| Centre Number | | | | | | Candidate Number | | | | |
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| Candidate Signature | | | | | | | | | | |

General Certificate of Education
Advanced Level Examination
June 2011

# Physics A PHYA4/1

## Unit 4 Fields and Further Mechanics
## Section A

**Tuesday 21 June 2011 9.00 am to 10.45 am**

**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.

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**Multiple-choice questions**

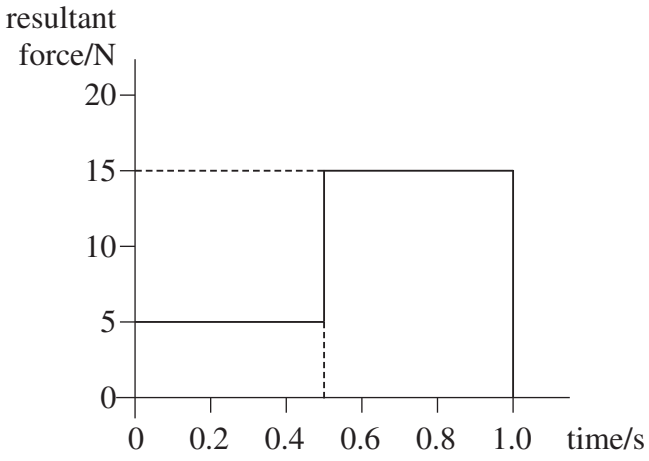
Each of Questions **1** to **25** is followed by four responses, **A**, **B**, **C**, and **D**. For each question select the best response and mark its letter on the answer sheet.

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

**1** Which line, **A** to **D**, in the table shows correctly whether the moment of a force, and momentum, are scalar or vector quantities?

| | **moment of force** | **momentum** |
|---|---|---|
| **A** | scalar | scalar |
| **B** | scalar | vector |
| **C** | vector | scalar |
| **D** | vector | vector |

**2** The graph shows how the resultant force applied to an object of mass 2.0 kg, initially at rest, varies with time.




What is the speed of the object after 1.0 s?

**A** $2.5\,m\,s^{-1}$
**B** $5.0\,m\,s^{-1}$
**C** $7.5\,m\,s^{-1}$
**D** $10\,m\,s^{-1}$

**3** Which of the following is a possible unit for rate of change of momentum?

**A** $N\,s$
**B** $N\,s^{-1}$
**C** $kg\,m\,s^{-1}$
**D** $kg\,m\,s^{-2}$

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**4** For a particle moving in a circle with uniform speed, which one of the following statements is correct?

**A** The kinetic energy of the particle is constant.
**B** The force on the particle is in the same direction as the direction of motion of the particle.
**C** The momentum of the particle is constant.
**D** The displacement of the particle is in the direction of the force.

**5** A young child of mass 20 kg stands at the centre of a uniform horizontal platform which rotates at a constant angular speed of $3.0\,\text{rad}\,\text{s}^{-1}$. The child begins to walk radially outwards towards the edge of the platform. The maximum frictional force between the child and the platform is 200 N. What is the maximum distance from the centre of the platform to which the child could walk without the risk of slipping?

**A** 1.1 m
**B** 1.3 m
**C** 1.5 m
**D** 1.7 m

**6** A particle travels at a constant speed around a circle of radius $r$ with centripetal acceleration $a$. What is the time taken for ten complete rotations?

**A** $\frac{\pi}{5}\sqrt{\frac{a}{r}}$

**B** $\frac{\pi}{5}\sqrt{\frac{r}{a}}$

**C** $20\pi\sqrt{\frac{a}{r}}$

**D** $20\pi\sqrt{\frac{r}{a}}$

**7** The frequency of a body moving with simple harmonic motion is doubled. If the amplitude remains the same, which one of the following is also doubled?

**A** the time period
**B** the total energy
**C** the maximum velocity
**D** the maximum acceleration

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**8** The time period of a pendulum on Earth is 1.0 s. What would be the period of a pendulum of the same length on a planet with half the density but twice the radius of Earth?

**A** 0.5 s
**B** 1.0 s
**C** 1.4 s
**D** 2.0 s

**9** Which one of the following statements always applies to a damping force acting on a vibrating system?

**A** It is in the same direction as the acceleration.
**B** It is in the same direction as the displacement.
**C** It is in the opposite direction to the velocity.
**D** It is proportional to the displacement.

**10** Masses of $M$ and $2M$ exert a gravitational force $F$ on each other when the distance between their centres is $r$. What is the gravitational force between masses of $2M$ and $4M$ when the distance between their centres is $4r$?

**A** 0.25 $F$
**B** 0.50 $F$
**C** 0.75 $F$
**D** 1.00 $F$

**11** A planet has a radius half the Earth's radius and a mass a quarter of the Earth's mass. What is the approximate gravitational field strength on the surface of the planet?

