Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Education
Advanced Level Examination
June 2012

Physics A PHYA4/1

Unit 4 Fields and Further Mechanics
Section A

Monday 11 June 2012 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.

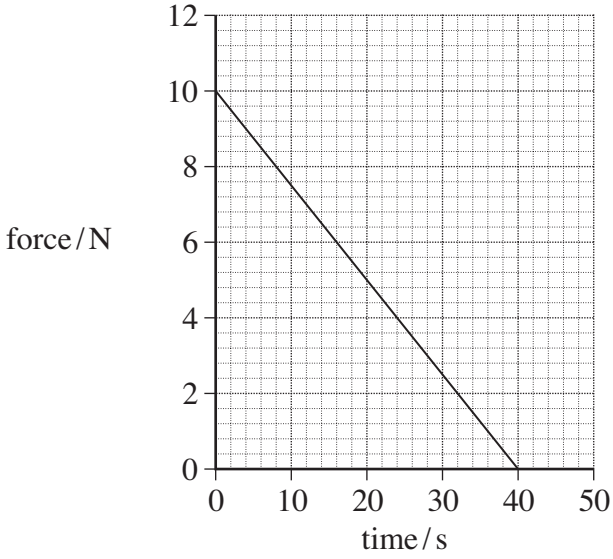
Information
- The maximum mark for this section is 25.
- All questions in Section A carry equal marks. No deductions will be made for incorrect answers.
- A *Data and Formulae Booklet* is provided as a loose insert.
- The question paper/answer book for Section B is enclosed within this question paper.

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 approximately **45 minutes** on this section.

1 The graph shows how the force acting on a body changes with time.



The body has a mass of 0.25 kg and is initially at rest. What is the speed of the body after 40 s assuming no other forces are acting?

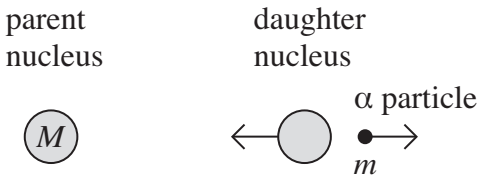
A $200\,\text{m s}^{-1}$

B $400\,\text{m s}^{-1}$

C $800\,\text{m s}^{-1}$

D $1600\,\text{m s}^{-1}$

2 A stationary unstable nucleus of mass M emits an α particle of mass m with kinetic energy E.



What is the speed of recoil of the daughter nucleus?

A $\dfrac{\sqrt{2mE}}{(M-m)}$

B $\dfrac{\sqrt{2mE}}{M}$

C $\dfrac{(M-m)}{\sqrt{2mE}}$

D $\dfrac{2mE}{(M-m)^2}$

3 Two ice skaters, initially at rest and in contact, push apart from each other.
Which line, **A** to **D**, in the table states correctly the change in the total momentum and the total kinetic energy of the two skaters?

	total momentum	**total kinetic energy**
A	unchanged	increases
B	unchanged	unchanged
C	increases	increases
D	increases	unchanged

4 The Earth moves around the Sun in a circular orbit with a radius of 1.5×10^8 km.
What is the Earth's approximate speed?

A $1.5 \times 10^3\,m\,s^{-1}$

B $5.0 \times 10^3\,m\,s^{-1}$

C $1.0 \times 10^4\,m\,s^{-1}$

D $3.0 \times 10^4\,m\,s^{-1}$

5 A particle moves in a circular path at constant speed. Which one of the following statements is correct?

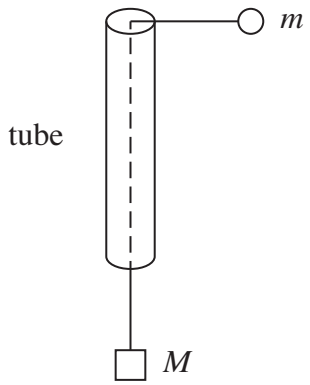
A The velocity of the particle is directed towards the centre of the circle.

B There is no force acting on the particle.

C There is no change in the kinetic energy of the particle.

