

**Final Report of Project**

Project No. : 2014 /0600

**Part A**

Project Title: Short Video Clips for Self-Paced Learning of Physics-Related Maths Techniques

Name of Organization/School: Department of Applied Physics, The Hong Kong Polytechnic University

Project Period: From 05/2016 (month/year) to 05/2017 (month/year)

**Part B**

*Please read the **Guidelines to Completion of Final Report of Quality Education Fund Projects** before completing this part of the report.*

Please use separate A4-size sheets to provide an overall report with regard to the following aspects:

1. Attainment of objectives
2. Project impact on learning effectiveness, professional development and school development
3. Cost-effectiveness – a self-evaluation against clear indicators and measures
4. Deliverables and modes of dissemination; responses to dissemination
5. Activity list
6. Difficulties encountered and solutions adopted

Name of Project Leader: \_\_\_\_\_ Name of Grantee\*: \_\_\_\_\_

Signature: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: 20 July 2017

Date: \_\_\_\_\_

*\* Final Report of Project should be submitted via "Electronic Project Management System" (EPMS). Once submitted, these reports are regarded as already endorsed by the supervisor of the school/the head of the organization or the one who signed the Quality Education Fund Agreement for allocation of grant on behalf of the organization.*

## Attachment

### Attainment of Objectives

In this project, three objectives have been proposed:

- 1) To establish students' skills in basic mathematical tools pertinent to physics learning through video tutorial clips.
- 2) To enhance students' competence with the use of mathematical tools and scientific techniques as applied in physics problems.

**Table 1: Attainment of Objectives**

Objective statement	Activities related to the objective	Extent of attainment of the objective	Evidence or indicators of having achieved the objective	Reasons for not being able to achieve the objective, if applicable
Objective 1	1) Five video modules have been developed in both English and Chinese version. 2) Learning and teaching materials of corresponding video were developed.	100% attained	1) The video was used by at least 3 different high schools. 102 secondary school students were recruited from three partner secondary schools in <b>pilot run</b>	
Objective 2	1) Questionnaires were given to different high school users for feedbacks.	90% attained	1) The feedbacks from both the high school teachers and students are positive.	



**Project impact on learning effectiveness, professional development and school development**

In this project, the five video modules (“Graph Sketching”, “Logarithmic Functions”, “Trigonometry”, “Unit Conversions” and “Vectors”) have been developed in both English and Chinese version and the L&T materials for the each module are completed (100% achieved). A pilot run in three partner secondary schools was conducted between Nov 2016 and Mar 2017 and an online questionnaire was developed to collect the feedback from teachers and students. A joined workshop held in Jan 2017 introduced our video to more secondary school. All videos are uploaded \_\_\_\_\_ that can be easily accessed by anyone thus enhance the publicity. A website which hosts all the materials prepared in the project, including (1) video clips, (2) suggestions on adopting the materials in physics teaching, and (3) post-activity questionnaires for collecting users’ opinions about the platform and their confidence in tackling various topics. The L&T materials will be provided by request.

The high school teachers can use the developed video clips, worked examples, alongside with suggested teaching plans conducting the learning for their students, following the concept of ‘flipped-classroom’ practices.

**Cost-effectiveness – a self-evaluation against clear indicators and measures**

Within the first 4 months, we have developed 2 video modules (Trigonometry and Vector) and launched the video modules to 3 partner schools \_\_\_\_\_ ) for pilot run. Based on the feedback and suggestion from users, we completed five video modules within the project period. A joined workshop held in Jan 2017 introduced our video to more secondary school. The stated objective for report period has been attained (with over 85% achieved) Sharing session has been organized in early May to collect teachers’ experience over this project.

**Table 2: Budget Checklist**

<b>Budget Items</b> <i>(Based on Schedule II of Agreement)</i>	<b>Approved Budget</b> <b>(a)</b>	<b>Actual Expense</b> <b>(b)</b>	<b>Change</b> <b>[(b)-(a)]/(a)</b> <b>+/- %</b>
Staff	144,963	144,963	0%
General Expense	5037	5000	-0.7%

**Deliverables and modes of dissemination; responses to dissemination**

A website ([http://ap.polyu.edu.hk/apshchoy/qef\\_project\\_2014\\_0600.html](http://ap.polyu.edu.hk/apshchoy/qef_project_2014_0600.html)) which hosts all the materials prepared in the project, including (1) suggestions on adopting the materials in physics teaching, (2) video clips (in both English and Chinese) (3) post-activity questionnaires for collecting users’ opinions about the platform and their confidence in tackling various topics and (4) L&T materials (such as the pre-test and

10/10

post-test) was developed and the screen captures of the developed webpage were shown in Figure 1. Figure 2 shows the screen captures the video clip “Trigonometry”.

