = mgh_B + \tfrac{1}{2}mv_B^2$$

$$(5)(9{,}8)(12) + \tfrac{1}{2}(5)(10)^2 = (5)(9{,}8)(3) + \tfrac{1}{2}(5)v_B^2$$

$$588 + 250 = 147 + 2{,}5v_B^2$$

$$v_B = 16{,}63\ m{\cdot}s^{-1}$$

ANSWERS *(Continued)*

1.2 Calculate the speed of the block at point C.

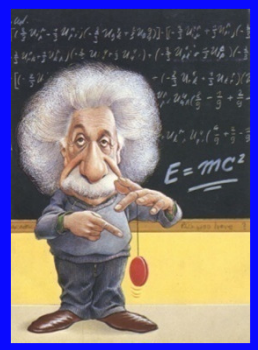
There is no friction: Use the law of conservation of mechanical energy.

Mechanical energy (A)= Mechanical energy (C)

$$(U + K)_A = (U + K)_C$$

$$mgh_A + + \tfrac{1}{2}mv_A^2 = mgh_C + \tfrac{1}{2}mv_C^2$$

$$(5)(9{,}8)(12) + \tfrac{1}{2}(5)(10)^2 = (5)(9{,}8)(6) + \tfrac{1}{2}(5)v_C^2$$



$$588 + 250 = 294 + 2{,}5v_C^2$$

$$v_C = 14{,}75\ m{\cdot}s^{-1}$$

ANSWERS *(Continued)*

1.3 Calculate the speed of the block at point D.

There is no friction: Use the law of conservation of mechanical energy.

Mechanical energy (A)= Mechanical energy (D)

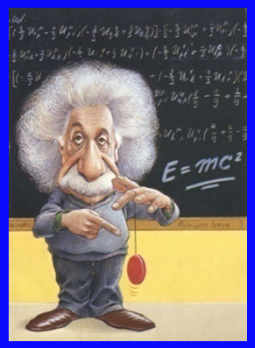
$$(U + K)_A = (U + K)_D$$

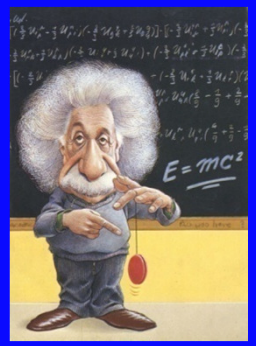
$$mgh_A + + \tfrac{1}{2}mv_A^2 = mgh_C + \tfrac{1}{2}mv_D^2$$

