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Preface

**Seminar Nasional Fisika (SNF) 2018
Universitas Negeri Surabaya, Surabaya, Indonesia
August 11, 2018**

At the beginning of 2019, we would like to present an international proceeding that contains the selected papers from the National Physics Seminar or Seminar Nasional Fisika (SNF 2018), entitled "Earthing Physics and Learning Physics in Building Global Wisdom" that was organized by the Physics Department of FMIPA Unesa - Surabaya on August 11, 2018.

This seminar is an annual important event to publish research results in physics and learning. We are hoping that the event will become a foothold of thinking in welcoming of global developments. In addition, publications packaged in this seminar is will further strengthening existence and reputation of the physics department as an educational institution that excels in scientific publication at national and international levels.

We hope the international proceeding will be able to encourage students, teachers, lecturers, practitioners, researchers, and higher education community in developing scientific research and publications to support the nation's independence.

We on behalf of the committee of the SNF 2018 would like to thank all parties for their participation in supporting this publication and we would like to invite the participants back to take a part in SNF 2019 which will be held by the Physics Department of FMIPA Unesa for this year.

Happy New Year
Thank you,

Dr. Eko Hariyono
Chairman
SNF 2018



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Seminar Nasional Fisika (SNF) 2018

Universitas Negeri Sutabaya, Surabaya, Indonesia

August 11, 2018

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Table of contents

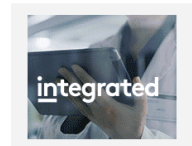
Volume 1171
2019
 ◀ Previous issue Next issue ▶

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Preface

OPEN ACCESS	011001
Seminar Nasional Fisika (SNF) 2018	
+ Open abstract View article PDF	
OPEN ACCESS	011002
Committee	
+ Open abstract View article PDF	
OPEN ACCESS	011003
Sponsorship	
+ Open abstract View article PDF	
OPEN ACCESS	011004
Photographs	
+ Open abstract View article PDF	
OPEN ACCESS	011005
Peer review statement	
+ Open abstract View article PDF	

Papers

Keynote Speaker Papers

OPEN ACCESS	012001
Grounding physics and its learning for building global wisdom in the 21st century	
S Sarwi, E Elianawati and Sulyanah	
+ Open abstract View article PDF	
OPEN ACCESS	012002
A journey to Earth Science Projects at Physics Department, the State University of Surabaya: progress in recent years	
T Prastowo	
+ Open abstract View article PDF	
OPEN ACCESS	012003
Demographic sources as a local wisdom: Potency of Indonesian physics education researchers in conducting survey research	
N Suprpto	
+ Open abstract View article PDF	

Invited Speaker Paper

OPEN ACCESS	012004
Effectiveness of literacy learning model to improve skills of scientific literacy learning plan for physics teacher candidates	
T Sunarti	
+ Open abstract View article PDF	

Parallel Papers

- OPEN ACCESS** 012005
Improving science process skills learning ability of physics teacher candidates through the implementation of CCDSR learning model
I Limatahu, S Sutoyo, Wasis, B K Prahani and J Alfin
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012006
Improving science process skills of junior high school students through the implementation of collaborative creativity learning (CCL) model in physics learning
S Astutik, M A Mahdiannur, Suiyanah and B K Prahani
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012007
The use of gravity anomaly data to estimate the depth of mohorovicic discontinuity in bali area used power spectral analysis
Ramadhan Priadi, Nurvita Fatmasari and Nur Hikmah Intansari
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012008
The relationship between students' views and performance of solving physics problems
J Sirait, H Hamdani and S Mursyid
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012009
Decay orbital period of the binary system on gravitational waves' detection
P Y D Sagita, A Suroso and F P Zen
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012010
The effect of flipped classroom and project based learning model on student's critical thinking ability
V S Andrini, H Pratama and T W Maduretno
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012011
Synthesis and characterization of swelling properties superabsorbent Hydrogel Carboxymethylcellulose-g-Poly (Acrylic Acid)/Natrium Alginate cross-linked by gamma-ray irradiation technique
P A Putro, A S Sulaeman and Erizal
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012012
The effect of optimization learning resource based on Planning, Organizing, Actuating, Controlling (POAC) on contextual learning to students' conceptual understanding of motion and force material
T W Maduretno and L Fajri
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012013
The influence of PBL-STEM on students' problem-solving skills in the topic of optical instruments
Parno, L Yulianti and B Q A Ni'mah
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012014
Van der Waals interaction of ground state energy on ion molecular Hidrogen H_2^+
T Prihandono, S H B Prastowo, B Supriadi, Z R Ridlo, Sudarti, S Bahri and N Karim
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012015
The prototype of infant incubator monitoring system based on the internet of things using NodeMCU ESP8266
R Firmansyah, A Widodo, A D Romadhon, M S Hudha, P P S Saputra and N A Lestari
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012016
A refractive index in bent fibre optics and curved space
Miftachul Hadi, Andri Husein and Utama Alan Deta
[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012017