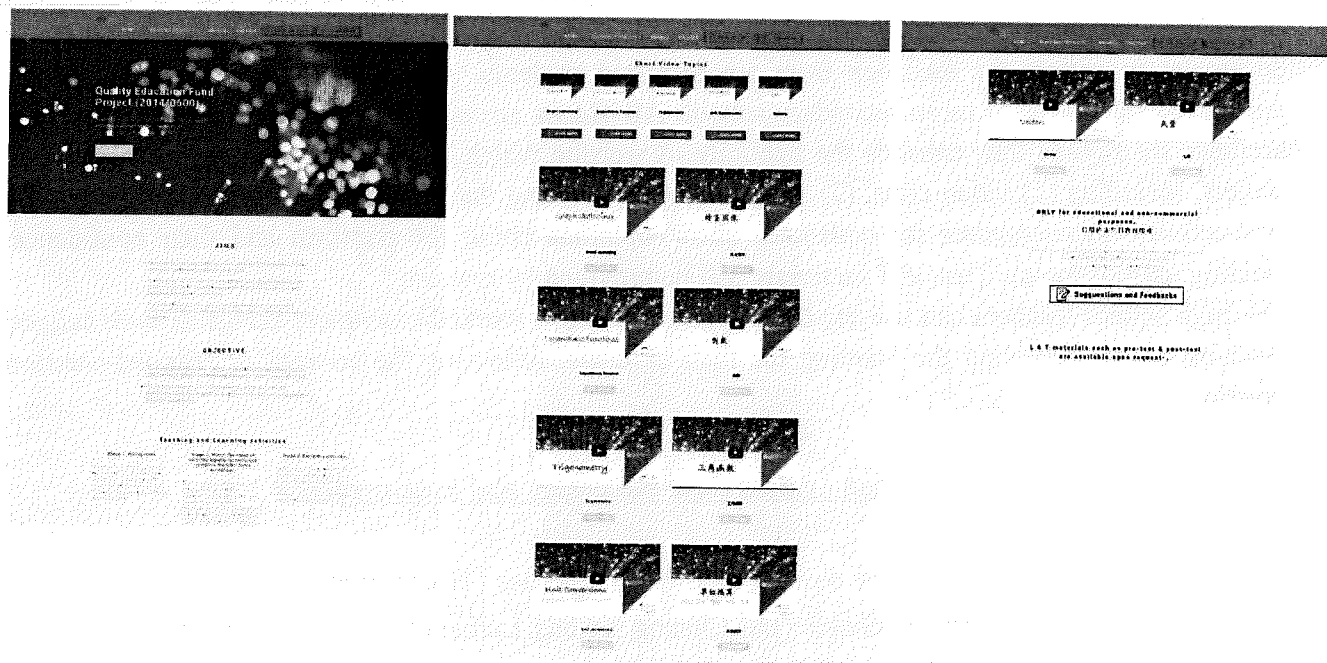


Figure 1 Screen captures of the developed webpage.