$$(5)(9{,}8)(12) + \tfrac{1}{2}(5)(10)^2 = 0 + \tfrac{1}{2}(5)v_D^2$$

$$588 + 250 = 0 + 2{,}5v_D^2$$

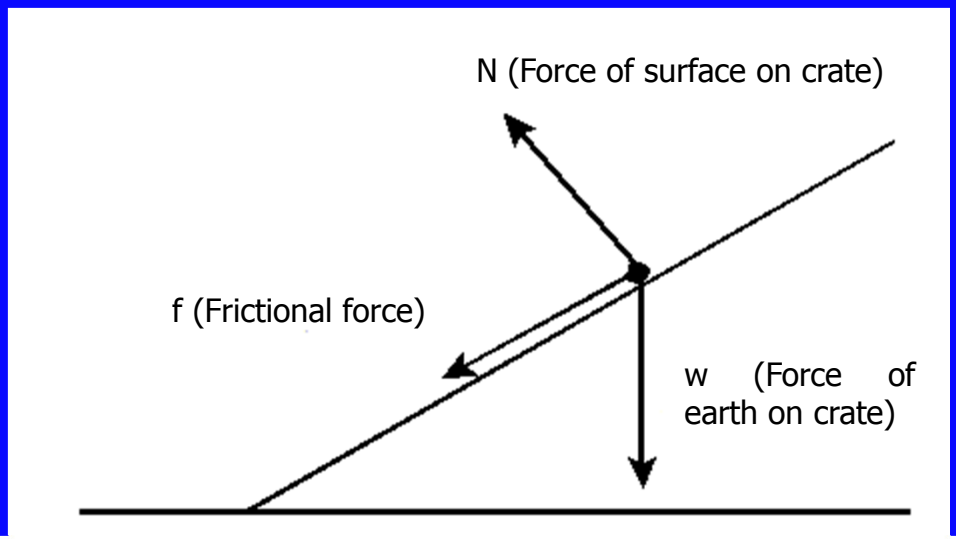
$$v_D = 18{,}31\ m{\cdot}s^{-1}$$



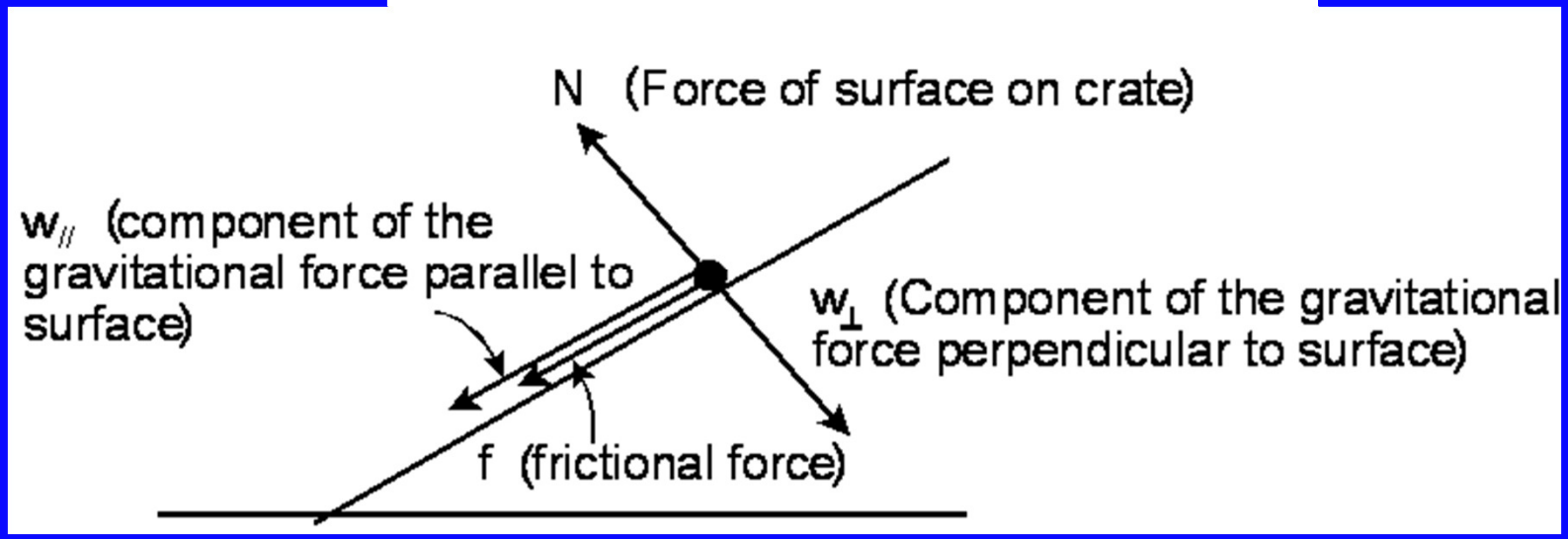


ANSWERS *(Continued)*

1.4 Draw a free body diagram of ALL the forces on the block as it moves up the plane.



OR



ANSWERS (Continued)

1.5 The crate reaches the top of the slope (point E) with a speed of 15,38 $m \cdot s^{-1}$ where after it moves further at this speed over the horizontal surface.

1.5.1 Calculate the work done on the crate by the gravitational force.

$W_w = w\Delta x\cos\theta$

$= mgx\cos 120^\circ$

$= (5)(9,8)(6)(-0,5)$

$= -147\ J$

...OR...

$W_w = w\Delta y\cos\theta$

$= mgh\cos 180^\circ$

$= (5)(9,8)(3)(-1)$

$= -147\ J$

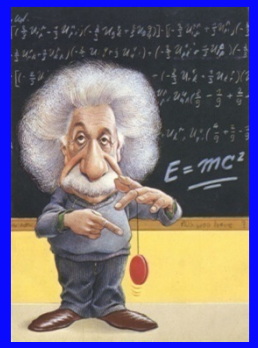
...OR...