Development of simple machines props to train student's science process skills

D Dewantara, Fibranti, M Widi and M Mastuang

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012018

Developing The Physics Module Containing Quranic Verses To Train The Local Wisdom Character

M Mastuang, M Misbah, A Yahya and S Mahtari

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012019

Developing the interactive multimedia in physics learning

Zainuddin, A R Hasanah, M A Salam, Misbah and S Mahtari

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012020

The effectiveness of implementation cooperative learning model oriented life skills for the 21st century to improve writing science skills in physics concepts

A H Odja and Mursalin

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012021

Developing of physics teaching material based on scientific literacy

S Hartini, R Latifah, M A Salam and Misbah

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012022

3-dimensional eksternal electric field effect (Stark effect) on the ground state energy of Tritium atom

I K Mahardika, A Harijanto, S Bahri and Z R Ridlo

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012023

Intrinsic thin film properties study of hydrogenated silicon using the method of RF-PECVD

Y Cahyono, M Zainuri, S Pratapa and Darminto

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012024

The use of android-based teaching materials in physics learning process at vocational high school

S R Hakim, R Kustijono and E Wiwin

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012025

The effectiveness of scientific approach through the website in physics learning process at vocational high school

E Wiwin, R Kustijono and S R Hakim

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012026

The effectiveness of android-based physics interactive media to train students' thinking and process skills

R Kustijono, E Wiwin and S R Hakim

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012027

The effectiveness of Problem Based Learning - physics module with authentic assessment for enhancing senior high school students' physics problem solving ability and critical thinking ability

I W Suastra, N P Ristiati, P P B Adnyana and N Kanca

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012028

Identification of high school students' problem-solving skills on rotational dynamics

H Mulyastuti, Sutopo and A Taufiq

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012029

Digital image segmentation for foaminess measurement on foam stability of the lubricant products

R T Yunardi, A Rizki, N Naulalams, P C S Ardiyanti

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012030

Immobilization of TiO₂ on transparent plastic and its application in photocatalytic wastewater treatment

F D Utami, D Y Rahman, Euis Sustini and M Abdullah

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012031

The application of Project Based Learning method in learning micro-hydro electrical power

I Prastyaningrum and H Pratama

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012032

Source parameters identification for July 17th, 2014 earthquake around Jayawijaya mountains, Indonesia

Supardiyo, T Prastowo and Madlazim

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012033

Effectiveness of the use of Integrated Project Based Learning model, Telegram messenger, and plagiarism checker on learning outcomes

H Pratama and I Prastyaningrum

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012034

Preparation of CaCO₃/MgO from Bangkalan's dolomite for raw biomaterial

S P Sholicha, W Setyarsih, G J Sabrina and L Rohmawati

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012035

Evaluation of melting behaviour of Nickel, Titanium, and NiTi alloy using EAM and MEAM type potential

R Anfin, M Malyadi, Munaji, G A Buntoro and Darminto

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012036

Specific capacitance of composite electrode activated carbon/rGO of coconut shell (*Cocos nucifera*) as supercapacitor electrode

L Rohmawati, S H Intifadhah, W Setyarsih and Tukiran

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012037

The validity of Four-Tier's misconception diagnostic test for Work and Energy concepts

S Anggrayni and F U Ermawati

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012038

Phase composition and particle size distribution in Mg(Ti_{1-x}Sn_x)O₃ powders

F U Ermawati, M H Ahfa and Supardiyo

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012039

Students' responds in using Beboo to learn Static Fluid concept

A S Adam, N Suprpto, A Kholiq and H Mubarak

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012040

Using Inquiry-Based Laboratory to improve students' Higher Order Thinking Skills (HOTS)

H Mubarak, N Suprpto and A S Adam

+ Open abstract [View article](#) [PDF](#)

OPEN ACCESS 012041

Analysis of High School Physics National Examination questions based on Bloom Taxonomy and National Examination Question Standard in 2017/2018