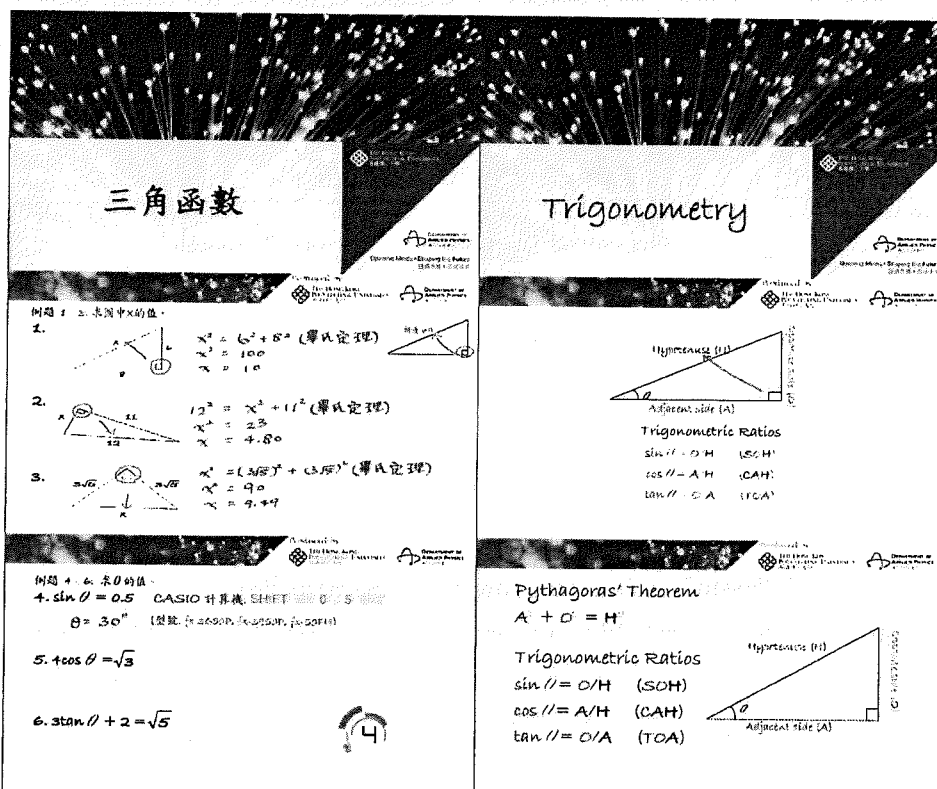


Figure 2 Screen captures of the video clip of “Trigonometry” (English and Chinese versions).

This form/guidelines can be downloaded from the QEF webpage at <http://qef.org.hk>.

Students and teachers can view the video clips on the developed website or on Youtube platform. Publish the video clips on Youtube platform will have a better publicity in this project and students can be easily accessed by smartphone applications which may enhance their learning experience. Table 1 summarized all the links on Youtube and its corresponding QR code for easy access.

Table 1 Summary of video clips and the corresponding QR code.

English Version	中文版本
<p>Graph sketching</p> 	<p>繪畫圖像</p> 
<p>Logarithms</p> 	<p>對數</p> 



<p>Trigonometry</p> 	<p>三角函數</p> 
<p>Unit conversions</p> 	<p>單位換算</p> 
<p>Vector</p> 	<p>矢量</p> 

The “L&T materials” and “suggestions on adopting the materials in physics teaching” is available by request through the webpage or by email. It allows a better control of the teaching materials only be accessed by teacher only but not students. As a result, teachers can have a higher flexibility and time saving by using the materials directly.

**Table 3 Dissemination Value of Project Deliverables**

Item description (e.g. type, title, quantity, etc.)	Evaluation of the quality and dissemination value of the item	Dissemination activities conducted (e.g. mode, date, etc.) and responses	Is it worthwhile and feasible for the item to be widely disseminated by the QEF? If yes, please suggest the mode(s) of dissemination.
A platform (webpage and Youtube) for Short Video Clips for Self-Paced Learning of Physics-Related Maths Techniques	1. Focus Group Interview Report (details see below)  2. Online Questionnaire (details see below)	A pilot run of the “Short Video” has been implemented in TWGHs Wong Fung Ling College Nov 2016 and Mar 2017. A focus group interview was conducted after the pilot run in April. 16 participants were invited to comment and share their experience on short video module of “Trigonometry”.  Online Questionnaire Student Feedback Survey was conducted by the Hong Kong Academy for Gifted Education on 11 Aug 2016. 27 participants completed the survey with 23 items from 1 (Strongly Disagree) to 4 (Strongly Agree). The responses are summarized below.	Yes. Through internet.

### Summary of the Focus Group Interview Report

A pilot run of the “Short Video” has been implemented in TWGHs Wong Fung Ling College Nov 2016 and Mar 2017. A focus group interview was conducted after the pilot run in April. 16 participants were invited to comment and share their experience on short video module of “Trigonometry”.

#### Advantages of Video modules

Participants were satisfied with the learning experience. 80% of interviewees agreed the video is useful for their self-learning and self-revision purpose. 75% of the interviewees agreed the watching video provides a

higher flexibility than the lesson in school.