**A** 1.6 N kg$^{-1}$
**B** 5.0 N kg$^{-1}$
**C** 10 N kg$^{-1}$
**D** 20 N kg$^{-1}$

**12** At the surface of the Earth the gravitational field strength is $g$, and the gravitational potential is $V$. The radius of the Earth is $R$. An object, whose weight on the surface of the Earth is $W$, is moved to a height $3R$ above the surface. Which line, **A** to **D**, in the table gives the weight of the object and the gravitational potential at this height?

| | **weight** | **gravitational potential** |
|---|---|---|
| **A** | $\frac{W}{16}$ | $\frac{V}{4}$ |
| **B** | $\frac{W}{4}$ | $\frac{V}{3}$ |
| **C** | $\frac{W}{4}$ | $\frac{V}{4}$ |
| **D** | $\frac{W}{16}$ | $\frac{V}{3}$ |

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**13** A satellite of mass $m$ travels in a circular orbit of radius $r$ around a planet of mass $M$. Which one of the following expressions gives the angular speed of the satellite?

**A** $\sqrt{GMr}$

**B** $\sqrt{Gmr}$

**C** $\sqrt{\frac{Gm}{r^3}}$

**D** $\sqrt{\frac{GM}{r^3}}$

**14** An electron and a proton are $1.0 \times 10^{-10}$ m apart. In the absence of any other charges, what is the electric potential energy of the electron?

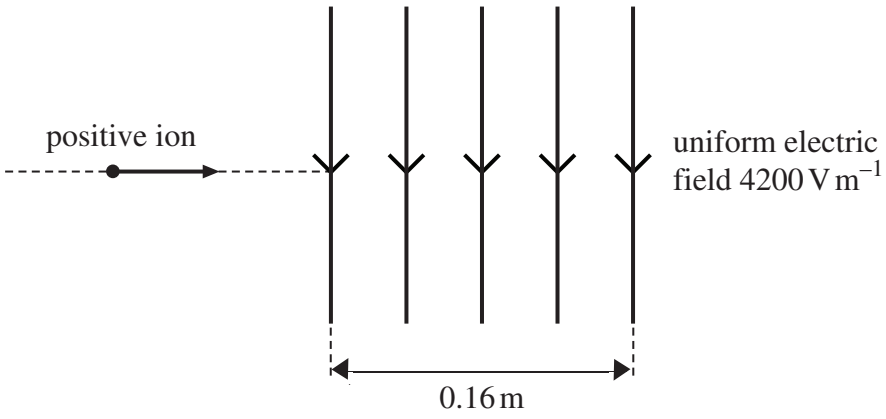
**A** $+2.3 \times 10^{-18}$ J

**B** $-2.3 \times 10^{-18}$ J

**C** $+2.3 \times 10^{-8}$ J

**D** $-2.3 \times 10^{-8}$ J

**15**




An ion carrying a charge of $+4.8 \times 10^{-19}$C travels horizontally at a speed of $8.0 \times 10^{5}$ m s$^{-1}$. It enters a uniform vertical electric field of strength 4200 V m$^{-1}$, which is directed downwards and acts over a horizontal distance of 0.16m.
Which one of the following statements is **not** correct?

**A** The ion passes through the field in $2.0 \times 10^{-7}$s.
**B** The force on the ion acts vertically downwards at all points in the field.
**C** The magnitude of the force exerted on the ion by the field is $1.6 \times 10^{-9}$ N.
**D** The horizontal component of the velocity of the ion is unaffected by the electric field.

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**16** The electric potential at a distance $r$ from a positive point charge is 45 V. The potential increases to 50 V when the distance from the charge decreases by 1.5 m. What is the value of $r$?

**A** 1.3 m
**B** 1.5 m
**C** 7.9 m
**D** 15 m

**17** A 400 μF capacitor is charged so that the voltage across its plates rises at a constant rate from 0 V to 4.0 V in 20 s. What current is being used to charge the capacitor?

**A** 5 μA
**B** 20 μA
**C** 40 μA
**D** 80 μA

**18** A capacitor of capacitance $C$ stores an amount of energy $E$ when the pd across it is $V$. Which line, **A** to **D**, in the table gives the correct stored energy and pd when the charge is increased by 50%?