A Nurlailiyah, U A Deta, L N Ain, M S Haq, N A Lestari and M Yantidewi

+ Open abstract  View article  PDF

OPEN ACCESS 012042

Effect of calcination temperature on characteristics of reduced Graphene Oxide (rGO) made from old coconut shell



N P Putri, D H Kusumawati, L Agustina and Munasir

+ Open abstract  View article  PDF

OPEN ACCESS 012043

Synthesis of graphene/polyaniline nanocomposite for supercapacitor electrodes

A Maddu, R A Nugroho, E Rustami, S Arjo and M Hidayat

+ Open abstract  View article  PDF

OPEN ACCESS 012044

Pharmacokinetics simulation of Metformin in type 2 Diabetes Mellitus



A Kartono, S Malik, H Syafutra, ST Wahyudi and T Sumaryada

+ Open abstract  View article  PDF

OPEN ACCESS 012045

Analysis of student's conceptual understanding on the work and energy of online hybrid learning

I Zulfa, S Kusairi, E Latifah and M N R Jauharyyah

+ Open abstract  View article  PDF

OPEN ACCESS 012046

Cycle stability of activated carbon/PANI composite as supercapacitor electrode based on natural material



N Anggraini, L Rohmawati and W Setyarsih

+ Open abstract  View article  PDF

OPEN ACCESS 012047

Practicality of Performance Assessment Instruments in Measurement Topic 10th Grade Secondary School



A Lutfiyah and Z A I Supardi

+ Open abstract  View article  PDF

OPEN ACCESS 012048

Synthesis and Characterization of Fe₃O₄@rGO Composite with Wet-Mixing (ex-situ) Process



Munasir and R P Kusumawati

+ Open abstract  View article  PDF

OPEN ACCESS 012049

Reinforcing Scientific Skills Based on Laboratory for Pre-Service Physics Teacher by Measurement System Understanding



N A Lestari, U A Deta, M Yantidewi and R Firmansyah

+ Open abstract  View article  PDF

OPEN ACCESS 012050

Synthesis and characterization of Fe₃O₄/SiO₂ composite with in-situ method: TEOS as SiO₂ NPs precursor



Munasir and A Terraningtyas

+ Open abstract  View article  PDF

OPEN ACCESS 012051

How the Predict-Observe-Explain (POE) learning strategy mediates students' misconception on Temperature and Heat materials?


S Latifah, I Inwandani, A Saregar, R Diani, O Fiani, W Widayanti and U A Deta

+ Open abstract  View article  PDF

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Analysis of physics teacher competence in post-SM-3T teacher education program



Suliyannah, S Admoko, B K Prahani, Yusrizal, S Astutik and R Pangastuti

+ Open abstract  View article  PDF

OPEN ACCESS 012053

The implementation of integrated remediation with conceptual interactive learning on momentum and impulse in senior high school

H T M Silitonga, T Djudin, E Oktavianty and Rooshardini

+ Open abstract  View article  PDF

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Analysis of physics teacher competence in post-SM-3T teacher education program

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Abstract. This study aims to analyze the competence of physics teachers in teacher education programs (i.e. PPG) post-SM-3T. The data of physics teacher competence is measured by using the Physics Teacher Competence Test Instrument (PTCTI). The subjects of this study were students of Teacher Education Program Post-SM-3T in 2018. The data analysis used the qualitative descriptive method. The results of this study indicate that (1) The average of physics teacher competence is 38.89 (Low); (2) The competence of professionalism is the difficulty of physics teachers to interpret problem-solving that requires multi-representation and high-order thinking skills; and (3) The pedagogic competence, especially in designing and implementing physics lesson is still low. The implication of this research is the need to increase the competence of physics teachers through innovative learning that has been declared qualified (valid, practical, and effective).

1. Introduction

Competence becomes the main requirement of teachers to be able to perform tasks professionally to achieve the goals of the curriculum and ideals of the Indonesian nation. According to Law Number 14 the Year 2005 on Teachers and Lecturers, competence is a set of knowledge, skills, and behaviors that must be possessed, experienced, and mastered by teachers or lecturers in performing professional duties. Teachers are the most important factor for learners especially during the learning process [1]. Teachers are the determinants of what is taught in the classroom and how to teach it [2]. The quality of education in schools is determined and accounted for by teachers [3]. The quality of teachers will have a direct impact on student's competence [4-5]. This is reinforced by opinions [6] that the nature of competence is the mental and physical force to perform the learned tasks or skills through practice and practice. According to Mulyasa, the competence of teachers is a combination of personal, scientific, technological, social, and spiritual capabilities that form the competence of teacher professional standards, which include mastery of materials, understanding the learners, educational learning, personal development and professionalism [7]. Teacher competence based on Law Number 14 the Year 2005 which furthermore regulated in Government Regulation Number 19 the Year 2005 is that



teacher must have pedagogic, personality, social and professional competence. Teacher's competence becomes the main part that must be owned by a teacher to maximally carry out their duty to educate the life of Indonesian nation through education. Based on the literature review conducted by the researchers, it was decided that the focus of this research is on physics teacher competence in terms of pedagogic and professional competence.