#### Disadvantages of Video modules

However, there are some drawbacks. First, around 30% of them thought there is a great different in level of difficulty between the pre-test and post-test. In the pilot run, there are 5 questions and 10 questions in the pre-test and post-test, respectively. The questions in the pre-test are simply, straight forward but the questions in post-test are more complicated. Over a half of questions in the post-test required more than 3 calculation steps to get the final answer. Students may lose all the marks if the any calculation step is wrong. In addition, around 40% of them thought there is a time indicator during the activities in the video helps them to have a better time control in the activities with calculation.

#### Suggestion/Improvement of Remote Lab

Finally, participants provided valuable suggestion to improve the video modules. The most concern of them is the difficulty between the pre-test and post-test. One third of them denoted parts of post-test are difficult. . Meanwhile, they suggested to have a pre-test and post-test with similar difficulty in level and have same number of questions in both tests. They can compare the result between pre- and post- tests as self-learning performance indicator to monitor their learning progress. In order to provide a better using experience for the user, a count-down timer was added in each activity. Student will have a better time control for working on the provided questions in the activities.

#### Conclusion

To conclude, video modules covered some important mathematics tools which is commonly used in physics. Student can make use of the videos as a platform for self-learning / self-revision purpose which enhance students' centered learning.

#### **Online Feedback Questionnaire**

Four “Five-point-scaled” questions were asked about general point of view about the video modules, such as teaching skill, quality of materials, teaching design and the time control. The results were shown in Figure 3. Over 85% of teachers/students have positive feedback on the video modules. The average score of Q1 to Q 4 are 3.73, 3.80, 3.64 and 3.61, respectively. Feedback of individual topics also included in the questionnaire and the finding is shown in Figure 4.

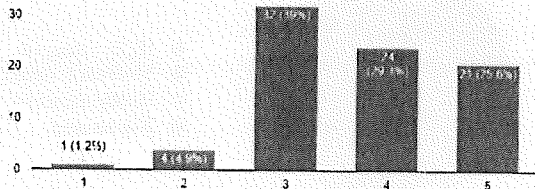




Q1: Teaching Skill of Video

教學表達技巧

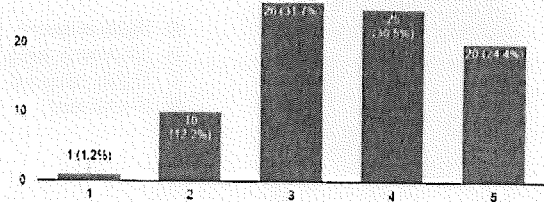
：明回答



Q3: The teaching design of Video

授課方式設計

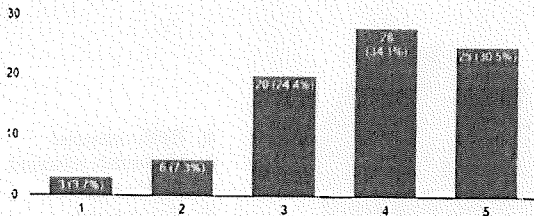
：明回答



Q2: Quality of the teaching materials of Video

教材內容的實用性

：明回答



Q4: Time Control of the Video

時間掌控方面巧

：明回答

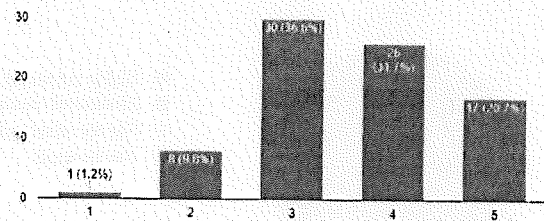
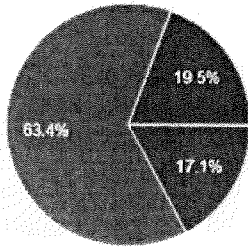


Figure 3 Finding in the questionnaire about their views of the video modules.

