

12

**Preliminary Exam**  
**Time: 60 minutes**

**First Semester 09/010**  
**Date: 2/10/ 2009**

Student Name: ~~XXXXXXXXXX~~ Student # ~~XXXXXXXXXX~~

ضع إشارة (X) في كل من المربع المقابل لمدرس شعبتك وعلى رقم الشعبة.

الشعبة	المدرس		الشعبة	المدرس	
8, 5	اسماعيل بدران	<input type="checkbox"/>	10, 9, 4, 3, 2	زياد سعيد	<input type="checkbox"/>
11	تيسير غاروري	<input type="checkbox"/>	1	رائد حسن	<input type="checkbox"/>
14, 13	هشام هلمي	<input type="checkbox"/>	7	يعقوب عيني	<input type="checkbox"/>
(12)	صافي صافي	<input checked="" type="checkbox"/>	6	عدنان عبدالباقى	<input type="checkbox"/>

تعليمات:

- (1) لا تفتح ورقة الامتحان حتى يسمح لك بذلك.
- (2) اكتب اسمك ورقمك في أعلى هذه الصفحة.
- (3) اختر الجواب الأكثر قربا للجواب الصحيح وانقله على هذه الصفحة، وذلك بوضع إشارة (X) في الخانة المناسبة.
- (4) السؤال الذي له أكثر من إجابة يعطى علامة صفر.
- (5) يجب إعادة أوراق الامتحان كاملة.
- (6) عدد الأسئلة 15 سؤالاً، وعدد الصفحات 4، تأكد من وجودها جميعاً.

Answer Sheet:

Q#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A														X	X
B														X	X
C	X			X	X						X				X
D					X	X			X	X		X		X	
E		X	X				X	X					X		

في هذه الخانة سواء وضعنا X أو لم نضعها  
 في خانة X يعني نفس المعنى  
 نفس المعنى

1) Consider a set of measurements for a certain physical quantity. Let  $\sigma_s$  be the sample standard deviation. The probability (احتمال) that any new measurement will not differ from the average value by more than  $\sigma_s$  is :

- a) 0.65
- b) 0.50
- c) 0.67
- d) 0.95
- e) 0.75

2) A cylinder has an inner radius of  $4.0 \pm 0.1$  cm and a length of  $15.4 \pm 0.2$  cm. the volume of water that can fill this cylinder is

$R = 4 \text{ cm}, L = 15.4$

$V = R^2 \pi L$   
 $= (4)^2 (3.14) (15.4) = 773.696$   
 $= 7.74 \times 10^2$

- a)  $774.1 \pm 48.7 \text{ cm}^3$
- b)  $774 \pm 49 \text{ cm}^3$
- c)  $464 \pm 37 \text{ cm}^3$
- d)  $(4.6 \pm 0.4) \times 10^2 \text{ cm}^3$
- e)  $(7.7 \pm 0.5) \times 10^2 \text{ cm}^3$

$\frac{\Delta V}{V} = 2 \frac{\Delta R}{R} + \frac{\Delta L}{L}$   
 $= \frac{2 \cdot 0.1}{4} + \frac{0.2}{15.4} = 0.0637$   
 $\Delta V = 49.81$

3) A boy runs at a speed of 10.35 km/h for 2.71 hours. The distance traveled during this time interval can be written to the correct number of significant figures as:

$10.35 \cdot 2.71 = 28.04$

- a) 27.945 km
- b) 27.9 km
- c) 27.94 km
- d) 28 km
- e) 28.0 km

4) Given  $x = 6046 \pm 43$ , Write  $x$  and its uncertainty in the correct form

- a)  $(6.046 \pm 0.043) \times 10^3$
- b)  $(6.09 \pm 0.04) \times 10^3$
- c)  $(6.05 \pm 0.04) \times 10^3$
- d)  $6050 \pm 40$
- e)  $(7.4 \pm 0.3) \times 10^2$

$6.050 \pm 40$   
 $(6.04 \pm 0.04) \times 10^3$

5) The number of significant figures in  $A = 0.009930$  is

- a) 7
- b) 6
- c) 5
- d) 4
- e) 3

$.009930$   
 $993 \times 10^{-5}$

6) Higher precision in a measurement is a result of

- a) Small systematic errors
- b) Large Systematic errors
- c) Large random errors
- d) Small random errors
- e) None of the above.

7) If  $A = 820.725$  and  $B = 54.0$ , Then  $A+B$  should be written as

$$820.725 + 54 = \cancel{1374.725} 874.725$$

- a) 874.725
- b) 874.72
- c) 870
- d) 875
- e) 874.7

Questions 8), 9), and 10) are related to the following statement:

A student measured the time of fall of a ball from the same height and got the following measurements,  $t = 5.75, 5.63, 5.71, 5.77, 5.84, 5.73, 5.65$  second.

8) The best estimation of the true value of the time interval is

- a) 5.738 sec
- b) 5.7 sec
- c) 5.74 sec
- d) 5.75 sec
- e) 5.73 sec

9) The sample standard deviation of the above measurements is

- a) 0.0716 sec
- b) 0.7 sec
- c) 0.072 sec
- d) 0.07 sec
- e) 0.071 sec

10) The standard deviation of the mean of the above measurements is

- a) 0.027 sec
- b) 0.02706 sec
- c) 0.01 sec
- d) 0.03 sec
- e) 0.07 sec

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Date: 9/10/2012

Time: 60 Minutes

Student Name: Adllah Iwisi

Student ID #: 1120925

ضع إشارة (x) في كل من المربع المقابل لمدرس الشعبة:

الشعبة	المدرس		الشعبة	المدرس	
10	عبدالله سيد احمد	<input type="checkbox"/>	1,4,8,11,13	زياد عزت	<input type="checkbox"/>
2,12,14	غاده دوشق	<input type="checkbox"/>	3	يعقوب عيني	<input type="checkbox"/>
15,16	ميساء ابو ريده	<input type="checkbox"/>	5	وفاء خاطر	<input type="checkbox"/>
17,18	هبة فطاطه	<input checked="" type="checkbox"/>	6	غسان انضوني	<input type="checkbox"/>
			7,9	تيسير عاروري	<input type="checkbox"/>

تعليمات الامتحان:

- لا تفتح ورقة الامتحان حتى يسمح لك بذلك.
- اكتب اسمك ورقمك الجامعي في أعلى هذه الصفحة.
- اختر الجواب الأكثر قرباً للجواب الصحيح وأنقله على هذه الصفحة وذلك بوضع إشارة (x) في الخانة المناسبة.
- السؤال الذي له أكثر من إجابة يعطى علامة صفر.
- عدد الأسئلة 15 سؤالاً وعدد الصفحات 5، تأكد من وجودها جميعاً.

Answer Sheet:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(a)						✓			✓				✓		
(b)		✓									✓				
(c)	✓						✓							✓	
(d)				✓				✓		✓					✓
(e)					✓							✓			

1) A student measured the density of a liquid to be  $10.950 \pm 0.003 \text{ g/cm}^3$ . The number of significant figures in the reported density is

- a. 3.
- b. 4.
- c. 5.
- d. 1.
- e. None of the above.

2) In the lab report for Physics 111. Your report and your partner report should

- a. have exactly the same result.
- b. have exactly the same data.
- c. have exactly the same written procedure.
- d. have exactly the same written abstract and conclusion.
- e. have all of the above.