According to [8], there is an academic qualification and pedagogic competence (formulated in Permendiknas Number 16 Year 2007 regarding Academic Qualification Standards and Teacher Competencies) that pedagogic competence consists of: (1) Mastering the characteristics of learners from the physical, moral, spiritual, social, cultural, emotional, and intellectual, (2) Mastering learning theories and principles of educational learning, (3) Developing curriculum that is related to subjects, (4) Organizing educational learning, (5) Utilizing information and communication technology for the sake of learning, (6) Facilitating the development of potential learners to actualize various potentials, (7) Communicating effectively, empathically and courteously with learners. Pedagogic competence includes not only planning, implementing and assessing the learning but also mastering the science of education (formulated in PP RI No. 19 the Year 2005). Educational science is needed because the teacher must know the insights about the existing education so that the teacher can prepare an effective and efficient strategy that should be used. Pedagogic competence is the ability in the management of learners which includes (a) understanding the knowledge or educational base, (b) understanding the learners, (c) curriculum or syllabus development, (d) learning design, (e) implementation of educational and dialogical learning, (f) evaluation of learning outcomes, and (g) development of learners to actualize their potentials [6]. Understanding the insights or educational platform is a pedagogic competence that must be had by teachers because teachers must understand the concept of education. Teachers have a scientific education background so that they have academic and intellectual expertise in their respective fields. Teachers must have a function and role in educational institutions and the national education system in the hope that they can innovate education in Indonesia. Learning system in education is based on subjects so that teachers must have a suitability between the background of science with their expertise subjects, in addition, teachers have knowledge and experience in the implementation of learning in class so that they can adjust themselves to face the learners [9].

According to the National Education Standards Agency (2006) in the book of Teacher Competence Improvement Through Training and Learning Resources Theory and Practice [6], professional competence is The ability of mastering the learning materials widely and deeply include; (a) the concepts, structures, and methods of science / technology / art that are coherent / coherent with teaching materials; (b) teaching materials that are presented in the school curriculum; (c) conceptual relationships among related subjects; (d) application of the science in everyday life concept; and (e) professional competence in a global context while maintaining national cultural values. Professional competence can only be done by people who have a profession so that the professional teacher is a teacher who mastered the learning materials to be transferred to learners to meet the established competency standards [9]. A professional physics teacher is a teacher who has a broad mastery of physics and learning materials. The above description shows how important the competence of physics teachers to prepare golden Indonesia in 2045. Therefore, research and innovation are needed to improve the competence of physics teachers in Indonesia.

The above expectation contradicts the preliminary study results in Teacher Education Program Surabaya State University that were conducted by researchers in 2017-2018 which stated that many physics teachers competence is still relatively low. Candidates for physics teachers also need to know pedagogic content knowledge even though they have not yet taught about it because pedagogic content knowledge will not appear when someone becomes a teacher [10-12]. These results are the problem that must be solved in order to maintain the quality of education in Indonesia. The alternative that has been prepared by the government of the Republic of Indonesia is with the Post SM-3T Teacher Education Program. SM3T is an Indonesian government program to optimize the fresh graduate process to educate in the foremost, outermost and underdeveloped areas. In the SM3T, the physics teacher education graduates will feel the inland areas, with illiterate public life and inadequate educational facilities. The physics teacher education graduates will teach students in remote areas with

less developed societies' education, especially in Indonesia. Physics education teacher graduates will be selected and dispatched to these areas to serve one year of service. All costs are borne by the government as a whole. The physics teacher education graduates who have already performed 1-year service in the foremost, outermost and underdeveloped areas, will get the opportunity to follow Teacher Education Program (i.e. PPG) for 1 year with the borne cost by the government, starting from tuition, monthly, dormitory, and health. Not only that, scholars will also get educational guidance from professional education experts. To prepare the post SM3T Teacher Education Program that is held by Surabaya State University to run effectively, it is required the initial data through preliminary study to see physics teachers competence before following the Post SM3T Teacher Education Program at Surabaya State University. Therefore, the focus of this study aims to analyze the competence of physics teachers in post SM3T teacher education programs. The results of the study are expected to provide fundamental implications and benefits on improving process quality and learning outcomes in Post SM3T Teacher Education Program at Surabaya State University.

