

Centre Number						Candidate Number				
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Other Names										
Candidate Signature										



General Certificate of Education
Advanced Level Examination
June 2014

Physics A

PHYA4/1

Unit 4 Fields and Further Mechanics Section A

Wednesday 11 June 2014 1.30 pm to 3.15 pm

In addition to this paper you will require:

- an objective test answer sheet
- a black ball-point pen
- a calculator
- a question paper/answer book for Section B (enclosed)
- a Data and Formulae booklet.

Time allowed

- The total time for both sections of this paper is 1 hour 45 minutes. You are advised to spend approximately 45 minutes on this section.

Instructions

- Use a black ball-point pen.
- 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

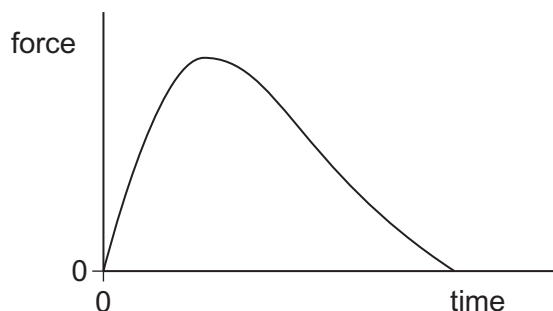
- The maximum mark for this section is 25.
- All questions in Section A carry equal marks. No deductions will be made for incorrect answers.
- A *Data and Formulae Booklet* is provided as a loose insert.
- The question paper/answer book for Section B is enclosed within this question paper.

Multiple choice questions

Each of Questions 1 to 25 is followed by four responses, **A**, **B**, **C**, and **D**. For each question select the best response and mark its letter on the answer sheet.

You are advised to spend about **45 minutes** on this section.

- 1 The graph shows how the force acting on a rocket varies with time.

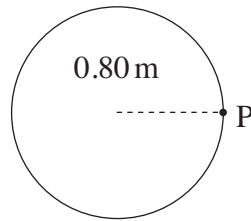


Which one of the following is represented by the area under the graph?

- A** distance travelled
B gain in kinetic energy
C change in velocity
D change in momentum
- 2 A golf club strikes a stationary golf ball of mass $4.8 \times 10^{-2} \text{ kg}$ and the ball leaves the club with a speed of 95 m s^{-1} . If the average force exerted on the ball is 7800 N , how long are the ball and club in contact?
- A** $5.8 \times 10^{-4} \text{ s}$
B $1.2 \times 10^{-2} \text{ s}$
C 0.51 s
D 0.58 s
- 3 Water of density 1000 kg m^{-3} flows out of a garden hose of cross-sectional area $7.2 \times 10^{-4} \text{ m}^2$ at a rate of $2.0 \times 10^{-4} \text{ m}^3$ per second. How much momentum is carried by the water leaving the hose per second?
- A** $5.6 \times 10^{-5} \text{ N s}$
B $5.6 \times 10^{-2} \text{ N s}$
C 0.20 N s
D 0.72 N s

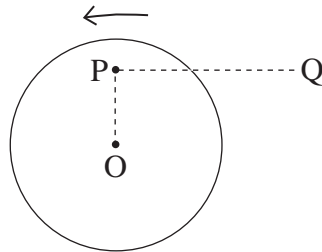


- 4 A model car moves in a circular path of radius 0.80 m at an angular speed of $\frac{\pi}{2}$ rad s⁻¹.



What is its displacement from point P 6.0 s after passing P?

- A zero
 B 0.4π m
 C 1.6 m
 D 1.6π m
- 5 A small mass is placed at P on a horizontal disc which has its centre at O. The disc rotates anti-clockwise about a vertical axis through O with constant angular speed.



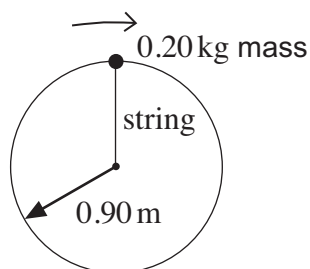
Which one of the following describes the force which keeps the mass at rest relative to the disc when in the position shown?

- A the weight of the mass
 B a frictional force from P to Q
 C a frictional force directed away from O
 D a frictional force directed towards O

Turn over ►



- 6 A 0.20 kg mass is whirled round in a vertical circle on the end of a light string of length 0.90 m.



At the top point of the circle the speed of the mass is 8.2 m s^{-1} . What is the tension in the string at this point?