**Graph sketching**

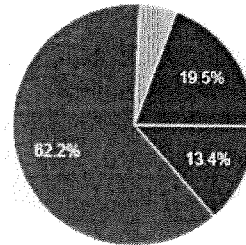
82 則回應



- Highly enhanced
- Moderately enhanced
- Slightly enhanced
- Not be used

**Unit conversions**

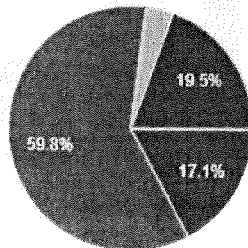
82 則回應



- Highly enhanced
- Moderately enhanced
- Slightly enhanced
- Not be used

**Logarithms**

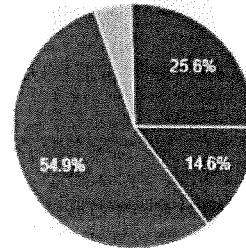
82 則回應



- Highly enhanced
- Moderately enhanced
- Slightly enhanced
- Not be used

**Vector**

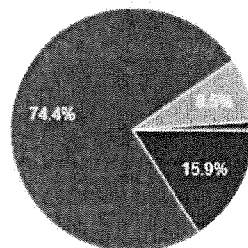
82 則回應



- Highly enhanced
- Moderately enhanced
- Slightly enhanced
- Not be used

**Trigonometry**

82 則回應



- Highly enhanced
- Moderately enhanced
- Slightly enhanced
- Not be used

**Question:**

What is the level of enhancement in your ability / performance after watching the video?

Figure 4 Summary of the rating of individual topic in the video module.

According to the finding of the questionnaire, over 90% of the users can have moderately or highly enhancement in their ability in the specified area after watching the video. To conclude, participants gave positive feedback and most of them were inspired and satisfied with the video modules. They have tried something new which enhanced their learning motivation.



### Activity list

Types of activities (e.g. seminar, performance, etc.)	Brief description (e.g. date, theme, venue, etc.)	No. of participants				Feedback from participants
		schools	teachers	students	others (Please specify)	
Pilot- run of video modules	Nov 2016 – Mar 2017, partner schools	3	3	>80		The general feedbacks from the students and teachers are good.
A the joined QEF workshop of “Flipped Classroom Learning – Physics Laboratory with “AP-Sensor”	10 <sup>th</sup> Jan, 2017 in Room CD620, The Hong Kong Polytechnic University	>10	>10	Nil	members of science education sections, CDI,EMB.	The comments from the teachers are positive.

### Difficulties encountered and solutions adopted

Nil



**Appendix:** Pre-test and Post-test of “Trigonometry”

Pre-test

**Solution**

Q.1 – 2: Solve the equations.

1.  $\cos \theta = \frac{\sqrt{3}}{2}$

$$\cos \theta = \frac{\sqrt{3}}{2}$$

$$\theta = 30^\circ$$

2.  $3 \tan \theta + 2 = 0$

$$3 \tan \theta + 2 = 0$$

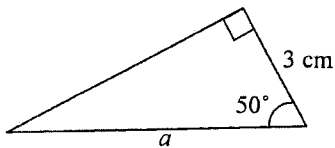
$$\tan \theta = -\frac{2}{3}$$

$$\theta = -33.7^\circ$$

$$= 146^\circ$$

Q.3 – 6: Find the unknown marked lengths and angles in the following figures.

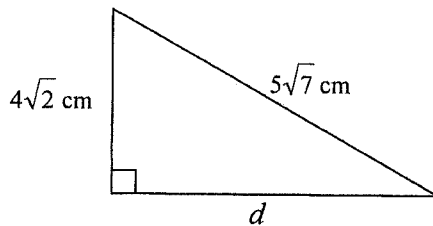
3.



$$\cos 50^\circ = \frac{3}{a}$$

$$a = 4.67 \text{ cm}$$

4.

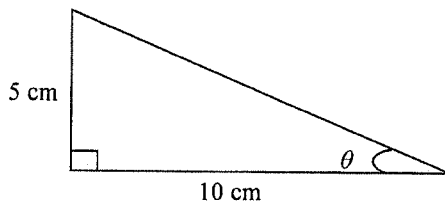


$$d^2 + (4\sqrt{2})^2 = (5\sqrt{7})^2 \quad (\text{Pythagoras' Theorem})$$

$$d = \sqrt{175 - 32}$$

$$= 12.0 \text{ cm}$$

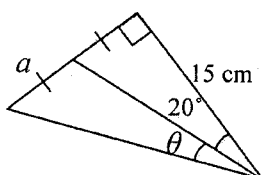
5.



$$\tan \theta = \frac{5}{10}$$

$$\theta = 26.6^\circ$$

6.



$$\tan 20^\circ = \frac{a}{15}$$

$$a = 5.46 \text{ cm}$$



$$\tan(20^\circ + \theta) = \frac{2a}{15}$$

$$\tan(20^\circ + \theta) = \frac{2 \times 5.46}{15}$$

$$20^\circ + \theta = 36.1^\circ$$

$$\theta = 16.1^\circ$$

### Post-test

### Solution

Q.1 – 2: Find the values of  $\theta$ .

