SAMPEL PERCUMA

# Kertas Trial STPM Semester 3 Fizik (Physics) Selangor 2024

## Set penuh: Kertas Percubaan STPM

Semester 3 · 10 subjek (2024)

**Sampel ini: 4 muka surat. Set penuh ada:**

- 2 fail PDF
- Semester 1: kertas percubaan (trial) negeri, subjek yang dipilih + skema
- Blueprint 30 hari Semester 1 (setiap subjek)
- Semester 3: percubaan 2024, 10 subjek, banyak negeri, soalan + skema dalam satu fail

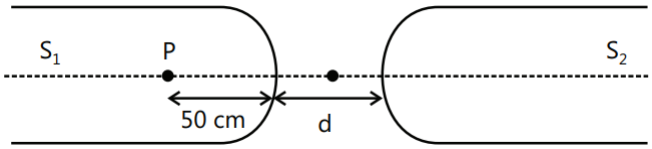
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Sampel bermula di muka surat sebelah

6. Two identical glass rods $S_1$ and $S_2$ (refractive index = 1.5) have one convex end of radius of curvature 10 cm. They are placed with the curved surfaces at a distance d as shown in the figure, with their axes (shown by the dashed line) aligned. When a point source of light P is placed inside rod $S_1$ on its axis at a distance of 50 cm from the curved face, the light rays emanating from it are found to be parallel to the axis inside $S_2$. The distance d is

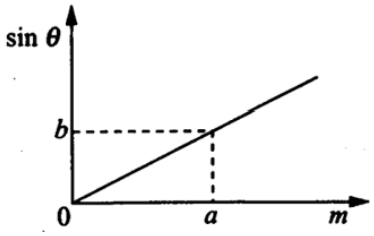



A. 60 cm B. 70 cm C. 80 cm D. 90 cm

7. Two polaroids $P_1$ and $P_2$ are placed with their axis perpendicular to each other. Unpolarised light $I_o$ is incident on $P_1$. A third polaroid $P_3$ is kept in between $P_1$ and $P_2$ such that its axis makes an angle $45^o$ with that of $P_1$. The in tensity of transmitted light through $P_2$ is

A. $I_o/2$ B. $I_o/4$ C. $I_o/8$ D. $I_o/16$

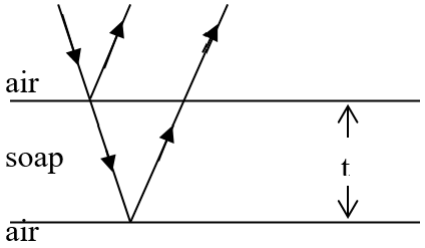
8. An experiment was carried out to determine the wavelength of monochromatic light using a diffraction grating which has N lines per unit length. A diffraction angle $\theta$ for each order $m$ was determined. The graph shows the variation of sin $\theta$ with $m$.




What is the wavelength of the light?

A. $\frac{a}{Nb}$ B. $\frac{b}{Na}$ C. $\frac{Na}{b}$ D. $\frac{Nb}{a}$

9. The figure shows monochromatic light of wavelength λ which illuminates at nearly normal incidence a thin soap film of thickness t and refractive index n.



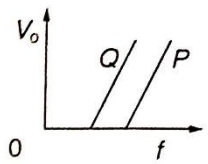

The optical path difference between the reflected rays from the upper and lower surfaces of the soap film is

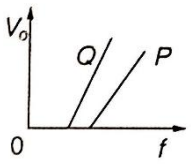
A. $\frac{2t}{n}$ B. 2nt C. $\frac{2t}{n} - \frac{\lambda}{2}$ D. $2nt - \frac{\lambda}{2}$

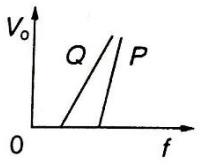
10. What is the de Broglie wavelength of a proton with kinetic energy $81.9 \times 10^{-15}$ J? [Given : mass of proton is 1836 times that of electron]

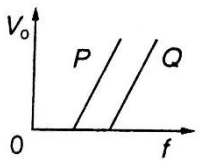
A. $4.01 \times 10^{-14}$ m B. $5.33 \times 10^{-14}$ m C. $7.11 \times 10^{-14}$ m D. $9.35 \times 10^{-14}$ m

11. In a photoelectric experiment, light of frequency f is incident on two different metals P and Q, with the work function of metal P higher than that of metal Q. The stopping potential difference Vs is measured and plotted against f. Which of the following graphs of Vs against f is correct?

A. 


B. 