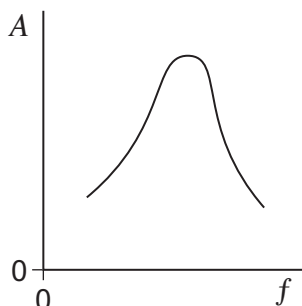
- A 10 N
 B 13 N
 C 17 N
 D 20 N
- 7 Which line, **A** to **D**, in the table gives the amplitude and frequency of a body performing simple harmonic motion whose displacement x at time t is given by the equation $x = P \cos Qt$?

	Amplitude	Frequency
A	$\frac{P}{2}$	$\frac{Q}{2\pi}$
B	P	$2\pi Q$
C	P	$\frac{Q}{2\pi}$
D	$2P$	$\frac{Q}{2\pi}$

- 8 The tip of each prong of a tuning fork emitting a note of 320 Hz vibrates in simple harmonic motion with an amplitude of 0.50 mm. What is the speed of each tip when its displacement is zero?
- A zero
 B $0.32\pi \text{ mm s}^{-1}$
 C $160\pi \text{ mm s}^{-1}$
 D $320\pi \text{ mm s}^{-1}$



- 9 A periodic force is applied to a lightly-damped object causing the object to oscillate. The graph shows how the amplitude A of the oscillations varies with the frequency f of the periodic force.



Which one of the following statements best describes how the shape of the curve would differ if the damping had been greater?

- A The curve would be lower at all frequencies.
- B The curve would be higher at all frequencies.
- C The curve would be unchanged except at frequencies above the resonant frequency where it would be lower.
- D The curve would be unchanged except at frequencies above the resonant frequency where it would be higher.
- 10 A spacecraft of mass m is at the mid-point between the centres of a planet of mass M_1 and its moon of mass M_2 . If the distance between the spacecraft and the centre of the planet is d , what is the magnitude of the resultant gravitational force on the spacecraft?
- A $\frac{Gm(M_1 - M_2)}{d}$
- B $\frac{Gm(M_1 + M_2)}{d^2}$
- C $\frac{Gm(M_1 - M_2)}{d^2}$
- D $\frac{Gm(M_1 + M_2)}{d}$

Turn over ►

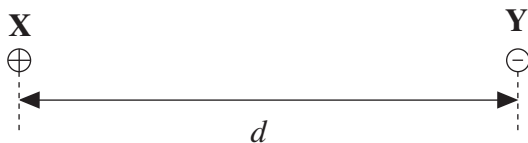


- 11 Which one of the following statements about gravitational potential is correct?
- A Gravitational potential can have a positive value.
 - B The gravitational potential at the surface of the Earth is zero.
 - C The gravitational potential gradient at a point has the same numerical value as the gravitational field strength at that point.
 - D The unit of gravitational potential is N kg^{-1} .

- 12 Which one of the following statements is correct?

The force between two charged particles

- A is always attractive.
 - B can be measured in $\text{C}^2 \text{F}^{-1} \text{m}^{-1}$.
 - C is directly proportional to the distance between them.
 - D is independent of the magnitude of the charges.
- 13 Two point charges, **X** and **Y**, exert a force F on each other when they are at a distance d apart.



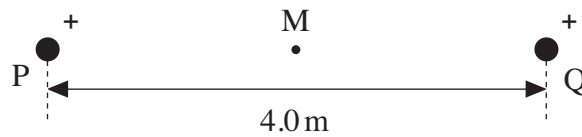
When the distance between them is 20 mm, the force they exert on each other is $0.5 F$.

What is the distance d ?

- A 7 mm
 - B 14 mm
 - C 15 mm
 - D 28 mm
- 14 Which one of the following statements is correct?
- When a negative ion is projected into an electric field
- A the field can change the magnitude of the velocity but not its direction.
 - B the field can change the direction of the velocity but not its magnitude.
 - C the field can change both the magnitude and the direction of the velocity.
 - D the ion will accelerate in the direction of the field.

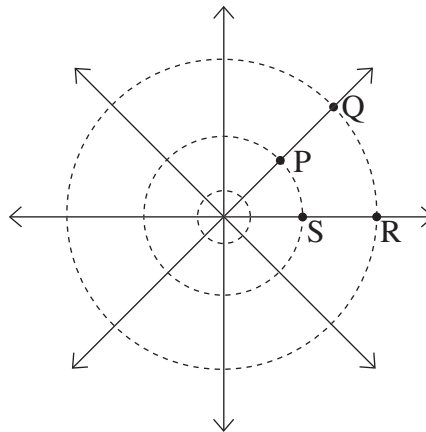


- 15 Two identical positive point charges, P and Q, are separated by a distance of 4.0 m. The resultant electric potential at point M, which is mid-way between the charges, is 25.0 V.