3) A physics student measured three lengths  $A$ ,  $B$  and  $C$  in cm and a time  $T$  in seconds:

$A = 56 \pm 2 \text{ cm}$ ,  $B = 23 \pm 2 \text{ cm}$ ,  $C = 72 \pm 2 \text{ cm}$  and  $T = 2.0 \pm 0.2 \text{ sec}$ . The student then correctly calculated  $R = (A - B + C)/T$  to be

- a.  $53 \pm 6 \text{ cm/sec}$
- b.  $52 \pm 8 \text{ cm/sec}$ .
- c.  $52 \pm 6 \text{ cm/sec}$ .
- d.  $52.5 \pm 8.2 \text{ cm/sec}$ .
- e.  $52.5 \pm 6.2 \text{ cm/sec}$ .

$$56 - 23 + 72 = 105 \pm (2 + 2 + 2)$$
$$\frac{105 \pm 6}{2.0} = 52.5 \pm 3$$

b

4) If someone tells you that a block of limestone (حجر الكلس) has a mass of  $2613.5729 \pm 0.8681 \text{ kg}$ . You should report the mass of the block as

- a.  $2613.6 \pm 0.8 \text{ kg}$ .
- b.  $2613.5 \pm 0.9 \text{ kg}$ .
- c.  $2613.57 \pm 0.87 \text{ kg}$ .
- d.  $2613.6 \pm 0.9 \text{ kg}$ .
- e.  $2614 \pm 1 \text{ kg}$ .

$$2613.6 \pm 0.9$$

5) A cube of mass  $5.5658 \pm 0.0002 \text{ kg}$  and edge length of  $6.60 \pm 0.05 \text{ cm}$ . What is the density of the cube material?

- a.  $0.0194 \pm 0.0004 \text{ g/cm}^3$ .
- b.  $19.35 \pm 0.44 \text{ g/cm}^3$ .
- c.  $19.4 \pm 0.5 \text{ g/cm}^3$ .
- d.  $19.3 \pm 0.4 \text{ g/cm}^3$ .
- e.  $19.4 \pm 0.4 \text{ g/cm}^3$ .

الكثافة =  $\frac{M}{V}$   
 $\frac{M}{(L^3)} = \frac{5.5658}{(6.60)^3} = 0.0843$   
 $= 0.0194$   
 $19.4$

$\frac{L^3 \Delta M + M \times 3L^2 \Delta L}{(L^3)^2}$

$\Delta M + 3L^2 \Delta L M$   
 $\pm 0.4$   
 $36.36$

6) Karim measured the following physical quantities:  $X \pm \Delta X$ ,  $Y \pm \Delta Y$  and  $Z \pm \Delta Z$ . If he wants to calculate  $R = 7Z^2Y^4/X^3$ , then  $\Delta R$  should be calculated using the following formula

- a.  $\frac{\Delta R}{R} = 2 \frac{\Delta Z}{Z} + 4 \frac{\Delta Y}{Y} + 3 \frac{\Delta X}{X}$ .
- b.  $\frac{\Delta R}{R} = 14 \frac{\Delta Z}{Z} + 28 \frac{\Delta Y}{Y} + 21 \frac{\Delta X}{X}$ .
- c.  $\frac{\Delta R}{R} = \frac{\Delta Z}{Z} + \frac{\Delta Y}{Y} + \frac{\Delta X}{X}$ .
- d.  $\frac{\Delta R}{R} = 2 \frac{\Delta Z}{Z} + 4 \frac{\Delta Y}{Y} - 3 \frac{\Delta X}{X}$ .
- e.  $\frac{\Delta R}{R} = 14 \frac{\Delta Z}{Z} + 28 \frac{\Delta Y}{Y} - 21 \frac{\Delta X}{X}$ .

$R = \frac{7Z^2Y^4}{X^3}$

$2 \frac{\Delta Z}{Z} + 4 \frac{\Delta Y}{Y} + 3 \frac{\Delta X}{X}$

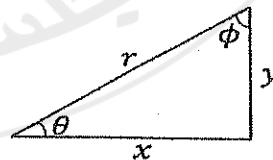
7) A cylindrical tank (خزان اسطواني الشكل) has a radius  $r = 0.94 \pm 0.04 \text{ m}$  and height  $h = 1.78 \pm 0.08 \text{ m}$ , respectively. The surface area of tank is (Hint:  $A = 2\pi r^2 + 2\pi rh$ )

- a.  $16.0 \pm 1.3 \text{ m}^2$ .
- b.  $16 \pm 1 \text{ m}^2$ .
- c.  $16.1 \pm 1.4 \text{ m}^2$ .
- d.  $16 \pm 2 \text{ m}^2$ .
- e.  $16.06 \pm 1.39 \text{ m}^2$ .

$A = 2\pi r^2 + 2\pi rh$   
 $= 2\pi \times (0.94)^2 + (2\pi \times 0.94 \times 1.78)$   
 $= 16.056$   
 $4\pi r \Delta r + (2\pi r \Delta h + 2\pi r h \Delta r)$   
 $= 1.3916$   
 $16.1 \pm 1.4$

8) If you measured  $r = 3.610 \pm 0.005 \text{ m}$  and  $\theta = 30.0^\circ \pm 0.5^\circ$  in the figure shown above, then  $x$  is given by

- a.  $3.126 \pm 0.002 \text{ m}$ .
- b.  $3.2 \pm 0.2 \text{ m}$ .
- c.  $3.1 \pm 0.2 \text{ m}$ .
- d.  $3.13 \pm 0.02 \text{ m}$ .
- e.  $3.12 \pm 0.02 \text{ m}$ .



Two students collaborated (تعاونوا) to measure the acceleration due to gravity ( $g$ ) using the following experiment: The first student dropped a ball 6 times from rest from a known height  $h = 24.53 \pm 0.09 \text{ m}$ . The other student measured the time it takes the ball to hit the ground each time as follows: 2.15, 2.36, 2.23, 2.28, 2.17, 2.31 sec. If the height is related to the measured time by the equation  $h = \frac{1}{2}gt^2$ , answer question #9 to question #12.

9) The sample standard deviation of the time measurements approximated to 2 significant figures is given by

- (a) 0.082 sec
- b. 0.074 sec
- c. 0.033 sec
- d. 0.086 sec
- e. 0.033

Handwritten calculations for Q9:  
 $\bar{x} = 2.25$   
 $s = 0.0817$   
 $\approx 0.082$   
 $(2.25 \pm 0.03)$

10) The best estimate of  $g$  is given by

- a.  $9.69 \pm 0.08 \text{ m/sec}^2$
- b.  $9.7 \pm 0.8 \text{ m/sec}^2$
- c.  $9.69 \pm 0.03 \text{ m/sec}^2$
- (d)  $9.7 \pm 0.3 \text{ m/sec}^2$

~~$9.69 \pm 0.07 \text{ m/sec}^2$~~

Handwritten calculations for Q10:  
 $h = \frac{1}{2}gt^2$   
 $24.53 = \frac{1}{2}g(2.25)^2$   
 $g = 9.690$

Handwritten derivation for Q10:  
 $\Delta h = \frac{1}{2}g^2 \Delta t + \frac{1}{2}g^2 \Delta t^2$   
 $\frac{2h}{t^2} = g$   
 $\frac{2\Delta h + 2h \times 2\Delta t}{t^2} = g$   
 $\frac{2\Delta h}{t^2} + \frac{2h \times 2\Delta t}{t^2} = g$   
 $\frac{2\Delta h}{t^2} + \frac{2h \times 2\Delta t}{t^2} = g$

11) If the standard value of the acceleration due to gravity  $g = 9.8 \text{ m/s}^2$ , then the discrepancy = 1.488 between the two students' result and the standard value of  $g$  is

- a. 0.1
- (b) 0.1 m/sec<sup>2</sup>
- c. 0.7 m/sec<sup>2</sup>
- d. 0.7
- e. 0.3 m/sec<sup>2</sup>