C. 


D. 


12. The characteristics lines in the X-ray spectrum is produced when
    A. an electron at the highest energy level is captured into the nucleus
    B. the incident electron successfully knocks out an electron from the outermost orbit of the target atom
    C. an electron in the target atom makes a transition to the innermost orbit
    D. the incident electron undergoes deceleration and radiates all its energy as a photon

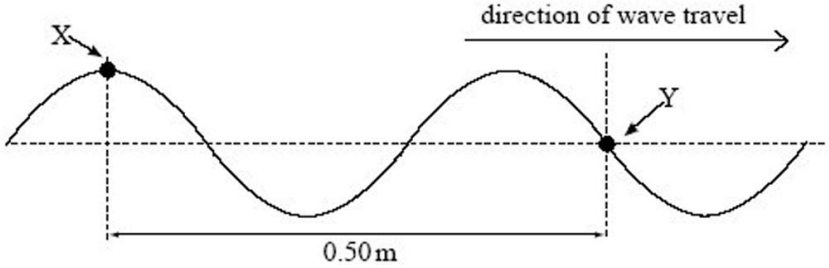
13. Bohr's contribution to the development of atomic structure
    A. was referred to as the "plum pudding model."
    B. was the discovery that electrons surround a dense nucleus.
    C. was proposed that electrons travel in circular orbits around the nucleus.
    D. is the quantum mechanical model.

14. The binding energy per nucleon may be used as a measurement of the stability of a nucleus. This quantity
    A. is directly proportional to the neutron/proton ratio of the nucleus
    B. is a maximum for nuclides in the middle of the Periodic table
    C. increases uniformly as the proton number increases
    D. has maximum values for nuclei of the inert gases

15. A radioactive isotope has a half-life of T years. How long will it take the activity to reduce to 3.125% of its original value?
    A. 2T B. 3T C. 5T D. 7T

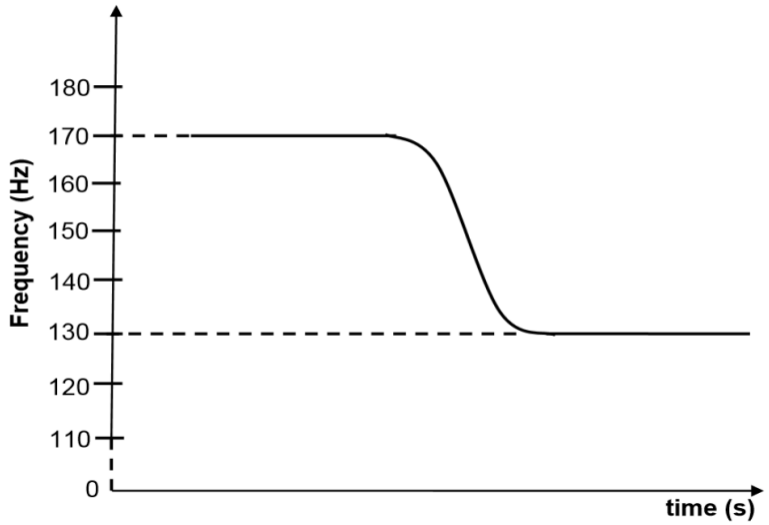
**SECTION B**. (15 marks)
Answer all questions.

16. The diagram below represents a progressive wave travelling from left to right on a stretched string.




a) Calculate the wavelength of the wave. [1 mark]
b) The frequency of the wave is 22 Hz. Calculate the speed of the wave. [2 marks]
c) Determine the phase difference between points X and Y on the string, giving an appropriate unit. [2 marks]
d) Describe how the displacement of point Y on the string varies in the next half-period. [2 marks]

17. A police car moving at a constant velocity with its siren on, passes a stationary listener. The graph below shows the changes in the frequency of the sound of the siren detected by the listener.




a) Describe the phenomenon called Doppler effect. [1 mark]
b) Write down the frequency of the sound detected by the listener as the police car
   i) approaches the listener [1 mark]
   ii) moves away from the listener [1 mark]
c) Calculate the speed of the police car. Take the speed of sound in air to be 340 $ms^{-1}$. [5 marks]

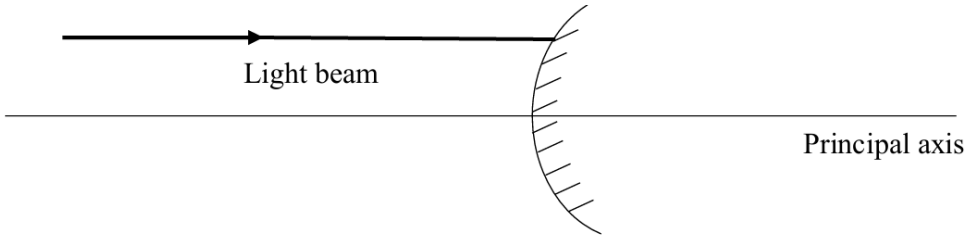
**SECTION C**. (30 marks)
Answer any **two** questions in this section.