2. Experimental Method

2.1 General Background of Research

This research is a pre-experiment research. The main objective of this research is to analyze the physics teacher's competence in Post SM3T Teacher Education Program of Surabaya State University (Indonesia) in 2018.

2.2 Sample of Research

The subject of this research was students of Post SM3T Teacher Education Program of Surabaya State University (Surabaya, Indonesia). The used technique to determine the sample of this research was purposive sampling. This to facilitate the research process that had limited time. The selected students of Post SM3T Teacher Education Program were 18 physics teacher of the 6th-grade physics education year 2018.

2.3 Instrument and Procedures

The physics teacher's competence data was measured by using the Physics Teacher Competence Test Instrument (PTCTI). This instrument has been declared valid and reliable by the drafting team. The research procedures include: (1) At the beginning of the meeting at the Post SM3T Teacher Education Program of Surabaya State University, the physics teachers were given the Physics Teacher Competence Test Instrument (PTCTI). (2) The time to complete PTCTI is 100 minutes. (3) Then a brief interview is conducted to find out the initial profile of the physics teacher competence. (4) The answers of the PTCTI results were analyzed by the researchers. (5) Creating a report. Some examples of PTCTI items are presented in Appendix.

2.4 Data Analysis

The physics teacher competence data was analyzed by using qualitative descriptive. This qualitative descriptive result will be used as a report and evaluation material in teaching and learning process of Post SM3T Teacher Education Program Post of Surabaya State University (Indonesia) in 2018, especially the 6th grade of physics teacher year 2018.

3. Result and Discussion

The results are presented in Table 1 which will be described as follows.

Table 1. Score of physics teacher competence.

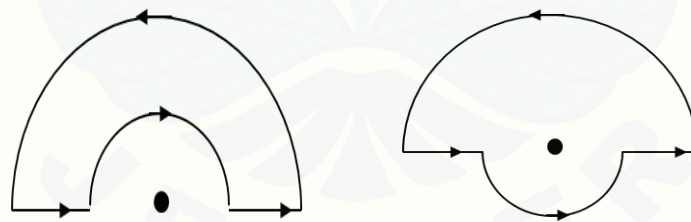
Initial Physics Teacher	Number of Correct Answers (50 Questions)	The Score of Physics Teacher Competence
T1	23	46.00
T2	27	54.00

Initial Physics Teacher	Number of Correct Answers (50 Questions)	The Score of Physics Teacher Competence
T3	18	36.00
T4	33	66.00
T5	17	34.00
T6	14	28.00
T7	20	40.00
T8	13	26.00
T9	20	40.00
T10	18	36.00
T11	15	30.00
T12	9	18.00
T13	31	62.00
T14	18	36.00
T15	18	36.00
T16	14	28.00
T17	24	48.00
T18	27	54.00
Average		39.89

Table 1 shows that out of 18 physics teachers who have competency score above 50 are only 3 people (T4, T13, and T18). 15 physics teachers have only a competency score below 50. This indicates the low competence of physics teachers after the SM3T program. This finding is used as a foundation for learning during PPG at Surabaya State University. Many aspects still need to be improved to produce qualified physics teachers. Some of the findings from the Physics Teacher Competence Test Instrument (PTCTI) will be described below.

Example 1.

Look at the following electrically wired loop image!



The strength of electric current on both loops equals to I , the radius of the small circle is r and the large circle is $2r$. The magnitude and direction of the magnetic induction at the center point of the circle segment in the left and right images are ____.

- A. $\frac{3\mu_0 I}{8r}$ the direction goes into the image area and $\frac{\mu_0 I}{8r}$ the direction goes out of the image area
 - B. $\frac{\mu_0 I}{8r}$ the direction goes into the image area and $\frac{3\mu_0 I}{8r}$ the direction goes out of the image area
- (Answer)
- C. $\frac{3\mu_0 I}{4r}$ the direction goes into the image area and $\frac{\mu_0 I}{4r}$ the direction goes out of the image area

- D. $\frac{\mu_o I}{4r}$ the direction goes into the image area and $\frac{3\mu_o I}{4r}$ the direction goes out of the image area

Example 2.

An object of mass m moves horizontally on the floor with a coefficient of friction μ then pouncing the spring until the spring is suppressed maximally as far as x , if the spring elasticity constant is k while the acceleration of gravity is g . Then the magnitude of the velocity of the object just when it will spike the spring is _____.