What would be the resultant electrical potential at a point 1.0 m closer to P?

- A 8.3 V
 B 12.5 V
 C 33.3 V
 D 37.5 V
- 16 The diagram below shows the field lines and equipotential lines around an isolated positive point charge.



Which one of the following statements concerning the work done when a small charge is moved in the field is **incorrect**?

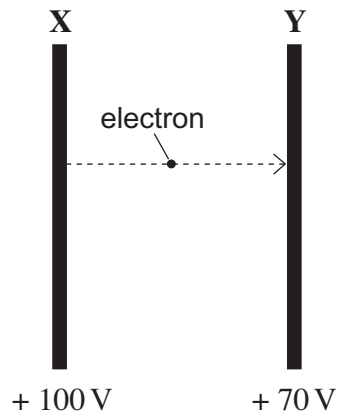
- A When it is moved from either P to Q or S to R, the work done is the same in each case.
 B When it is moved from Q to R no work is done.
 C When it is moved around the path PQRS, the overall work done is zero.
 D When it is moved around the path PQRS, the overall work done is equal to twice the work done in moving from P to Q.

Turn over ►



17

Two fixed parallel metal plates **X** and **Y** are at constant potentials of + 100 V and + 70 V respectively. An electron travelling from **X** to **Y** experiences a change of potential energy ΔE_p

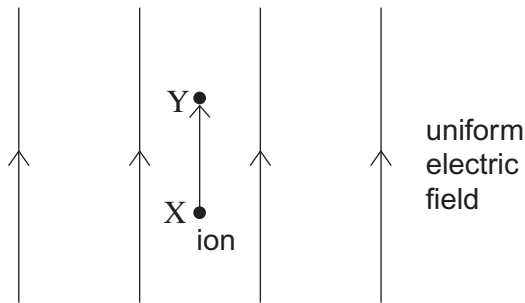


Which line, **A** to **D**, in the table shows correctly the direction of the electrostatic force F on the electron and the value of ΔE_p ?

	Direction of F	ΔE_p
A	towards X	+ 30 eV
B	towards Y	- 30 eV
C	away from X	+ 30 eV
D	away from Y	- 30 eV



- 18 A uniform electric field of electric field strength E is aligned so it is vertical. An ion moves vertically through a small distance Δd from point X to point Y in the field. There is a uniform gravitational field of field strength g throughout the region.



Which line, **A** to **D**, in the table correctly gives the gravitational potential difference, and the electric potential difference, between X and Y?

	Gravitational potential difference	Electric potential difference
A	$g\Delta d$	$E\Delta d$
B	$g\Delta d$	$\frac{E}{\Delta d}$
C	$\frac{g}{\Delta d}$	$E\Delta d$
D	$\frac{g}{\Delta d}$	$\frac{E}{\Delta d}$

- 19 Initially a charged capacitor stores $1600 \mu\text{J}$ of energy. When the pd across it decreases by 2.0 V , the energy stored by it becomes $400 \mu\text{J}$.

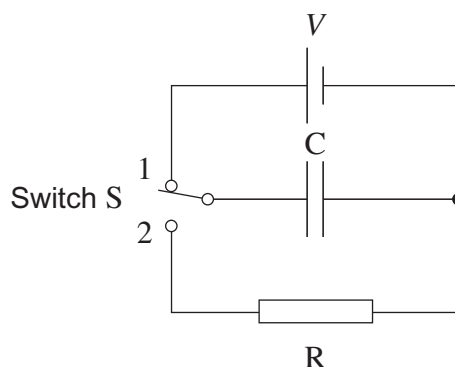
What is the capacitance of this capacitor?

- A** $100 \mu\text{F}$
B $200 \mu\text{F}$
C $400 \mu\text{F}$
D $600 \mu\text{F}$

Turn over ►



- 20 Switch S in the circuit is held in position 1, so that the capacitor C becomes fully charged to a pd V and stores energy E .