Handwritten calculations for Q11:  
 $D = 24.53 - 2.25$   
 $\approx 2.28$   
 $9.8 - 9.7 = 0.1$

12) The two students' result

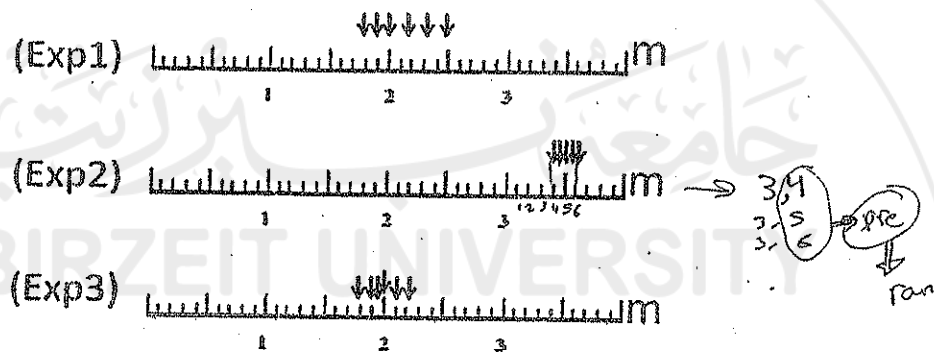
- a. is not accepted because it is not in agreement with the standard value of  $g$  within experimental errors.
- b. is not good.
- c. has no random errors.
- d. is very accurate.
- (e) is accepted because it is in agreement with the standard value of  $g$  within experimental errors.

13) Systematic errors leads to

- a. A lack of accuracy in measurements.
- b. A lack (نقص) of precision in measurements.
- c. Larger sample standard deviation of measurements.
- d. Random errors.
- e. None of the above.

The measurements (indicated by arrows الموضحة بأسهم) shown in the figure below were obtained in three independent experiments to measure the circumference of a cylindrical marble column (عمود اسطواني من الرخام) of radius 0.318 m.

$$2\pi R^2 h$$



14) Result obtained in experiment #3

- a. is more precise than that of experiment #2.
- b. is affected by a very large systematic error.
- c. is more precise than that of experiment #1.
- d. is not affected by random errors.
- e. is less precise than that of experiment #1.

15) Result obtained in experiment #2

- a. is more accurate than that of experiment #3.
- b. is more accurate than that of experiment #1.
- c. is less precise than measurements of experiment #1.
- d. is not affected by random errors.
- e. is affected by a very large systematic error.

e



**Preliminary Exam**  
**Time: 60 minutes**

**First Semester 2011/2012**  
**Date: 4/10/2011**

Student Name: Anton Dalu Student #: 1111252

ضع إشارة  في كل من المربع المقابل لمدرس شعبتك وعلى رقم الشعبة.

الشعبة	المدرس	
1,13,4	زياد سعيد	<input type="checkbox"/>
2,7	يعقوب عيني	<input checked="" type="checkbox"/>
8,5,6	وفاء خاطر	<input type="checkbox"/>
9,11	تيسير عاروري	<input type="checkbox"/>
10,2,12	عبد الله احمد	<input type="checkbox"/>
14	غسان عباس	<input type="checkbox"/>

**تعليمات:**

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- (6) عدد الأسئلة 15 سؤالاً، وعدد الصفحات 4، تأكد من وجودها جميعاً.

Answer Sheet:

No.	a	b	c	d	e
1			✓		
2		✓			
3				✓	
4		✓			
5		✓			
6	✓				
7			✓		
8		✓			
9				✓	
10	✓				
11				✓	
12			✓		
13	✓				
14					✓
15			✓		

14

1. Choose the correct statement:

- a. The accuracy of a measurement is reduced by large random errors. ~~X~~
- b. The accuracy of a measurement is increased by large systematic errors. ~~X~~
- c. The accuracy of a measurement is increased by small systematic errors. ~~X~~
- d. The precision of a measurement is reduced by small random errors. ~~X~~
- e. The precision of a measurement is decreased by small systematic errors. ~~X~~

H. a → S.S  
H. P → S.R

High accuracy

→ small

Low precision

large random

0.040

2. You measured the following quantity:  $C = 27580 \pm 40$  meter. Your result C has:

- a. 5 significant figures
- b. 4 significant figures
- c. 3 significant figures
- d. Very large systematic errors
- e. No random errors

$$C = 2.7580 \pm 0.004$$

$$2.758 \pm 0.004$$

\* The surface area of a sphere of radius  $r = 1.3$  cm is:

- ~~a.  $9.2 \text{ cm}^3$~~
- ~~b.  $10.0 \text{ cm}^3$~~
- ~~c.  $10 \text{ cm}^3$~~
- d.  $21.2 \text{ cm}^2$
- e.  $21 \text{ cm}^2$

surface =  $4R^2 \pi$   
 $= 4R^2 \pi$   
 $= 4 \times 1.3 \times 1.3 \pi$   
 $= 21.23 \text{ cm}^2$

4. You measured the speed of a ball and repeated your measurements twenty times. The sample standard deviation of your measurements was 12 m/s. The standard deviation of the mean is:

- a. 12 m/s
- b. 3 m/s
- c. 2 m/s
- d. 2
- e. 3

$$s_n = \frac{s_s}{\sqrt{n}} = \frac{12}{\sqrt{20}} = 2.683 \text{ m/s}$$

Eight different students measured the radius  $r$  of a disk (قرص دائري) and found the following values: 6.04 cm, 5.90 cm, 5.93 cm, 5.97 cm, 5.88 cm, 6.02 cm, 5.95 cm, 5.96 cm. Answer the following four questions:

5. The best value for the radius  $r$  and the error in it is:

- a.  $5.96 \pm 0.06$  cm ✗
- b.  $5.95 \pm 0.02$  cm
- c.  $5.95 \pm 0.02$  cm
- d.  $5.95 \pm 0.06$  cm ✗
- e.  $5.94 \pm 0.03$  cm

$$\bar{x} = 5.95625$$

$$R = 5.96 \pm 0.02$$

$$\sigma_n = 0.01935$$

$$5.95 - 0.06, 5.95 + 0.06$$

6. There is a probability (احتمالية):

- a. That 2/3 of the measurements lie in the interval (تقع في الفترة)  $[5.96 - 0.06, 5.96 + 0.06]$  cm. ✓
- b. That 2/3 of the measurements lie in the interval (تقع في الفترة)  $[5.97 - 0.03, 5.97 + 0.03]$  cm.
- c. That 2/3 of the measurements lie in the interval (تقع في الفترة)  $[5.96 - 0.02, 5.96 + 0.02]$  cm.
- d. That 2/3 of the measurements lie in the interval (تقع في الفترة)  $[5.94 - 0.06, 5.94 + 0.06]$  cm.
- e. That 2/3 of the measurements lie in the interval (تقع في الفترة)  $[5.95 - 0.06, 5.95 + 0.06]$  cm.