- A. $\sqrt{x} \left(2\mu g + \frac{kx}{m} \right)$
 B. $\sqrt{x} \left(2\mu g + \frac{kx}{m} \right)^{1/2}$ (Answer)
 C. $x \left(\mu g + \frac{kx}{m} \right)^{1/2}$
 D. $x^2 \left(2\mu g + \frac{kx}{m} \right)^{1/2}$

Based on the problems in Example 1 and Example 2 above, physics teachers still have many errors. The findings indicate that physics teachers find it difficult to solve problems that require high-level reasoning. Some previous researchers indicate that students' understanding of physics concepts remains low (e.g. Newtonian mechanics [13-16], electric circuit [17]).

Example 3.

Here is presented the material topics/sub material topics in physics

- | | |
|-------------------------|---------------------------------|
| a. Magnitude and Unit | b. Acceleration for a moment |
| c. Average acceleration | d. Vector and scalar quantities |
| e. Movement | f. Average speed |
| g. Distance | h. Immediate velocity |

The order/hierarchy of the most appropriate material presentation to achieve Basic Competence "Analyzing physical quantities on a straight motion with constant velocity and straight motion with constant acceleration" is _____.

- A. 1, 5, 7, 6, 8, 3
 B. 4, 5, 6, 7, 3, 2
 C. 1, 5, 7, 6, 8, 3
 D. 5, 7, 6, 8, 3, 2

Example 4.

A suitable indicator formulation of Basic Competency 'describes the circuit and working principle of the electrical appliances in the direction of DC and the alternating current (AC) in everyday life is _____.

- A. Analyze direct current electric circuits based on graph
 B. Formulate replacement resistance equations in series and parallel circuits
 C. Compare large voltages between series and parallel circuits
 D. Explain the voltage characteristics, electric current strength, and resistance in series and parallel circuit (Answer)

Example 5.

Mr. Tono undertook the core activities of learning as follows: 1) showing a video setting the angle of fire to adjust the height of shoot targets on sports firing, 2) asking questions about video content, 3) forming small heterogeneous groups, submitting group assignments to find track equations and

distance, 4) conveying a number of keywords as an alternative to answer questions, 5) being a facilitator and motivator when learners perform group work, 6) giving opportunities to group representatives to deliver their group work and 7) engaging learners to make a conclusion. Mr.Tono is applying the learning model of _____.

- A. *Discovery Learning* (Answer)
- B. *Problem Based Learning*
- C. *Cooperative Learning*
- D. *Problem Solving*

Based on the questions in Example 3, Examples 4 and Example 5 above, physics teachers still have many errors. The findings show that physics teachers have difficulties in designing and implementing physics lessons. The results of other studies indicate that the evaluation of the trend of educational quality on the target of teacher's learning plan in Indonesia has not been achieved [18]. These findings reinforce the idea that the competition will be obtained completely when a prospective teacher has taught in the real class. Candidates for physics teachers also need to know pedagogic content knowledge (PCK) even though they have not yet taught about it because PCK will not appear when someone becomes a teacher [10-12]. The results of this study provide major implications for improving the quality of processes and learning outcomes in Post SM3T Teacher Education Program of Surabaya State University. The improvement can be done by using qualified (valid, practical, and effective) learning, teaching, and learning media to improve the competence of physics teachers, among others: (1) Problem-based hybrid learning model in physics teaching to enhance critical thinking [19]; (2) Multi representation based on scientific investigation for enhancing students' representation skills [20-21]; (3) Critical inquiry based learning model to promote critical thinking ability of pre-service teachers [22-23]; (4) C3PDR teaching model to improve students' scientific creativity [24]; (5) Physics independent learning model to improve physics problem solving and self-directed learning skills [25]; (6) INQF-based learning on a general physics for improving student's learning outcomes [26]; and (7) Innovative learning models based on inquiry to improve process performance and high-level skills [27-29]. The above innovations need to be implemented to increase the importance of the competence of qualified physics teachers to prepare golden Indonesia in 2045.

4. Conclusion

The results of this study indicate that (1) The average competence of novice physics teachers is 38.89 (Low); (2) Competence of professionalism is the difficulty of novice physics teachers to interpret problem-solving that requires multi-representation and high-order thinking skills; and (3) pedagogic competence, especially in designing and implementing physics lesson is still low. The implications of this research are the need to improve the competence of novice physics teachers through learning, teaching, and innovative learning media to improve the competence of physics teacher that has been declared qualified (valid, practical, and effective).

