Benha University
2^{nd} Term Exam (May 2016) Final Exam
Class: 1^{st} Year Students
Subject: Physics (II)

Faculty of computer & informatics
Date: 25/05/2016
Time: 3 Hs.
Examiners: Dr. Nabil Hendawy & Dr. Salah Hamza

د نبيل هنداوي — د./ صلاح عيد إبراهيم حمزة

دور مايو 2016 — تاريخ الامتحان: 2016/05/25

الفرقة: الأولي — نموذج إجابة مادة الفيزياء

Q1) Choose the correct answer and shaded its circle in the answer sheet: [34 marks]
Answers is in red color

1. Object A has a charge $2\mu C$, and object B has a charge $6\mu C$. Which statement is true?
(a) $\vec{F}_{AB} = -3\vec{F}_{BA}$ (b) $\vec{F}_{AB} = -\vec{F}_{BA}$ (c) $3\vec{F}_{AB} = -\vec{F}_{BA}$

2. The SI unit of the electric field, N/C, can also be expressed as:
(a) V/m (b) $kg\, m S^2 / C$ (c) No answer

3. The surface charge density σ is measures in:
(a) $C^2\, m$ (b) $C m^2$ (c) C/m^2

4. Coulomb constant in SI system has the units
(a) Nm^2C^{-2} (b) NmC^2 (c) $Nm^{-2}C^2$

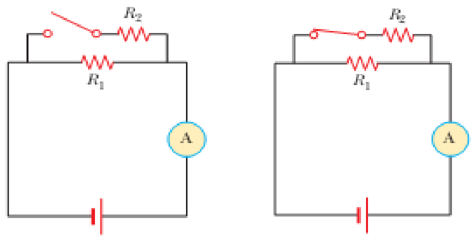
5. The electric flux Φ_E is has the units
(a) $Tesla\, C^{-1}m^2$ (b) $Tesla\ m^2$ (c) $NC^{-1}m^2$

6. The electric flux Φ_E is has the units
(a) $Tesla\, C^{-1}m^2$ (b) $Tesla\ m^2$ (c) $NC^{-1}m^2$

7. The electric force is inversely proportional to:
(a) r (b) r^2 (c) $|q_1||q_2|$

8. The volume charge density σ is measures in:
(a) $C^2 m$ (b) $C m^2$ (c) C/m^3

9. In Figure the current is measured with the ammeter. When the switch is closed, the reading on the ammeter
(a) increases,
(b) decreases, or
(c) remains the same.



10. If the incidence angle equal to 30^0, the emerging ray of light from a slab is (a) deflecting (b) parallel (c) all previous.

11. Snell's law state that (a) $n_2/n_1 = v_2/v_1$ (b) $n_2/n_1 = \lambda_2/\lambda_1$ (c) $v_2/v_1 = \lambda_2/\lambda_1$.

12. At the critical angle ($\theta_c = 50^o$) for the air–water boundary, the refractive index (n) equal to (a) 1.5 (b) 1.15 (c) 1.3.

13. If the focal length of the lens (f =10cm), the distance between the object at center of curvature and its image is (a) 20cm (b) 0.4m (c) 10cm.

14. If the focal length of the magnifier (f = 2.5cm), the magnification of a magnifier (M) is (a) 25 (b) 11 (c) 22.

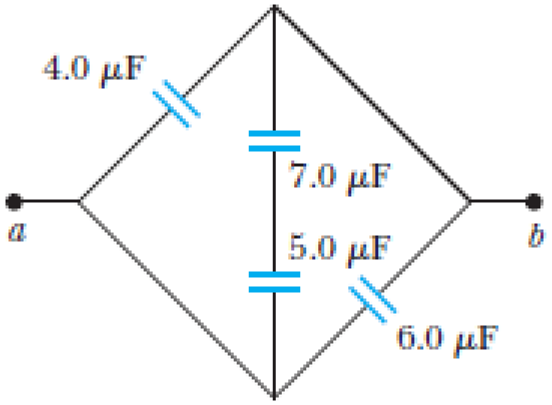
15. Healthy person sees the objects at a distance (a) 25m (b) 0.25m (c) 2.5m.

16. Two plane mirrors, the angle between them 120^o, the angle of incidence of ray on the first mirror equal to 65^o, then the reflection angle from the second mirror is (a)52^o (b)50^o (c) 55^o.

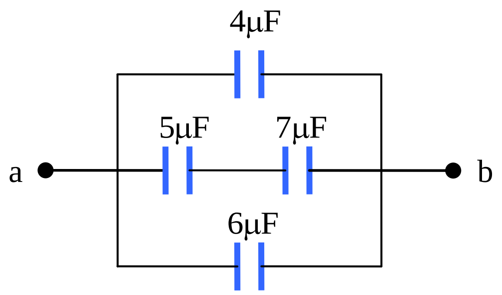
17. The fringes at the screen in Young's double slits are (a) equals (b) unequally (c) nothings

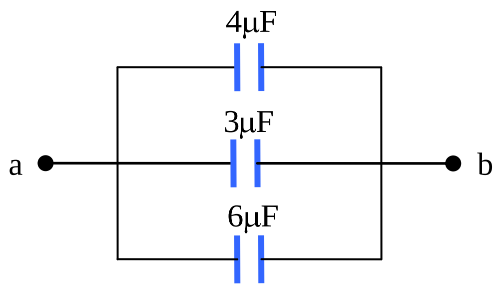
Q3) [16 marks]

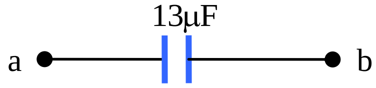
Find the equivalent capacitance between points *a* and *b* in the combination of capacitors shown in the figure



-- **Solution** --







Q3) [20 marks]

Deduce the width of the fringe ΔY in Young's double slits experiment. A light source emits visible light of two wavelengths λ = 430nm and $\lambda^{/}$ = 510nm. The source is used in a double- slit interference experiment in which L = 1.5m and d = 0.025mm. Find the separation distance between the third–order bright fringes for the two wavelengths.