7. The area of the disk is:

- a.  $111.2 \pm 0.8$  cm<sup>2</sup>
- b.  $110.85 \pm 0.01$  cm<sup>2</sup>
- c.  $111.6 \pm 0.8$  cm<sup>2</sup>
- d.  $111 \pm 2$  cm<sup>2</sup>
- e.  $112 \pm 1$  cm<sup>2</sup>



$$\text{Area} = R^2 \pi$$

$$A = R^2 \pi \Rightarrow A = (5.96)^2 \pi$$

$$= 111.5943$$

$$\frac{\Delta A}{A} = \frac{2R \pi \Delta R}{R^2 \pi}$$

$$\frac{\Delta A}{A} = \frac{2 \Delta R}{R} = \frac{2 \Delta R A}{R A}$$

$$111.6 \pm 0.7$$

$$111.6$$

$$111.5943 \pm 0.7989$$

$$111.5943 \pm 0.7989$$

8. Suppose (افترض) there was systematic error of  $+0.08$  cm because the instrument used for the measurements was not calibrated (أداة القياس لم تكن معايرة), then:

- a. The standard deviation of the measurements above will increase by 0.08 cm ✓ ↑
- b. The standard deviation of the measurements above will not be affected
- c. The standard deviation of the measurements above will decrease by 0.08 cm ✓
- d. The standard deviation of the measurements above will increase by 0.03 cm
- e. The standard deviation of the measurements above will decrease by 0.03 cm

$$6.12, 5.96, 6.01, 6.05, 5.96, 6.01, 6.04, 6.1$$

$$5.96, 5.93, 5.97, 5.88, 5.95 \Rightarrow$$

$$A = R^2 \pi \Rightarrow = 5.96 \times 5.96 \times \pi$$

$$= 111.639$$

$$\frac{\Delta A}{A} = \frac{2R \pi \Delta R}{R^2 \pi} \Rightarrow \frac{\Delta A}{A} = \frac{2 \Delta R}{R}$$

$$\Delta A = 0.7989$$

In an experiment to determine the speed of sound in air, you found that  $S = (341 \pm 1)$  m/s. While your classmate Ahmad (زميلك أحمد) found that  $S = (340 \pm 5)$  m/s. The universal value (القيمة المعتمدة عالمياً) for the speed of sound in air is 345 m/s. Answer the following three questions:

9. The discrepancy between your result and the universal value is:

- a. 5 m/s
- b. 5
- d. 4 m/s
- e. 3 m/s

Discrepancy

$$|345 - 341| = 4 < 2 \times 1$$

( $S = 341 \pm 1$ )

( $S = 340 \pm 5$ )

(345)

10. The discrepancy between Ahmad's result and the universal value is:

- a. 5 m/s
- b. 5
- c. 6 m/s
- d. 4 m/s
- e. 4

$$D = |345 - 340| = 5 < 2 \times 5$$

5 < 10 ✓

11. Choose the correct statement

- a. Only your result is accepted because it agrees with the universal value within the experimental errors.
- b. Both your result and Ahmad's result have the wrong number of significant figures.
- c. Both your result and Ahmad's result are accepted because they agree with the universal value within the experimental errors.
- d. Only Ahmad's result is accepted because it agrees with the universal value within the experimental errors.
- e. Both your result and Ahmad's result have the wrong units.

$$560 + 11.8 = 571.8$$

$$\underline{\underline{572}}$$

12. The result of:  $5.6 \times 10^2 + 11.8$  is:

- ~~a. 548.2~~
- ~~b. 548~~
- c. 572
- ~~d. 571.8~~
- ~~e. 6.6~~

13. You measured the following quantities:  $Y \pm \Delta Y$ ,  $T \pm \Delta T$ ,  $Z \pm \Delta Z$ , you want to calculate  $R = YT^3/Z^2$ , then  $\Delta R$  can be calculated using the formula:

$$R = \frac{YT^3}{Z^2} \Rightarrow YT^3Z^{-2}$$

- a.  $\Delta R = R [(\Delta Y/Y) + 2(\Delta Z/Z) + 3(\Delta T/T)]$
- b.  $\Delta R = (\Delta Y/Y) + 2(\Delta Z/Z) + 3(\Delta T/T)$
- c.  $\Delta R = R [3(\Delta Y/Y) + (\Delta T/T) + 4(\Delta Z/Z)]$
- d.  $\Delta R = R [(\Delta Y/Y) + 3(\Delta T/T) - 2(\Delta Z/Z)]$
- e.  $\Delta R = (\Delta Y/Y) + 3(\Delta T/T) - (\Delta Z/Z^2)$

$$\Delta R = \frac{\Delta Y T^3 Z^2}{Z^2} + 3T^2 Y Z^2 \frac{\Delta T}{Z^2} - 2Z \frac{YT^3}{Z^2} \Delta Z$$

$$\frac{\Delta R}{R} = \frac{\Delta Y}{Y} + 3 \frac{\Delta T}{T} + \frac{2\Delta Z}{Z}$$

14. You measured an angle (زاوية)  $\theta = 43.0^\circ \pm 0.5^\circ$ , then calculated  $R = \sin\theta$  to find:

- a.  $R = 0.682 \pm 0.4^\circ$  ✓
- ~~b.  $R = 0.731 \pm 0.3^\circ$~~
- ~~c.  $R = 0.731 \pm 0.600$~~
- ~~d.  $R = 0.731 \pm 0.006 \text{ rad}$~~
- e.  $R = 0.682 \pm 0.006$  ✓

$$\Delta R = \cos\theta \Delta\theta$$

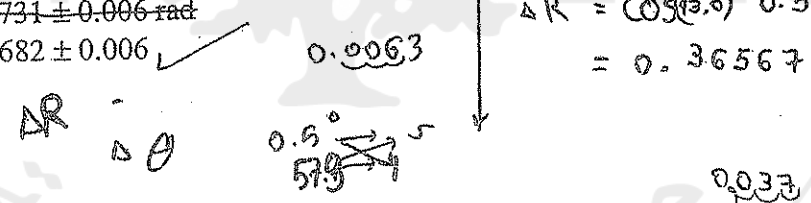
$$= \cos(43.0) \cdot 0.5$$

$$= 0.36567$$

$$\sin(43.0) = 0.68199836$$

$$\Delta R = \cos\theta \Delta\theta = 0.682$$

$$= 0.36567$$



15. The correct form to write the measurement  $F = (4978 \pm 37)$  kg is:

- a.  $F = 2980 \pm 40$  kg.
- b.  $F = 498 \pm 4$  kg.
- c.  $F = 4980 \pm 40$  kg.
- d.  $F = 498 \pm 40$  kg.
- e.  $F = (2.98 \pm 0.04) \times 10^3$  kg.

$$4.978 \pm 0.037$$

$$(4.98 \pm 0.04) \times 10^3$$

$$4980 \pm 40$$

**Preliminary Exam**  
**Time: 60 minutes**

**2nd Semester 2009/10**  
**Date: 2/2/ 2010**

Student Name: _____	Student # _____
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ضع إشارة (X) في كل من المربع المقابل لمدرس شعبتك وعلى رقم الشعبة.

الشعبة	المدرس		الشعبة	المدرس
5,14	صافي صافي	<input type="checkbox"/>	1,2,3,10	زياد سعيد
6,7	تيسير عاروري	<input type="checkbox"/>	12	عسان أنصوني
8,9	هشام هدمي	<input type="checkbox"/>	4,11,13	يعقوب عنييني

**تعليمات:**

- (1) لا تفتح ورقة الامتحان حتى يسمح لك بذلك.
- (2) اكتب اسمك ورقمك في أعلى هذه الصفحة.
- (3) اختر الجواب الأكثر قربا للجواب الصحيح وانقله على هذه الصفحة، وذلك بوضع إشارة (X) في الخانة المناسبة.
- (4) السؤال الذي له أكثر من إجابة يعطى علامة صفر.
- (5) يجب إعادة أوراق الامتحان كاملة.
- (6) عدد الأسئلة 15 سؤالاً، وعدد الصفحات 4، تأكد من وجودها جميعاً.

**Answer Sheet:**

Q#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A															
B															
C															
D															
E															

1) A car traveled for 1.50 hours at an average speed of 61.45 km/h. The distance traveled during this time interval can be written to the correct number of significant figures as:

- a) 92.175 km
- b) 92.18 km
- c) 92 km
- d) 92.2 km
- e) 92.1 km

2) Low precision in a measurement is a result of :

- a) Small systematic errors
- b) Large Systematic errors
- c) Large random errors
- d) Small random errors
- e) None of these.