1.  $\sin \theta = 0.8$

$$\sin \theta = 0.8$$

$$\theta = 53.1^\circ$$

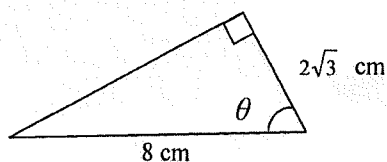
2.  $\tan 60^\circ = \frac{4}{x}$

$$\tan 60^\circ = \frac{4}{x}$$

$$x = 2.31$$

Q.3 – 6: Find the unknown marked lengths and angles in the following figures.

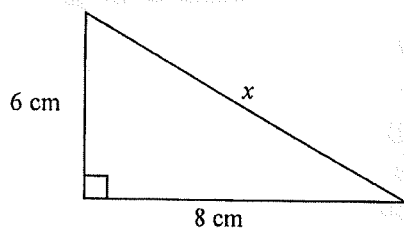
3.



$$\cos \theta = \frac{2\sqrt{3}}{8}$$

$$\theta = 64.3^\circ$$

4.

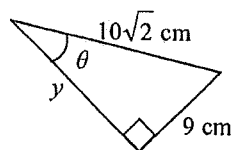


$$x^2 = 6^2 + 8^2 \text{ (Pythagoras' Theorem)}$$

$$x = \sqrt{100}$$

$$= 10 \text{ cm}$$

5.



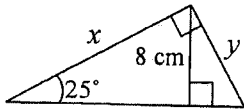
$$y^2 + 9^2 = (10\sqrt{2})^2 \text{ (Pythagoras' Theorem)}$$

$$y = \sqrt{200 - 81}$$

$$= 10.9 \text{ cm}$$



6.



$$\sin \theta = \frac{9}{10\sqrt{2}}$$

$$\theta = 39.5^\circ$$

$$\sin 25^\circ = \frac{8}{x}$$

$$x = 18.9 \text{ cm}$$

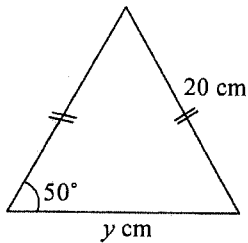
$$\tan 25^\circ = \frac{y}{x}$$

$$\tan 25^\circ = \frac{y}{18.9}$$

$$y = 8.23 \text{ cm}$$

Q.E1 – E3: Find the unknown marked lengths and angles in the following figures.

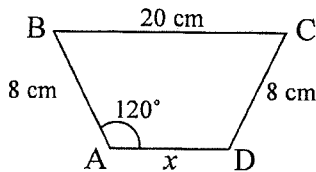
E1.



$$\cos 50^\circ = \frac{y}{20}$$

$$y = 25.7 \text{ cm}$$

E2.



Draw a line from A perpendicular to BC at X

$$\sin \angle BAX = \frac{BX}{8}$$

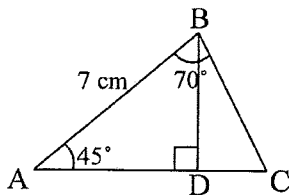
$$\sin 30^\circ = \frac{BX}{8}$$

$$BX = 4 \text{ cm}$$

$$x = 20 - 4 - 4$$

$$= 12 \text{ cm}$$

E3.



$$\sin 45^\circ = \frac{BD}{7}$$

$$BD = 4.95 \text{ cm}$$

$$AD = BD = 4.95 \text{ cm}$$



Find the length of BD and AC.

$$\begin{aligned}\angle BCD &= 180^\circ - 45^\circ - 70^\circ \\ &= 65^\circ\end{aligned}$$

$$\tan \angle BCD = \frac{BD}{CD}$$

$$\tan 65^\circ = \frac{4.95}{CD}$$

$$CD = 2.31\text{cm}$$

$$AC = 4.95 + 2.31 = 7.26\text{cm}$$