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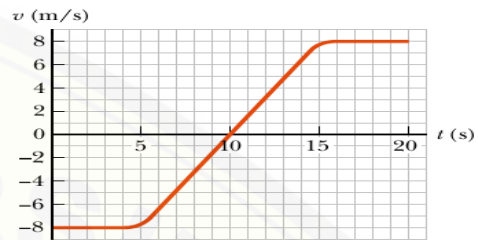
Appendix

PHYSICS TEACHER COMPETENCE TEST INSTRUMENT

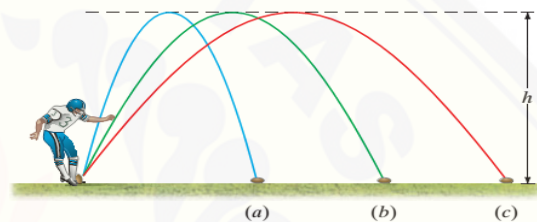
Hint:

Choose the correct answer by crossing [X] on the answer sheet provided!

- The time-velocity graph ($v-t$ graph) of an object is given by the image next to this. The description of the object's motion from $t = 5$ s to $t = 15$ s are _____.
 - The object is always accelerated
 - The object is always slowed
 - The objects are slowed until stop and then reversed and accelerated
 - The object is accelerated until stop then reversed and slowed

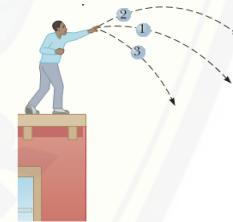


- Look at the picture on the side. The three spherical trajectories have the same maximum height h . The longest ball trajectory form in the air is _____.
 - (a)
 - (b)
 - (c)
 - (a) = (b) = (c)



- Spring 1 has a spring constant k . The spring constant of spring 2 is unknown. The parallel arrangement of these two springs is hung and loaded with a mass of m . The load is pulled down then released so that the oscillation motion occurs with the period $T_p = 2\pi\sqrt{(2m / 3k)}$. Spring 2 is hung by load m then withdrawn and released until it oscillates. The ratio of the oscillating period of the parallel spring arrangement to the oscillation period of spring 2 is _____.
 - $1 : \sqrt{3}$
 - $\sqrt{3} : 1$
 - $2 : \sqrt{3}$
 - $\sqrt{3} : 2$

- A person at the top of the building throws three identical balls of the same initial speed but in different directions as shown by the picture on the side. The swipes of the ball with air can be ignored. The truest statement about the speed of the ball when it hits the ground is _____.
 - $v_2 > v_1 > v_3$
 - $v_3 > v_1 > v_2$
 - $v_2 = v_1 = v_3$
 - $v_1 > v_2 > v_3$



- The picture shows a pipe-shaped wheel with radius (the mass is centered on a pipe) and a disc of the same mass and radius.



When the two wheels rotate at the same angular velocity, the kinetic energy of the wheel's rotation is _____.

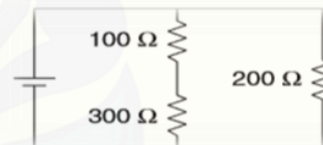
- Both of them have the same kinetic rotational energy
- The pipe wheel has twice kinetic rotational energy of the disc wheel's
- The disc wheel has twice kinetic rotational energy of the pipe wheel's
- The disc wheel has a larger kinetic rotational energy but is not twice of the pipe wheel's

6. An ideal fluid flows through a pipe whose cross-sectional diameters vary. The height of the pipe position is also varied. The true statements is ____.
- The pressure decreases as the diameter and height of the pipe decreases
 - The pressure increases as the diameter and height of the pipe increase
 - The pressure decreases as the diameter decreases and the height of the pipe increases
 - The pressure increases as the diameter decreases and the height of the pipe increases
7. Look at the picture below!



- The correct statement about the nature of the gas in this same volume vessel is ____.
- If the temperature is the same, then the large pressure vessel has the smallest number of gas molecules
 - If the temperature is the same, then in a large pressure vessel the molecule moves faster
 - If the number of molecules is the same, the gas in the low-pressure vessel moves its molecules more rapidly
 - If the number of molecules is the same, the gas in a large pressure vessel has a higher temperature
8. The Superposition of two waves runs on the rope $y_1 = A \sin(kx - \omega t)$ and $y_2 = A \sin(kx + \omega t)$ produce the resultant wave $y_r = 2A \sin kx \cos \omega t$. Which of the following statements is WRONG about the resultant wave?
- It is a silent wave.
 - It has an amplitude of $2A$.
 - It has a wavelength of $(2\pi / k)$.
 - The points on the rope vibrate harmoniously with the amplitude of $2A \sin kx$.