Questions 3), 4), and 5) are related to the following:

A student measured the width of a metal block 7 times and got the following measurements:  $w = 6.75, 6.63, 6.71, 6.77, 6.84, 6.73, 6.65$  cm.

3) The best estimation of the true value of the width is

- a) 6.7 cm
- b) 6.726 cm
- c) 6.72 cm
- d) 6.73 cm
- e) 6.725 cm

4) The sample standard deviation of the above measurements is

- a) 0.0716 cm
- b) 0.7 cm
- c) 0.072 cm
- d) 0.071 cm
- e) 0.07 cm

5) The standard deviation of the mean of the above measurements is

- a) 0.01 cm
- b) 0.02706 cm
- c) 0.027 cm
- d) 0.03 cm
- e) 0.07 cm

- 6) One of these does not match the purpose (لا يناسب أهداف) of this course:
- To learn how to do an experiment.
  - To plan an experiment.
  - To learn the theory of Physics.
  - To setup the apparatus of an experiment.
  - To analyze the measurement of an experiment
- 7) If the sample standard deviation of 60 measurements of the height  $h$  is 0.6 cm, then the standard deviation of the mean is
- 0.07 cm
  - 0.1 cm
  - 0.08 cm
  - 0.077 cm
  - None of these
- 8) Consider a set of measurements for a certain physical quantity. Let  $\sigma_s$  be the sample standard deviation. The probability (احتمال) that any new measurement will not differ from the average value by more than  $2\sigma_s$  is :
- 0.65
  - 0.50
  - 0.95
  - 0.75
  - 0.67
- 9) A cylinder (اسطوانة) with radius of  $3.5 \pm 0.1$  cm and length of  $12.4 \pm 0.2$  cm. Its volume is:
- $477 \pm 40$  cm<sup>3</sup>
  - $(4.8 \pm 0.3) \times 10^2$  cm<sup>3</sup>
  - $(4.8 \pm 0.4) \times 10^2$  cm<sup>3</sup>
  - $(4.8 \pm 0.5) \times 10^2$  cm<sup>3</sup>
  - None of these
- 10) The average tall of BZU students is:
- $172 \pm 10$  cm.
  - $135 \pm 60$  cm.
  - $150 \pm 17$  cm.
  - $190 \pm 45$  cm.
  - $172 \pm 7$  cm.



11) If  $B = 77^\circ \pm 1^\circ$  then  $\sin B$  is equal to :

- a)  $0.97 \pm 0.01$
- b)  $0.974 \pm 0.004$
- c)  $0.9744 \pm 0.003$
- d)  $0.225 \pm 0.001$
- e) None of these

12) Given  $x = 8045 \pm 63$ , Write  $x$  and its uncertainty in the correct form

- a)  $(8.045 \pm 0.063) \times 10^3$
- b)  $8050 \pm 60$
- c)  $(8.04 \pm 0.06) \times 10^3$
- d)  $(8.05 \pm 0.06) \times 10^3$
- e) None of these

13) The number of significant figures in  $A = 0.020300$  is

- a) 7
- b) 6
- c) 5
- d) 4
- e) 3

14) If  $A = 487.803$  and  $B = 24.7$  and  $C = 54$ , Then  $A+B-C$  should be written as

- a) 458.1
- b) 458.503
- c) 458
- d) 459
- e) 460

15) A student measured the acceleration of gravity in the lab and found that  $g = 9.73 \pm 0.03 \text{ m/s}^2$ . If the accepted value of  $g$  in this lab is  $9.81 \text{ m/s}^2$ , then according to what you have learned in this course

- a) His results were satisfactory (مقبولة).
- b) Most likely (على الأغلب) he hasn't done any random errors in measurements.
- c) Most likely he has done some systematic errors in measurements.
- d) The student must be more careful when taking the measurements.
- e) None of the above

Physics 111 Preliminary Exam

First Semester 2013/2014

Date: 12/11/2013

Time: 60 Minutes

Student Name: <u>Abdelhakim Al-Nawaj</u>	Student ID #: <u>11111111</u>
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ضع إشارة (x) في كل من المربع المقابل لمدرس الشعبة:

الشعبة	المدرس		الشعبة	المدرس
12, 19	سهاد دراغمة	<input type="checkbox"/>	1,4,5,8,21	زياد عزت
14	محمد فرج	<input type="checkbox"/>	2,10,(13)	يعقوب عيني
15,18	دعاء حوامده	<input type="checkbox"/>	3,6,9	عبدالله سيد احمد
16, 17	تسنيم رشيد	<input type="checkbox"/>	7	غسان عباس
20	وصال حلايقة	<input type="checkbox"/>	11	صافي صافي

تعليمات الامتحان:

- لا تفتح ورقة الامتحان حتى يسمح لك بذلك.
- اكتب اسمك ورقمك الجامعي في أعلى هذه الصفحة.
- اختر الجواب الأكثر قربا للجواب الصحيح وأنقله على هذه الصفحة وذلك بوضع إشارة (x) في الخانة المناسبة.
- السؤال الذي له أكثر من إجابة يعطى علامة صفر.
- عدد الأسئلة 15 سؤالاً وعدد الصفحات 5، تأكد من وجودها جميعاً.

Answer Sheet:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(a)						✓					✓		✓	✓	
(b)			✓						✓						
(c)		✓										✓			
(d)				✓				✓							
(e)	✓				✓		✓			✓					✓

1) A student measured the density of a material to be  $(1.930 \pm 0.005) \times 10^3 \text{ g/cm}^3$ . The number of significant figures in the reported density is

- a. 7.
- b. 6.
- c. 5.
- d. 4.
- e. 3.

$$(19.30 \pm 0.05) \times 10^2$$

$$1930 \pm 5$$

2) Large systematic errors lead to

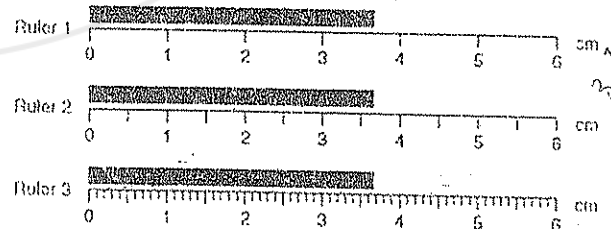
- a. A lack (نقص) of precision in measurements.
- b. Random errors.
- c. A lack of accuracy in measurements.
- d. Good results.
- e. Large sample standard deviation of measurements.

3) Precision is

- a. a measure of how close a series of measurements to one another.
- b. a measure of how close a series (مجموعة) of measurement to the true value.
- c. usually enhanced (تزداد وتتعزيز) by reducing systematic errors.
- d. the same thing as accuracy.
- e. None of the Above.