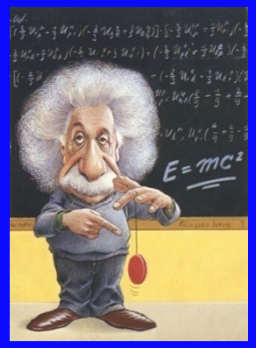
$W_w = w_{//}\Delta x\cos\theta$

$= (mg\sin 35^\circ)(6)(\cos 180^\circ)$

$= (5)(9,8)\sin 30^\circ(6)(-1)$

$= -147\ J$





ANSWERS *(Continued)*

1.5.2 Calculate the work done on the crate by the frictional force.

There is now friction: Use the work energy theorem

$$W_{net} = \Delta K$$

$$W_w + W_N + W_f = \Delta K$$

$$-147 + N\Delta x\cos 90^{\circ} + W_f = \tfrac{1}{2}mv_f^2 - \tfrac{1}{2}mv_i^2$$

$$-147 + 0 + W_f = \tfrac{1}{2}(5)(15{,}38)^2 - \tfrac{1}{2}(5)(18{,}31)^2$$

$$W_f = -99{,}78 \text{ J}$$

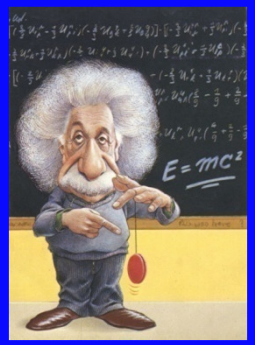
ANSWERS (Continued)

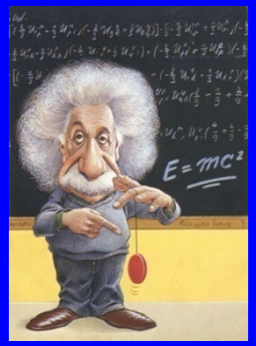
1.5.3 The size of the friction that is exerted on the crate.

$$W_f = f\Delta x\cos\theta$$

$$-99{,}78 = f(6)\cos 180$$

$$f = 16{,}36\ \text{N}$$





Are there any questions?

Thank you

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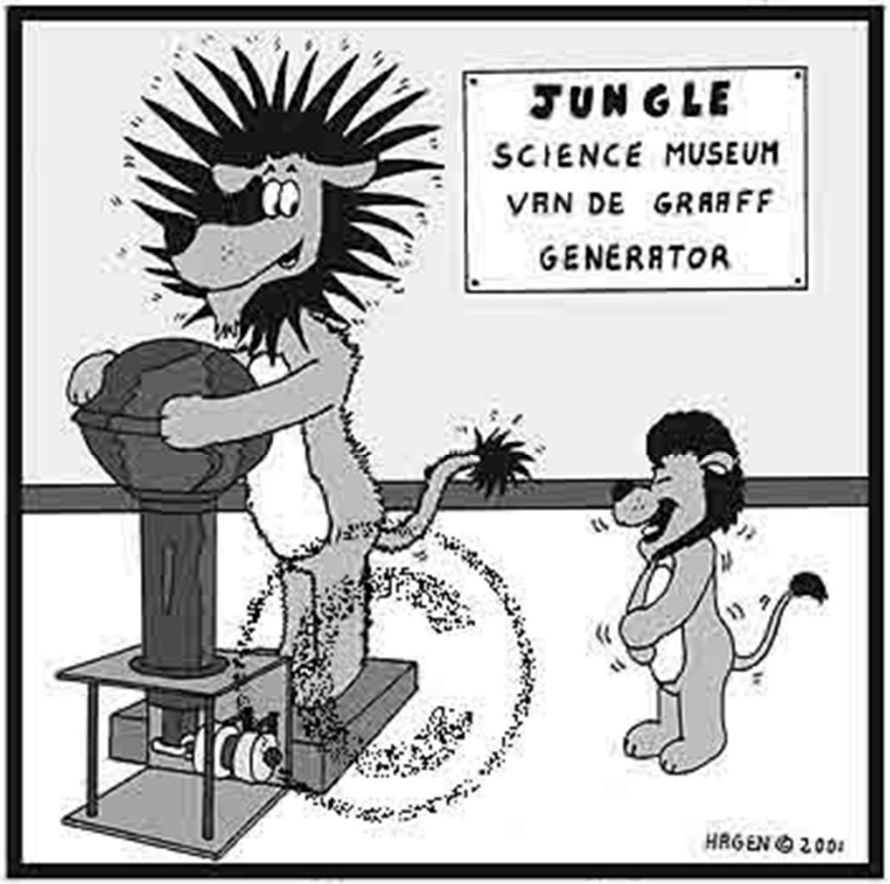

I told you Science was fun!