9. The following figure shows three resistors that are connected in an electrical circuit with a battery. Which is the order of electrical energy magnitude that is dissipated by any true resistors?
- $E_{200\Omega} > E_{200\Omega} > E_{100\Omega}$
 - $E_{200\Omega} > E_{100\Omega} > E_{200\Omega}$
 - $E_{200\Omega} > E_{300\Omega} > E_{100\Omega}$
 - $E_{200\Omega} > E_{100\Omega} > E_{300\Omega}$



10. In a photoelectric experiment, no electrons are released if the light energy that hit the metal is less than $h\nu$ with h is Planck's constant. ν is ____.
- The maximum frequency that is required to release electrons that have the smallest kinetic energy
 - The minimum frequency that is required to release electrons that have the greatest kinetic energy
 - The maximum frequency that is required to release electrons that have the greatest kinetic energy
 - The minimum frequency that is required to release electrons that have the smallest kinetic energy
11. If the wavelength that carries the largest radiation energy is longer, then the temperature of the black body ____.
- Will be larger at the whole wavelength value
 - Will be smaller at the whole wavelength value
 - Will be larger at the high wavelength and smaller at low wavelengths
 - will be larger at the low wavelength and smaller at high wavelength
12. A radioactive element has a half-life of 20 days. The amount of the radioactive substance that has not decayed after 60 days is ____.
- 1/2 part
 - 1/4 part
 - 1/8 part
 - 1/12 part
13. A set of plans and arrangements about objectives, content, and learning materials and the means used as guidelines for the implementation of learning activities to achieve specific educational objectives, is ____.
- Syllabus
 - Learning plans and programs
 - Outline of learning program
 - Curriculum

14. A learner always wants to dominate in a learning group. He does not give any other members the opportunity to express an opinion. If another friend leads and controls the course of the discussion, he breaks apart and tends to learn on his own. This learner is experiencing problems in the development of _____.
A. Social-emotional
B. Cognitive
C. Moral
D. Spiritual
15. An approach that views that students build knowledge through the process of social interaction that is implemented in learning become active and fun learning is _____.
A. *Cooperative learning*
B. *Learning observation*
C. *Constructivism*
D. *Inquiry learning*
16. The following lesson activities are presented in KD "Analyzing the relationship between force, mass, and movement of objects on a straight motion":
a. Drawing gravity, normal force, and rope tension force in the discussion of straightforward motion problems without friction
b. Discuss the influence of an object's mass and its force on the speed of motion
c. Asking the relationship between force, mass, and movement of objects in a straight motion
d. The object is withdrawn or pushed to produce motion
e. Calculate the acceleration of objects in the system that is located on the incline, the plane, and the pulley system in the class discussion.
The sequence of learning activities that are included in the act of observing, questioning, gathering information, associating, and communicating respectively is _____.
A. 4, 3, 1, 2, 5
B. 1, 3, 2, 5, 1
C. 4, 3, 2, 5, 1
D. 1, 3, 4, 5, 2
17. A Physics teacher will teach learners to KD. 'Analyzing the relationship between force, mass, and movement of objects in a straight motion'. The required prerequisite of knowledge is _____.
A. Knowledge of displacement and distance concept
B. Knowledge of vector and scalar quantities
C. Knowledge of mass and acceleration concept
D. Knowledge of speed and velocity concept
18. Doing item analysis on a subject to know its consistency to measure student's ability is by doing analysis about _____.
A. Qualitative and analysis
B. The Form and type of questions
C. The differentiating power of the item
D. The question's reliability level
19. From the following PTK (classroom action research) problem formulation, which is the best formulation of PTK problem?
A. Does the influence of role-playing can improve the activity of students in class XI of SMAN18 Surabaya?
B. How to improve students' ability in analyzing experimental data in Physics lesson of Class XI IPA 2?
C. Why do students of SMAN 18 Surabaya always become champions in various national competitions?
D. How to use props that come from the school environment?
20. The design model of PTK lies in the flow of performed action. It is also a marker or a special feature that distinguishes PTK with other types of research. The flow of action research here is _____.
A. Observation -> reflection -> planning -> implementation of action
B. Reflection -> planning -> implementation of action -> observation
C. Planning -> observation -> action execution -> reflection
D. Planning -> action implementation -> observation -> reflection