4) The measurements on the rulers in the following figure are

- a.  $4.0 \pm 0.1 \text{ cm}$ ,  $3.5 \pm 0.1 \text{ cm}$  and  $3.7 \pm 0.1 \text{ cm}$
- b.  $4.0 \pm 0.5 \text{ cm}$ ,  $3.5 \pm 0.5 \text{ cm}$  and  $3.7 \pm 0.5 \text{ cm}$
- c.  $4.0 \pm 0.1 \text{ cm}$ ,  $3.5 \pm 1 \text{ cm}$  and  $3.7 \pm 0.5 \text{ cm}$
- d.  $4 \pm 1 \text{ cm}$ ,  $3.5 \pm 0.5 \text{ cm}$  and  $3.7 \pm 0.1 \text{ cm}$
- e.  $3.7 \pm 0.1 \text{ cm}$ ,  $3.7 \pm 0.1 \text{ cm}$  and  $3.7 \pm 0.1 \text{ cm}$



5) If someone tells you that a block of limestone (حجر الكلس) has a mass of  $2613.57 \pm 0.97 \text{ kg}$ . You should report the mass of the block as

- a.  $2613.57 \pm 0.97 \text{ kg}$ .
- b.  $2613.5 \pm 0.9 \text{ kg}$ .
- c.  $2613.6 \pm 0.9 \text{ kg}$ .
- d.  $2613 \pm 1 \text{ kg}$ .
- e.  $2614 \pm 1 \text{ kg}$ .

$$\begin{array}{r} 2613.6 \pm \\ 2614 \pm 1 \end{array}$$

6) If  $v_0 = 3.56 \text{ m/s}$ ,  $a = 3.15 \text{ m/s}^2$ ,  $\Delta t = 0.2 \text{ s}$ , then  $v = v_0 + a\Delta t$  is

- a.  $4.19 \text{ m/s}$ .
- b.  $4.2 \text{ m/s}$ .
- c.  $4 \text{ m/s}$ .
- d.  $4.19 \text{ m/s}^2$ .
- e.  $4.2 \text{ m/s}^2$ .

$$v = 3.56 + 3.15 * 0.2$$

7) A physics student measured two lengths and  $h_1$  and  $h_2$  in cm as follows:  $h_1 = 32.4 \pm 0.3 \text{ cm}$ ,  $h_2 = 16.2 \pm 0.3 \text{ cm}$ . If the student correctly calculated  $R = \ln\left(\frac{h_1}{h_2}\right)$ , the value of  $R$  is

- a.  $0.69 \pm 0.02$
- b.  $0.69 \pm 0.03$
- c.  $0.693 \pm 0.003$
- d.  $0.693 \pm 0.009$
- e.  $0.7 \pm 0.2$

$\Delta R =$

$$\begin{array}{r} 0.69 \\ 0.7 \end{array}$$

8) Ahmad measured the following physical quantities:  $X \pm \Delta X$ ,  $Y \pm \Delta Y$  and  $Z \pm \Delta Z$ . If he wants to calculate  $R$  from  $\frac{1}{R} = \frac{1}{X} - \frac{1}{Y}$ , then  $\Delta R$  can be calculated using the following formula

- a.  $\frac{\Delta R}{R} = \frac{\Delta X}{X} + \frac{\Delta Y}{Y}$   
 b.  $\frac{\Delta R}{R} = \frac{\Delta X}{X} - \frac{\Delta Y}{Y}$   
 c.  $\frac{\Delta R}{R^2} = \frac{\Delta X}{X^2} + \frac{\Delta Y}{Y^2}$   
 d.  $\frac{\Delta R}{R^2} = \frac{\Delta X}{X^2} - \frac{\Delta Y}{Y^2}$   
 e.  $\frac{\Delta R}{R^2} = \frac{\Delta X}{Y^2} + \frac{\Delta Y}{X^2}$

$$\frac{1}{R} = \frac{1}{X} - \frac{1}{Y}$$

$$-R^{-2} \Delta R = -X^{-2} \Delta X - Y^{-2} \Delta Y$$

$$-\frac{\Delta R}{R^2} = -\frac{\Delta X}{X^2} - \frac{\Delta Y}{Y^2}$$

$$\frac{\Delta R}{R^2} = \frac{\Delta X}{X^2} - \frac{\Delta Y}{Y^2}$$

9) A cylindrical tank (خزان اسطواني الشكل) has a radius  $r = 0.94 \pm 0.04$  m and height  $h = 1.78 \pm 0.08$  m, respectively. The volume of the tank is

- a.  $5 \pm 1$  m<sup>3</sup>.  
 b.  $4.9 \pm 0.6$  m<sup>3</sup>.  
 c.  $4.9 \pm 0.1$  m<sup>3</sup>.  
 d.  $4.94 \pm 0.64$  m<sup>3</sup>.  
 e.  $4.94 \pm 0.13$  m<sup>3</sup>.

$$V = r^2 \pi h$$

$$= (0.94)^2 \pi * 1.78$$

$$= 4.94$$

$$\Delta V = 2r \Delta r \pi h + r^2 \pi \Delta h$$

$$= 2 * 0.94 * 0.04 \pi * 1.78 + (0.94)^2 \pi * 0.08$$

10) A solid sphere of mass  $5.5658 \pm 0.0005$  kg and radius of  $6.60 \pm 0.06$  cm. What is the density of the sphere material?

- a.  $0.00462 \pm 0.00013$  g/cm<sup>3</sup>.  
 b.  $4.62 \pm 0.17$  g/cm<sup>3</sup>.  
 c.  $4.6 \pm 0.1$  g/cm<sup>3</sup>.  
 d.  $4.6 \pm 0.2$  g/cm<sup>3</sup>.  
 e.  $4.62 \pm 0.13$  g/cm<sup>3</sup>.

density =  $\frac{\text{mass}}{\text{Volume}}$

$$\text{mass} = 5.5658 \text{ kg}$$

$$V = r^2 \pi$$

$$= (6.60)^2 \pi = 136.85 \text{ cm}^3$$

$$\Delta V = 2r \Delta r \pi$$

$$= 2 * 6.60 * 0.06 \pi = 41.4690$$

11) If you took an angle measurement:  $\theta = 38^\circ \pm 2^\circ$  and you needed to find  $Z = \sin(\theta)$ , then  $Z$  is equal to:

- a.  $0.62 \pm 0.03$   
 b.  $0.61 \pm 0.03$   
 c.  $0.61 \pm 0.02$   
 d.  $0.62 \pm 0.02$   
 e.  $0.615 \pm 0.014$

$$2^\circ \Rightarrow \pi \rightarrow 180$$

$$2 \rightarrow 2$$

$$\frac{2 * \pi}{\pi} = 0.034 \approx 0.03$$

$$\sin 38 = 0.62$$

$$\Delta Z = \cos \theta \Delta \theta$$

$$= \cos 38 * 2$$

0.03

$$\text{density} = \frac{5.5658}{136.85}$$

$$= \frac{5.5658}{136.85} = 40.6 \text{ g/cm}^3$$

A group of students measured the acceleration due to gravity,  $g$ , with a pendulum (بندول) and obtained the following values in  $m/s^2$ : 9.80, 9.72, 9.73, 9.78, 9.67, 9.81 and 9.63.

Answer the following four questions:

12) The sample standard deviation for the measurements approximated to three significant figures is

- a.  $0.00675 m/s^2$
- b.  $0.0675 m/s$
- c.  $0.0675 m/s^2$
- d.  $0.0625 m/s^2$
- e.  $0.0625 m/s$

13) The best estimate of  $g$  is

- a.  $9.73 \pm 0.02 m/s^2$
- b.  $9.72 \pm 0.02 m/s^2$
- c.  $9.74 \pm 0.03 m/s^2$
- d.  $9.73 \pm 0.03 m/s^2$
- e.  $9.74 \pm 0.02 m/s^2$

$9.73 \pm 0.02$   
 $D = 19.80 - 9.73 = 0.07$   
 $D = 2 \times \text{uncertainty} = 2 \times 0.02 = 0.04$   
 $D = 2 \times \text{uncertainty}$

14) If the standard value of the acceleration due to gravity  $g = 9.80 m/s^2$ , then the students' result

- a. is not accepted because it is not in agreement with the standard value of  $g$  within experimental errors.
- b. is not good.
- c. has no random errors.
- d. is very accurate.
- e. is accepted because it is in agreement with the standard value of  $g$  within experimental errors.

