General Certificate of Education
June 2008
Advanced Level Examination

PHYSICS (SPECIFICATION A) **PA04**
Unit 4 Waves, Fields and Nuclear Energy

Section A

Wednesday 11 June 2008 9.00 am to 10.30 am

For this paper you must have:
- an objective test answer sheet
- a black ball-point pen
- a calculator
- a question paper/answer book for Section B (enclosed)
- a data sheet insert.

Time allowed: The total time for Section A and Section B of this paper is 1 hour 30 minutes.

Instructions
- Use a black ball-point pen. Do **not** use a pencil.
- Answer **all** questions in this section.
- For each question there are four responses. When you have selected the response which you think is the most appropriate answer to a question, mark this response on your answer sheet.
- Mark all responses as instructed on your answer sheet. If you wish to change your answer to a question, follow the instructions on your answer sheet.
- Do all rough work in this book **not** on the answer sheet.

Information
- The maximum mark for this paper is 30.
- All questions in Section A carry equal marks. No deductions will be made for incorrect answers.
- A *Data Sheet* is provided as a loose insert to this question paper.
- The question paper/answer book for Section B is enclosed within this question paper.

SECTION A

In this section each item consists of a question or an incomplete statement followed by four suggested answers or completions. You are to select the most appropriate answer in each case.

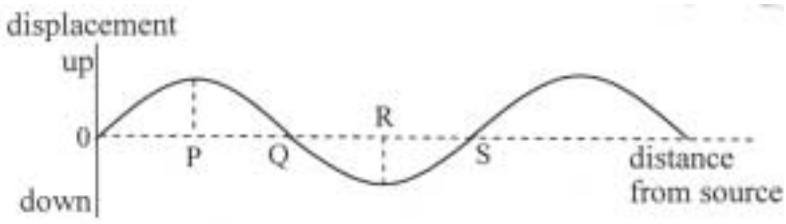
1 Which one of the following statements concerning the acceleration of an object moving with simple harmonic motion is correct?

A It is constant.
B It is at a maximum when the object moves through the centre of the oscillation.
C It is zero when the object moves through the centre of the oscillation.
D It is zero when the object is at the extremity of the oscillation.

2 When the length of a simple pendulum is decreased by 600 mm, the period of oscillation is halved. What was the original length of the pendulum?

A 800 mm
B 1000 mm
C 1200 mm
D 1400 mm

3



The graph shows, at a particular instant, the variation of the displacement of the particles in a transverse progressive water wave, of wavelength 4 cm, travelling from left to right. Which one of the following statements is **not** true?

A Particles at P and R are in a phase.
B The velocity of the particle at Q is a maximum.
C The particle at S is moving downwards.
D The distance PS = 3 cm.

4 Which one of the following statements is **not** correct?

Progressive longitudinal waves can

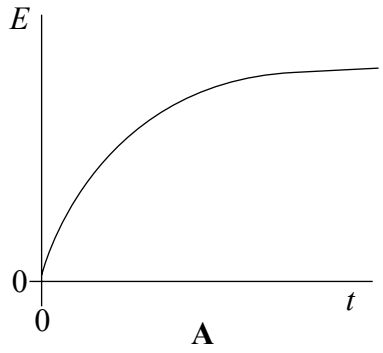
A show interference effects.
B be diffracted.
C superpose to form a stationary wave.
D be polarised.

5 Light of wavelength 590 nm is incident normally on a diffraction grating with 500 lines per mm.

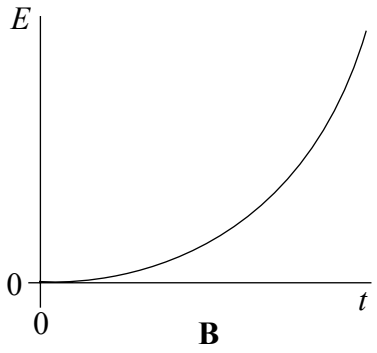
What is the maximum number of orders that will be observed in the light emerging from the grating?

A 2
B 3
C 4
D 5

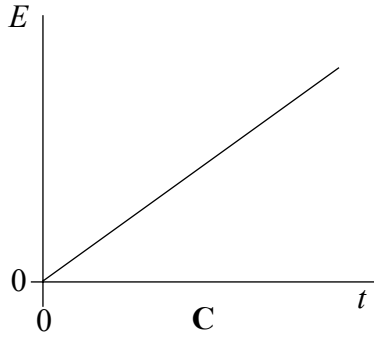
6 An uncharged capacitor of fixed capacitance is connected in series with a switch and battery. The switch is closed at time $t = 0$. Which graph, **A** to **D**, shows how the energy, E, stored by the capacitor, changes with time, t, after the switch is closed?