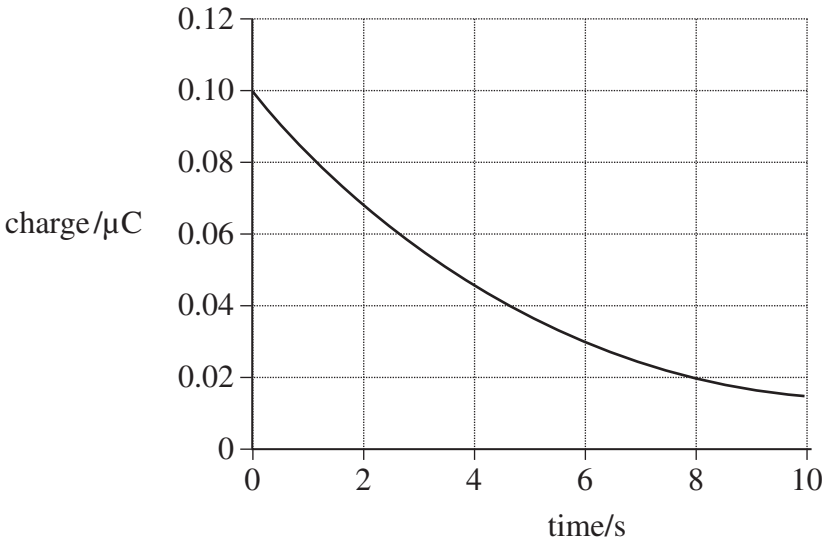
| | **energy** | **pd** |
|---|---|---|
| **A** | 1.5 $E$ | 1.5 $V$ |
| **B** | 1.5 $E$ | 2.25 $V$ |
| **C** | 2.25 $E$ | 1.5 $V$ |
| **D** | 2.25 $E$ | 2.25 $V$ |

**19** A capacitor of capacitance $C$ discharges through a resistor of resistance $R$. Which one of the following statements is **not** true?

**A** The time constant will decrease if $C$ is increased.
**B** The time constant will increase if $R$ is increased.
**C** After charging to the same voltage, the initial discharge current will increase if $R$ is decreased.
**D** After charging to the same voltage, the initial discharge current will be unaffected if $C$ is increased.

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**20** The graph shows how the charge on a capacitor varies with time as it is discharged through a resistor.




What is the time constant for the circuit?

**A** 3.0 s
**B** 4.0 s
**C** 5.0 s
**D** 8.0 s

**21** Two charged particles, P and Q, move in circular orbits in a magnetic field of uniform flux density. The particles have the same charge but the mass of P is less than the mass of Q. $T_P$ is the time taken for particle P to complete one orbit and $T_Q$ the time for particle Q to complete one orbit. Which one of the following is correct?

**A** $T_P = T_Q$

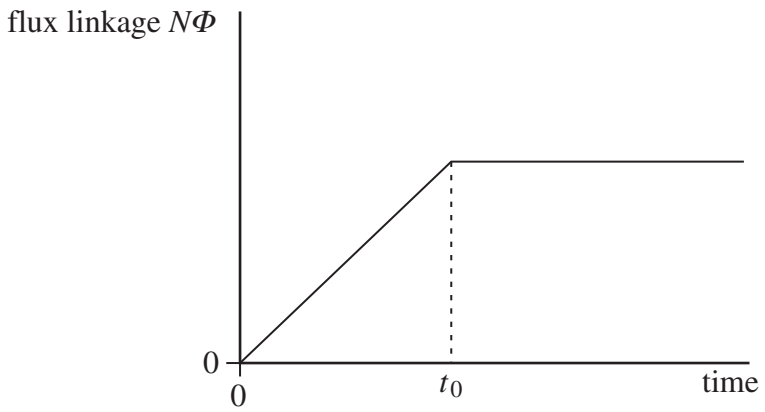
**B** $T_P > T_Q$

**C** $T_P < T_Q$

**D** $T_P - T_Q = 1$

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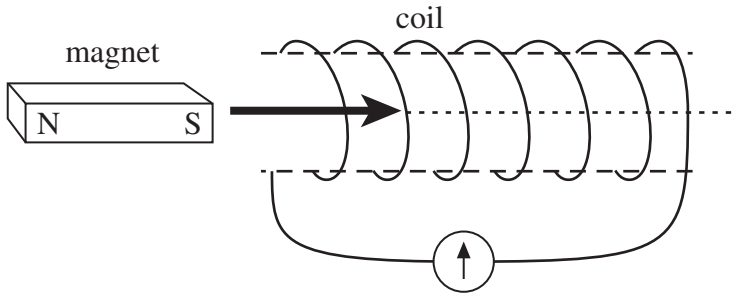
**22** The graph shows how the flux linkage, $N\Phi$, through a coil changes when the coil is moved into a magnetic field.




The emf induced in the coil

**A** increases then becomes constant after time $t_0$.
**B** is constant then becomes zero after time $t_0$.
**C** is zero then increases after time $t_0$.
**D** decreases then becomes zero after time $t_0$.