15) There is an approximately 95% probability that a single measurement of  $g$  would lie in the range

- a. [9.70, 9.76]
- b. [9.67, 9.79]
- c. [9.67, 9.87]
- d. [9.60, 9.76]
- e. [9.60, 9.87]

$0.14$   
 $9.60 - 9.87$

  
**BIRZEIT UNIVERSITY**  
 Physics 111 Preliminary Exam  
 Second Semester 2014/2015

13

1/4/2014

Time: 60 Minutes

Student Name: <u>Alena Al-Najjar</u>	Student ID #: <u>12345678</u>
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ضع إشارة (x) في كل من المربع المقابل لمدرس الشعبة:

الشعبة	المدرس		الشعبة	المدرس	
7	أريج عبدالرحمن	<input type="checkbox"/>	1,4	يعقوب عيني	<input type="checkbox"/>
8	زياد عزت	<input checked="" type="checkbox"/>	2	تسنيم رشيد	<input type="checkbox"/>
9	دعاء حوامده	<input type="checkbox"/>	3	تيمير عاروري	<input type="checkbox"/>
11	غسان عباس	<input type="checkbox"/>	5,10	عبدالله سيد احمد	<input type="checkbox"/>
12	لميس نذاف	<input type="checkbox"/>	6	محمد فرج	<input type="checkbox"/>

تعليمات الامتحان:

- لا تفتح ورقة الامتحان حتى يسمح لك بذلك.
- اكتب أسمك ورقمك الجامعي في أعلى هذه الصفحة.
- اختر الجواب الأكثر قربا للجواب الصحيح وأنقله على هذه الصفحة وذلك بوضع إشارة (x) في الخانة المناسبة.
- السؤال الذي له أكثر من إجابة يعطى علامة صفر.
- عدد الأسئلة 15 سؤالا وعدد الصفحات 5، تأكد من وجودها جميعا.

Answer Sheet:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
(a)												<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>
(b)							<input checked="" type="checkbox"/>				<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>	
(c)		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>									
(d)									<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>			
(e)	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>					<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>					

1) A student measured the density of a material to be  $(1.9306 \pm 0.0002) \times 10^1 \text{ g/cm}^3$ . The number of significant figures in the reported density is

- a. 1.
- b. 4.
- c. 7.
- d. 6.
- e. 5.

2) Large random errors lead to

- a. Small sample standard deviation of measurements.
- b. Systematic errors.
- c. A lack of precision in measurements.
- d. Good results.
- e. A lack (نقص) of accuracy in measurements.

3) Large systematic errors lead to

- a. Random errors.
- b. Good results.
- c. Large sample standard deviation of measurements.
- d. A lack of precision in measurements.
- e. A lack of accuracy in measurements.

4) For a ruler with 0.1 m as the smallest marked division, measurements should be estimated to the nearest

- (a) 1 m
- (b) 2 m
- (c) 0.1 cm
- (d) 0.1 m
- (e) 0.01 cm



$|The - measured| \leq 2\Delta$  .  $|9.8 - 9.74| = 0.06 \leq 0.08$  ✓  
 $9.8 - 9.0 = 0.8 \leq 0.6$  ✗  
 Ahmad ✓  
 Amal ✗  
 Amani ✗

5) Ahmad, Amal and Amani measured the acceleration due to gravity ( $g$ ) to be  $9.6 \pm 0.3 \text{ m/s}^2$ ,  $9.74 \pm 0.04 \text{ m/s}^2$ ,  $9.775 \pm 0.001 \text{ m/s}^2$ , respectively. If the accepted value of  $g$  is  $9.80 \text{ m/s}^2$ , then

- a. All results agree with the accepted value of  $g$ .
- b. Only Ahmad's result agrees with the accepted value of  $g$ .
- c. Only Amani's result does not agree with the accepted value of  $g$ .**
- d. Only Amal's result does not agree with the accepted value of  $g$ .
- e. Only Amal's result agrees with accepted value of  $g$ .

6) If  $v_0 = 3.56 \text{ m/s}$ ,  $a = 3.15 \text{ m/s}^2$ ,  $\Delta t = 0.4 \text{ s}$ , then  $v = v_0 + a\Delta t$  is

- a.  $4.82 \text{ m/s}$ .  $3.56 + (3.15 \times 0.4) = 3.56 + 1.26 = 4.82$
- b.  $4 \text{ m/s}$ .
- c.  $4.8 \text{ m/s}$ .
- d.  $5 \text{ m/s}^2$ .**
- e.  $4.82 \text{ m/s}^2$ .

7) If you took an angle measurement:  $\theta = 47^\circ \pm 2^\circ$  and you needed to find  $Z = \sin(\theta)$ , then  $Z$  is equal to

- a.  $0.73 \pm 0.03$**
- b.  $0.73 \pm 0.02$
- c.  $0.71 \pm 0.02$
- d.  $0.72 \pm 0.02$
- e.  $0.72 \pm 0.03$

$Z = \sin \theta = 0.73$   
 $DZ = \cos \theta D\theta$   
 $= 0.68 \times 0.03$   
 $= 0.02$   
 $Z = \sin \theta = 0.73$   
 $DZ = \cos \theta D\theta$   
 $= 0.68 \times 0.03$   
 $= 0.02$

8) The area of a rectangular plate was found by measuring its length and its width. The length was found to be  $8.27 \pm 0.05 \text{ m}$ . The width was found to be  $5.12 \pm 0.02 \text{ m}$ . The area of the plate is

- a.  $42.4 \pm 0.5 \text{ m}^2$ .
- b.  $43 \pm 2 \text{ m}^2$ .
- c.  $42.54 \pm 0.42 \text{ m}^2$ .
- d.  $42 \pm 1 \text{ m}^2$ .
- e.  $42.3 \pm 0.4 \text{ m}^2$ .**

$A = w \times L = 8.27 \times 5.12 = 42.3584 = A$   
 $\frac{\Delta A}{A} = \frac{\Delta w}{w} + \frac{\Delta L}{L}$   
 $= \frac{0.05}{8.27} + \frac{0.02}{5.12}$   
 $= 0.006 + 0.004$   
 $= 0.01$

$42.3 \pm$

$0.02 \times 0.05 \times 10^{-3}$

If  $y$  can be evaluated using the following formula  $y = v_i t - \frac{1}{2} g t^2$  and the quantities  $v_i$ ,  $g$  and  $t$  are measured to be  $v_i = 50 \pm 2 \text{ m/s}$ ,  $g = 9.80 \pm 0.02 \text{ m/s}^2$  and  $t = 1.45 \pm 0.05 \text{ s}$ , then answer the following two questions

$$y = v_i t - \frac{1}{2} g t^2$$

$$y = (50)(1.45) - \frac{1}{2} (9.80)(1.45)(1.45)$$

$$73.0 - 10.3 = 62.7$$

$$63 = y$$

$$\frac{\Delta y}{y} = \frac{\Delta v_i}{v_i} + \frac{\Delta t}{t} - \left[ 0.5 \times \frac{\Delta g}{g} + 2 \frac{\Delta t}{t} \right]$$

$$= \frac{2}{50} + \frac{0.05}{1.45} - \left[ 0.5 \times \frac{0.02}{9.80} + 2 \times \frac{0.05}{1.45} \right]$$

$$0.04 + 0.03 - [0.5 \times 0.002 + 0.07]$$

$$0.04 + 0.03 - 0.031$$

$$\frac{\Delta y}{y} = 0.009 \rightarrow \Delta y$$

9)  $y + \Delta y$  equals

- a.  $62 \pm 5 \text{ m}$ .
- b.  $62.2 \pm 4.7 \text{ m}$ .
- c.  $62.2 \pm 6.1 \text{ m}$ .
- d.  $62 \pm 6 \text{ m}$ .
- e.  $62 \pm 4 \text{ m}$ .