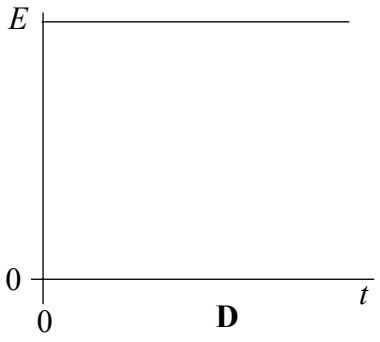
A



B



C



D

7 The voltage across a capacitor falls from 10 V to 5 V in 48 ms as it discharges through a resistor. What is the time constant of the circuit?

A 24 ms
B 33 ms
C 69 ms
D 96 ms

8 The wheel of the London Eye has a diameter of 130 m and can rotate at a steady speed, completing one rotation every 30 minutes. What is the centripetal acceleration of a person in a capsule at the rim?

A $1.2 \times 10^{-4}\,\text{m s}^{-2}$
B $2.5 \times 10^{-4}\,\text{m s}^{-2}$
C $3.9 \times 10^{-4}\,\text{m s}^{-2}$
D $7.9 \times 10^{-4}\,\text{m s}^{-2}$

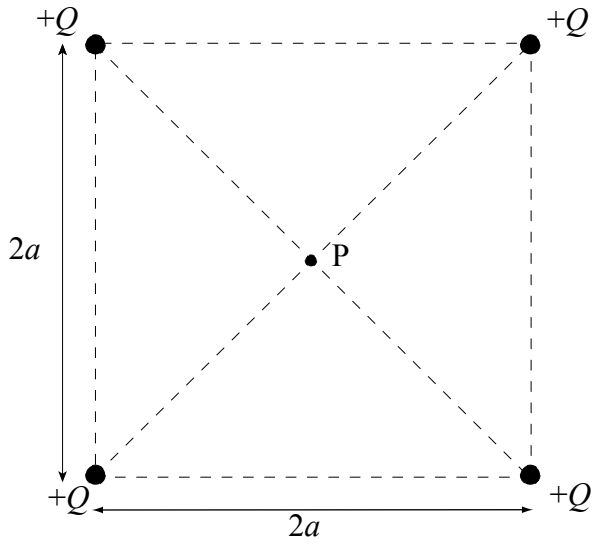
9 Which one of the following has different units to the other three?

A gravitational potential gradient
B gravitational field strength
C force per unit mass
D gravitational potential

10 A charged particle of mass 4.80×10^{-13} kg and charge 8.00×10^{-19} C is stationary in a vertical electric field. What is the value of the electric field?
(Assume that the gravitational field strength is $10.0\,\text{N kg}^{-1}$)

A $6.00 \times 10^{5}\,\text{V m}^{-1}$
B $1.67 \times 10^{6}\,\text{V m}^{-1}$
C $6.00 \times 10^{6}\,\text{V m}^{-1}$
D $1.67 \times 10^{7}\,\text{V m}^{-1}$

11 The diagram shows four point charges, each $+Q$, at the corners of a square of side $2a$. What is the electric field strength at P, the centre of the square?



A zero

B $\frac{Q}{4\pi\varepsilon_0 a^2}$

C $\frac{Q}{2\pi\varepsilon_0 a^2}$

D $\frac{Q}{\pi\varepsilon_0 a^2}$

12 An α particle and a β^- particle both enter the same uniform magnetic field, which is perpendicular to their direction of motion. If the β^- particle has a speed 15 times that of the α particle, what is the value of the ratio

$$\frac{\text{magnitude of the force on the } \beta^- \text{ particle}}{\text{magnitude of the force on the } \alpha \text{ particle}} ?$$

A 3.7
B 7.5
C 60.0
D 112.5

13 If 1g of matter is completely transformed into energy, how much energy is released?

A 9.0×10^{13} MeV
B 9.0×10^{16} MeV
C 5.6×10^{23} MeV
D 5.6×10^{26} MeV

14 Which one of the following statements correctly describes the changes that occur when a uranium nucleus undergoes fission?

A The binding energy per nucleon decreases and one or more neutrons are released.
B The binding energy per nucleon decreases and one or more protons are released.
C The binding energy per nucleon increases and one or more neutrons are released.
D The binding energy per nucleon increases and one or more protons are released.

15 A nucleus of ${}^{235}_{92}\mathrm{U}$ absorbs a neutron and undergoes fission. Which one of the following gives possible products of this process?

A $2\,{}^{4}_{2}\mathrm{He} + {}^{228}_{88}\mathrm{Ra}$

B ${}^{141}_{56}\mathrm{Ba} + {}^{92}_{36}\mathrm{Kr} + 3\,{}^{1}_{0}\mathrm{n}$

C $2\,{}^{0}_{-1}\mathrm{e} + {}^{236}_{94}\mathrm{Pu}$

D ${}^{212}_{84}\mathrm{Po} + 4\,{}^{4}_{2}\mathrm{He} + 8\,{}^{1}_{0}\mathrm{n}$

END OF SECTION A

There are no questions printed on this page

There are no questions printed on this page