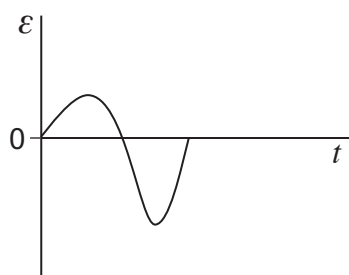
The switch is then moved quickly to position 2, allowing C to discharge through the fixed resistor R . It takes 36 ms for the pd across C to fall to $\frac{V}{2}$. What period of time must elapse, after the switch has moved to position 2, before the energy stored by C has fallen to $\frac{E}{16}$?

- A 51 ms
 B 72 ms
 C 432 ms
 D 576 ms
- 21 The path followed by an electron of momentum p , carrying charge $-e$, which enters a magnetic field at right angles, is a circular arc of radius r .
- What would be the radius of the circular arc followed by an α particle of momentum $2p$, carrying charge $+2e$, which entered the same field at right angles?
- A $\frac{r}{2}$
 B r
 C $2r$
 D $4r$
- 22 In which one of the following applications does electromagnetic induction **not** take place?
- A the generators at a nuclear power station
 B the ac power adapter for a laptop computer
 C the wings of an aircraft cutting through the Earth's magnetic field
 D the back up capacitor of an electric timer



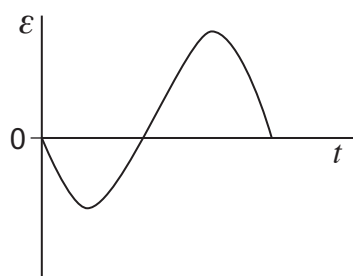
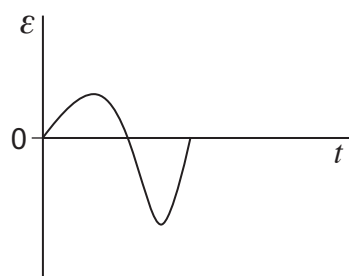
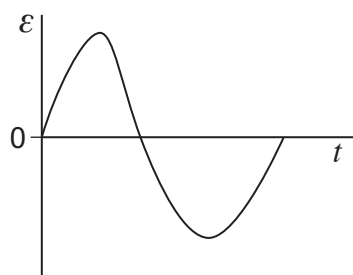
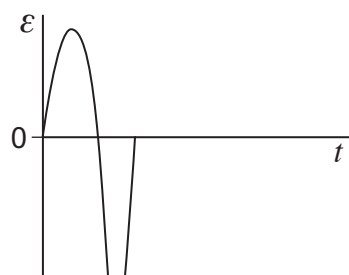
23

When a magnet is dropped through an aluminium ring an emf is induced. A data logger connected to the ring records the variation of the induced emf ε with time t as shown below.



In a second experiment, the magnet is dropped from a greater height.

Which one of the following graphs best represents the induced emf in the second experiment?

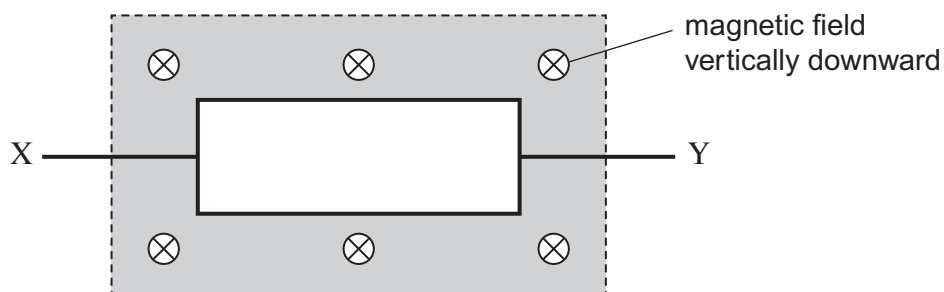
**A****B****C****D**

Turn over ►



- 24** A rectangular coil of area A has N turns of wire. The coil is in a uniform magnetic field, as shown in the diagram.

When the coil is rotated at a constant frequency f about its axis XY , an alternating emf of peak value ε_0 is induced in it.



What is the maximum value of the magnetic flux linkage through the coil?

- A** $\frac{\varepsilon_0}{2\pi f}$
- B** $\frac{\varepsilon_0}{\pi f}$
- C** $\pi f \varepsilon_0$
- D** $2\pi f \varepsilon_0$
- 25** A transformer has 1150 turns on the primary coil and 500 turns on the secondary coil. The primary coil draws a current of 0.26 A from a 230 V ac supply. The current in the secondary coil is 0.50 A. What is the efficiency of the transformer?
- A** 42%
- B** 50%
- C** 84%
- D** 100%

END OF QUESTIONS