-- **Solution** --

Interference in light waves from two sources was first demonstrated by Thomas Young in 1801. We can describe Young's experiment with the help of Figure (4). The screen is located a distance L from the double slit S_1 and S_2, which are separated by a distance d and the source is monochromatic. under these conditions, the waves emerging from S_1 and S_2 have the same frequency and amplitude and are in phase. Note that, in order to reach P, a wave from S_2 travels farther than a wave from S_1 by a distance $d\sin\theta$. This distance is called the ***path difference***, δ, where

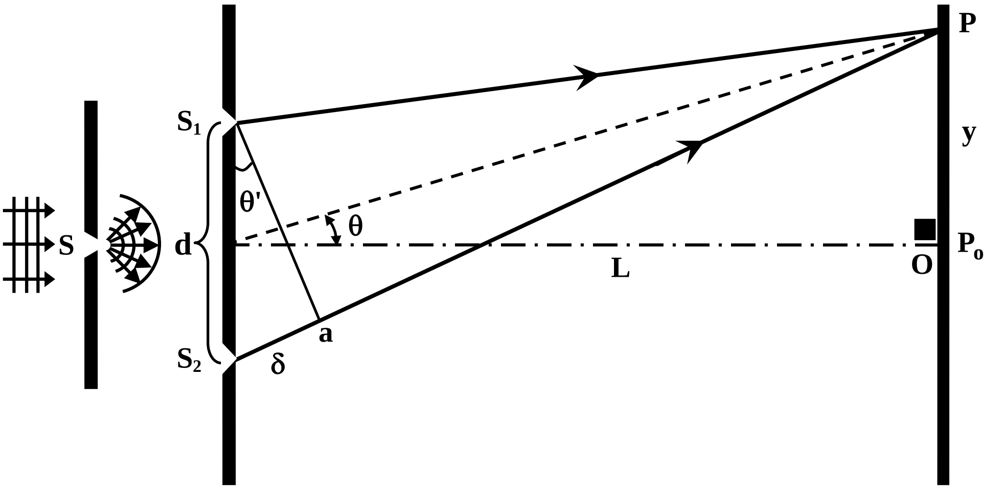


Fig. (4): Geometric construction for describing Young's double-slit experiment.

$$\delta = r_2 - r_1 = d\sin\theta, \tag{1}$$

This equation assumes that r_1 and r_2 are parallel, which is approximately true because L is much greater than d. The value of this path difference determines whether or not the two waves are in phase when they arrive at P. If the path difference is either zero or some integral multiple of the wavelength, the two waves are in phase at P and constructive interference results. Therefore, the condition for bright fringes, or constructive interference, at P is

$$\boxed{\delta = d \sin\theta = m\lambda \qquad (m = 0, \pm 1, \pm 2, \ldots).} \tag{2}$$

The number m is called the order number. The central bright fringe at $\theta = 0$ $(m = 0)$ is called the zero-order maximum. The first maximum on either side, when $m = \pm 1$, is called the first- order maximum, and so forth.

When the path difference is an odd multiple of $\frac{\lambda}{2}$, the two waves at P are 180° out of phase and will give rise to destructive interference. Therefore, the condition for dark fringes, or destructive interference, at P is

$$\delta = d \sin\theta = (m + \tfrac{1}{2})\lambda \qquad (m = 0, \pm 1, \pm 2, \ldots). \tag{3}$$

It is useful to obtain expressions for the positions of the bright and dark fringes measured vertically from O to P. Since the angle θ is small, we can use the approximation $\sin\theta \approx \tan\theta$, or

$$\sin\theta \approx \tan\theta = \frac{y}{L}, \tag{4}$$

Using this result together with Eq. (2), we see that the position of the bright fringes measured from O are given by

$$y_{bright} = m\frac{\lambda L}{d}, \tag{5}$$

Similarly, using Eq. (3) and (4), we find that the dark fringes are located at

$$y_{dark} = (m + \tfrac{1}{2})\frac{\lambda L}{d}, \tag{6}$$

The spacing or distance between the centers of two adjacent bright (or dark) fringes is given by

$$y_{m+1} - y_m = \frac{\lambda L}{d}, \tag{7}$$

Notice that, $y_{m+1} - y_m$ is independent of the order of the fringes.

Problem: A light source emits visible light of two wavelengths: $\lambda = 430\,\text{nm}$ and $\lambda' = 510\,\text{nm}$. The source is used in a double slit interference experiment in which $L = 1.5\,\text{m}$ and $d = 0.025\,\text{mm}$. Find the separation between the third order bright fringes.

--- **Solution** ---

$m = 3$, $\lambda = 430\times10^{-9}\,\text{m}$,

$\lambda' = 510\times10^{-9}\,\text{m}$,

$L = 1.5\,\text{m}$, $d = 0.025\times10^{-3}\,\text{m}$,

$$y_3 = m\frac{\lambda L}{d} = 3\times\frac{430\times10^{-9}\times1.5}{0.025\times10^{-3}} = 7.74\times10^{-2}\,\text{m}$$

$$y'_3 = m\frac{\lambda' L}{d} = 3\times\frac{510\times10^{-9}\times1.5}{0.025\times10^{-3}} = 9.18\times10^{-2}\,\text{m}$$

Hence the separation between the two fringes is

$$y'_3 - y_3 = 1.4\times10^{-2}\,\text{m} = 1.4\,\text{cm}$$