**23** A bar magnet is pushed into a coil connected to a sensitive ammeter, as shown in the diagram, until it comes to rest inside the coil.

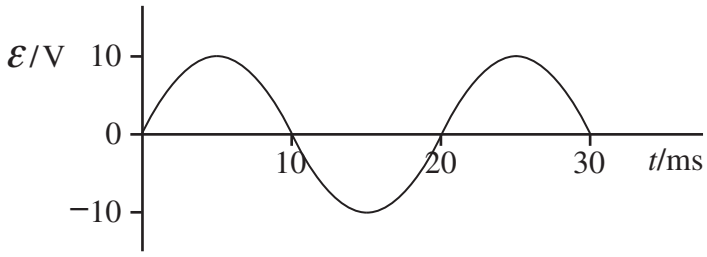



Why does the ammeter briefly show a non-zero reading?

**A** The magnetic flux linkage in the coil increases then decreases.
**B** The magnetic flux linkage in the coil increases then becomes constant.
**C** The magnetic flux linkage in the coil decreases then increases.
**D** The magnetic flux linkage in the coil decreases then becomes constant.

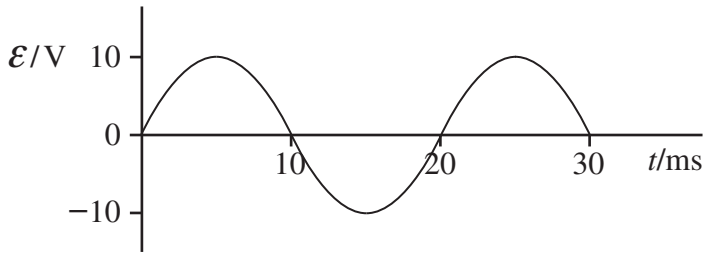
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**24**

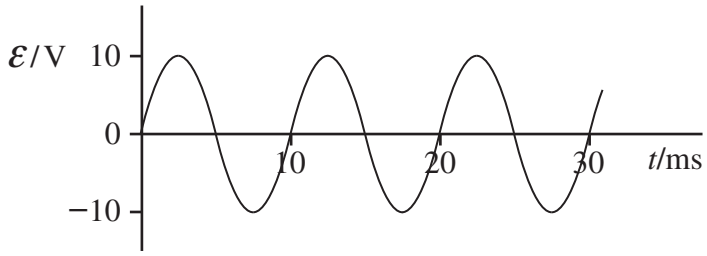



The above graph shows how the output emf, $\mathcal{E}$, varies with time, $t$, for a coil rotating at angular speed $\omega$ in a uniform magnetic field of flux density $B$. Which one of the following graphs shows how $\mathcal{E}$ varies with $t$ when the same coil is rotated at angular speed $2\omega$ in a uniform magnetic field of flux density $0.5\,B$?

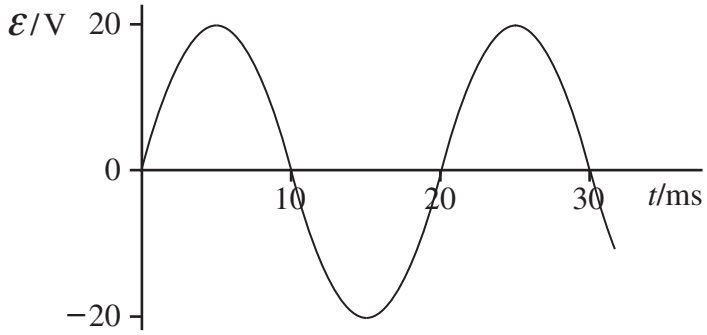
**A**



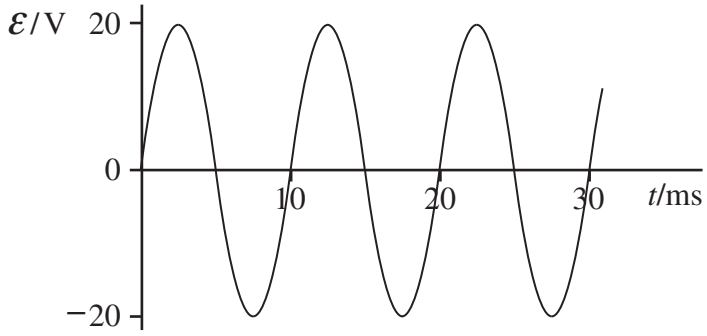

**B**




**C**




**D**



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**25** Which one of the following is **not** a cause of energy loss in a transformer?

**A** good insulation between the primary and secondary coil
**B** induced currents in the soft iron core
**C** reversal of magnetism in the soft iron core
**D** resistances in the primary and secondary coil

**END OF QUESTIONS**

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