10) Of the three given quantities  $v_i$ ,  $g$  and  $t$  which has the most important effect on  $\Delta y$ ?

- a.  $t$
- b.  $v_i$ .
- c.  $g$ .
- d. The three quantities has the same effect on  $\Delta y$ .
- e.  $\Delta y$  does not depend on any one of these quantities.

A group of students measured the height of a building in meters as follows: 20.2, 20.1, 20.3, 20.7, 20.2 and 20.4. Answer the following two questions

11) The sample standard deviation of the measurements approximated to 3 significant figures is  $s_s$

- a. 0.213 m
- b. 0.214 m.
- c. 0.195 m.
- d. 0.195 .
- e. 0.3 m.

$$s_m = \frac{0.214}{\sqrt{6}}$$

12) The best estimate of the building height is

- a.  $20.3 \pm 0.2 \text{ m}$
- b.  $20.4 \pm 0.2 \text{ m}$
- c.  $20.3 \pm 0.1 \text{ m}$
- d.  $20.32 \pm 0.09 \text{ m}$
- e.  $20.32 \pm 0.08 \text{ m}$



✓ A car travels a distance of 480.46 km at a speed of 70.0 km/hr. The time interval which the car took to cover this distance can be written to the nearest number of significant figures as :

- a) 6.86 hour
- b) 6.8637 hour
- c) 6.864 hour
- d) 6.9 hour
- e) 6.90 hour

Questions 2) and 3) are related to the following statement:

A physics 111 student measured the length of the physics 111 manual. She found the following measurements,  $x = 28.4, 28.3, 28.5, 28.4, 28.5, 28.2$  cm.

✓ 2) The best estimation of the true value of the manual length is

- a) 28.0 cm
- b) 28.2 cm
- c) 28.5 cm
- d) 28.4 cm
- e) 28.3 cm

3) The standard deviation of the mean of the above measurements is

- a) 0.04 cm
- b) 0.05 cm
- c) 0.07 cm
- d) 0.01 cm
- e) 0.08 cm

4) Two students measured the thickness (T) of the physics book. Student A found  $T = 5.7$  cm, and student B found  $T = 5.713$  cm. Which of the following statements best describes the above situation:

- a) Student A and B most likely did the measurements at different times.
- b) The tool used by Student A is less precise than that used by student B.
- c) The tool used by Student A is less accurate than that used by student B.
- d) Student A and B most likely used the same instrument in measurement.
- e) None of the above.

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5) Given  $x = x \pm \Delta x$ ,  $y = y \pm \Delta y$ , and  $z = 5x^2 y$ , the error in Z is found from

a)  $\frac{\Delta z}{z} = 2 \frac{\Delta x}{x} + \frac{\Delta y}{y}$

$\frac{\Delta z}{z} = \frac{2\Delta x}{x} + \frac{\Delta y}{y}$

$\frac{\Delta z}{z} = \frac{2\Delta x}{x} + \frac{\Delta y}{y}$

b)  $\frac{\Delta z}{z} = 10 \frac{(\Delta x)^2}{x} + \frac{\Delta y}{y}$

c)  $\frac{\Delta z}{z} = 5 \frac{\Delta x}{x^2} + \frac{\Delta y}{y}$

d)  $\frac{\Delta z}{z} = 2 \frac{\Delta x}{x^2} + \frac{\Delta y}{y}$

e)  $\frac{\Delta z}{z} = 2 \frac{\Delta x}{x} - \frac{\Delta y}{y}$

6) Lower precision in a measurement is a result of

- a) Small systematic errors
- b) Large random errors
- c) Large Systematic errors
- d) Small random errors
- e) None of the above.

7) If the sample standard deviation of 81 measurements of the length of an object is 0.3 cm, then the standard deviation of the mean is

- a) 0.1 cm
- b) 0.01 cm
- c) 0.3 cm
- d) 0.09 cm
- e) 0.03 cm

$\sigma_m = \frac{\sigma}{\sqrt{N}} = \frac{0.3}{\sqrt{81}}$

8) A cube has an edge of  $5.0 \pm 0.1$  cm. The volume of the cube should be written as

- a)  $125.0 \pm 7.5$  cm<sup>3</sup>
- b)  $125 \pm 8$  cm<sup>3</sup>
- c)  $25.1 \pm 0.1$  cm<sup>3</sup>
- d)  $252 \pm 20$  cm<sup>3</sup>
- e)  $125 \pm 7$  cm<sup>3</sup>

$\frac{\Delta V}{V} = \frac{3\Delta x}{x}$

$\Delta V = \frac{3 \times 0.1}{5} \times 125$

$V = x^3 = 25 \times 125$

$\frac{\Delta V}{V} = \frac{3\Delta x}{x}$

$= \frac{3 \times 0.1}{5} = 0.06 \times 25$

$25 \pm 1.5$

$2.5 \pm 0.15$

9) Which of the following statements is not true

- a) The standard deviation of the mean is equal to the sample standard deviation divided by the number of measurements.
- b) Systematic errors tend to shift errors in one direction.
- c) Random errors are due to limitations in the sensitivity of the instruments used.
- d) Errors determine the number of significant figures in a result
- e) The fractional error is the error divided by the value of the quantity

10) If  $x = \cos(\theta)$ , and  $\theta = 45 \pm 1$  degree, then  $x$  is equal to

- a)  $0.707 \pm 0.707$
- b)  $3.144 \pm 0.102$
- c)  $0.707 \pm 0.012$
- d)  $3.144 \pm 0.014$
- e)  $3.144 \pm 0.012$

$$x = \cos(45) = 0.7$$

$$\sin \theta = 45$$

$$0.7 \times \frac{\pi}{180} = 0.012$$

$$\Delta x = \sin \theta \Delta \theta$$

$$= \sin 45 \times 1 \times \frac{\pi}{180}$$

$$0.707 = 0.012$$

$$0.707 \pm 0.012$$

11) Given  $x = 4274 \pm 312$ , Write  $x$  and its uncertainty in the correct form

- a)  $(4.27 \pm 0.31) \times 10^3$
- b)  $427 \pm 312$
- c)  $(427 \pm 3) \times 10^2$
- d)  $(4.3 \pm 0.3) \times 10^3$
- e)  $427.4 \pm 31.2$

$$4,274 \pm 312$$

$$4.3 \pm 0.3 \times 10^3$$

$$(4.3 \pm 0.3) \times 10^3$$

12) The number of significant figures in the value of the electron charge to mass;  $e/m = 1.76 \times 10^{11}$  is

- a) 3
- b) 1
- c) 2
- d) 4
- e) 11

13) If  $A = 520.126$  and  $B = 43.40$ , Then  $A+B$  should be written as

- a) 563.526
- b) 563.53
- c) 563.52
- d) 563.53
- e) 563.5

14) The speed of light  $c = 299,792,458$  m/s. This can be written in scientific notation rounded to 2 significant figures as:

- a)  $2.9 \times 10^8$  m/s
- b)  $3.0 \times 10^{10}$  m/s
- c)  $2.9 \times 10^9$  m/s
- d)  $3.0 \times 10^8$  m/s
- e)  $2.90 \times 10^8$  m/s

$$3.0 \times 10^8$$

15) A student measured the acceleration of gravity in the lab and found that  $g = 9.80 \pm 0.02$  m/s<sup>2</sup>. If the accepted value of  $g$  in this lab is  $9.77$  m/s<sup>2</sup>, then according to what you have learned in this course

- a) Most likely he has done some random errors in measurements.
- b) His results were satisfactory.
- c) Most likely he has done some systematic errors in measurements.
- d) The student must be more careful when taking the measurements.
- e) None of the above

$$0.03 < 0.04$$