18. a) Define frequency. [1mark]
b) What do you understand by a body undergoing simple harmonic motion? [2 marks]
c) Given that the velocity v of a body of mass m undergoing simple harmonic motion is given by

$$v = \pm \omega \sqrt{A^2 - x^2}$$

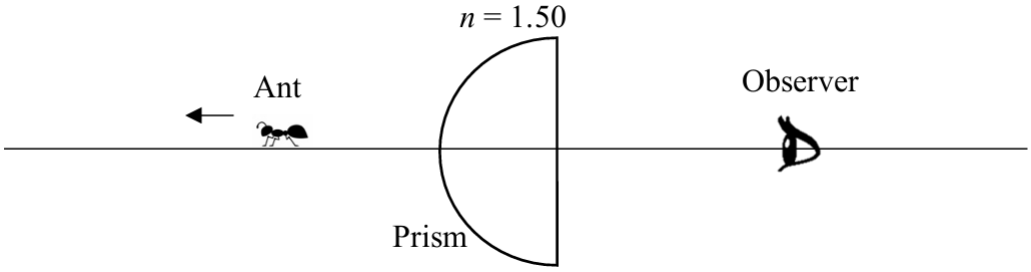
Find the kinetic energy of the body in terms of its displacement x, angular frequency ω and amplitude A. [2 marks]
d) Sketch graphs, using the same horizontal axis, to show how the velocity and the kinetic energy vary with the displacement of a body undergoing simple harmonic motion. [3 marks]
e) A block attached to a horizontal spring performs simple harmonic motion with frequency 12.0 Hz and amplitude 4.50 cm on a smooth horizontal surface. The force constant of the spring is 1500 N $m^{-1}$.
   i) Sketch a graph of variation of potential energy U against displacement and variation of total energy E of the system against displacement on the same axes. [3 marks]
   ii) What is the maximum velocity and maximum kinetic energy of the block? [4 marks]

19. a) The diagram below shows a beam of light rays propagate parallel to the principal axis of a convex mirror.




i) Copy the diagram and sketch the reflected light ray. Mark the focus point of the mirror. [2 marks]
ii) If the light beam is originated from a real, distant object, what are the characteristics and position of the image? [2 marks]

b) An observer observes an ant through a hemispherical prism. Given the radius of the curved surface is 20.0 cm. The ant climbs slowly away from the prism.




i) When the ant is 20.0 cm from the curved surface, where is its image relative to the ant as observed by the observer? [3 marks]
ii) What are the characteristics of the image in b)i)? [1 mark]
iii) As the ant climbs further away from the prism, what happens to the image of the ant as observed by the observer? [2 marks]
iv) Find the position of the ant at which the observer starts to lose sight of it. [4 marks]
v) If the prism is replaced with a water prism(refractive index = 1.33), what would happen to the position in b)iv)? [1 mark]

20.a) i) What is meant by radioactive decay? [1 mark]
ii) Derive an expression for decay constant, $\lambda$ in terms of half-life $T_{½}$. [4 marks]

b) The bombardment of a beryllium nucleus by an $\alpha$-particle produces a fundamental particle X, as follows:

$$\alpha + {}^{9}_{4}\mathrm{Be} \rightarrow {}^{12}_{6}\mathrm{C} + \mathrm{X}$$

i) Complete the equation above by giving the proton and nucleon numbers to the $\alpha$-particle and X.
ii) What are the $\alpha$- particle and X?
iii) State two important properties which cause X difficult to be detected. [5 marks]

c) ${}^{220}_{86}\mathrm{Rn}$ (Radon) decays spontaneously with a half-life of 56 s to form polonium (Po). During this decay, an $\alpha$-particle and a $\gamma$-ray photon are emitted with energies of 6.29MeV and 0.55 MeV respectively.
i) Write down an equation to represent the decay of Radon nucleus. [1mark]
ii) Calculate for this decay, the mass equivalence of the energy released during the decay and the wavelength of the emitted $\gamma$-ray photon. [4 marks]

TAMAT SAMPEL

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