D The particle has an acceleration directed along a tangent to the circle.

6 The diagram shows a smooth thin tube through which passes a string with masses m and M attached to its ends. The tube is moved so that the mass m travels in a horizontal circle of constant radius r at constant speed v.



Which one of the following expressions is equal to M?

A $\frac{mv^2}{2r}$

B mv^2rg

C $\frac{mv^2}{rg}$

D $\frac{mv^2g}{r}$

7 A mass on the end of a spring undergoes vertical simple harmonic motion. At which point(s) is the magnitude of the resultant force on the mass a minimum?

A at the centre of the oscillation
B only at the top of the oscillation
C only at the bottom of the oscillation
D at both the top and bottom of the oscillation

8 A baby bouncer consisting of a harness and elastic ropes is suspended from a doorway. When a baby of mass 10 kg is placed in the harness, the ropes stretch by 0.25 m. When the baby bounces, she starts to move with vertical simple harmonic motion. What is the time period of her motion?

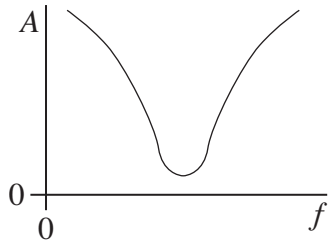
A 1.0 s
B 2.1 s
C 2.3 s
D 3.1 s

9 A simple pendulum and a mass-spring system both have the same time period T at the surface of the Earth. If taken to another planet where the acceleration due to gravity is twice that on Earth, which line, **A** to **D**, in the table gives the correct new time periods?

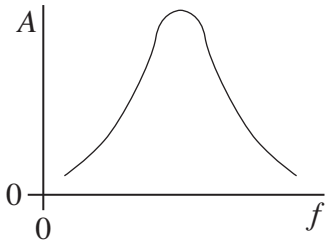
	simple pendulum	**mass-spring**
A	$T\sqrt{2}$	$\frac{T}{\sqrt{2}}$
B	$T\sqrt{2}$	T
C	$\frac{T}{\sqrt{2}}$	T
D	$\frac{T}{\sqrt{2}}$	$T\sqrt{2}$

10 An oscillatory system, subject to damping, is set into vibration by a periodic driving force of frequency f. The graphs, **A** to **D**, which are to the same scale, show how the amplitude of vibration A of the system might vary with f, for various degrees of damping.

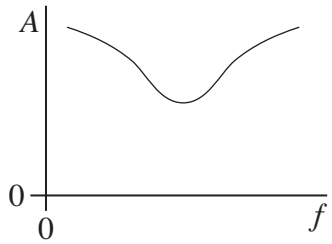
Which graph best shows the lightest damping?



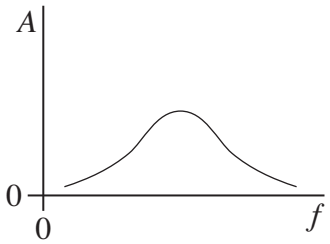
A



B



C



D

11 Which one of the following statements about gravitational fields is **incorrect**?

A Moving a mass in the direction of the field lines reduces its potential energy.

B A stronger field is represented by a greater density of field lines.

C Moving a mass perpendicularly across the field lines does not alter its potential energy.

D At a distance r from a mass the field strength is inversely proportional to r.

12 An object on the surface of a planet of radius R and mass M has weight W. What would be the weight of the same object when on the surface of a planet of radius $2R$ and mass $2M$?

A $\frac{W}{4}$

B $\frac{W}{2}$

C W

D $2W$

13 The gravitational field strength on the surface of a planet orbiting a star is $8.0\,\text{N kg}^{-1}$. If the planet and star have a similar density but the diameter of the star is 100 times greater than the planet, what would be the gravitational field strength at the surface of the star?

A $0.0008\,\text{N kg}^{-1}$

B $0.08\,\text{N kg}^{-1}$

C $800\,\text{N kg}^{-1}$

D $8000\,\text{N kg}^{-1}$

14 Two satellites, P and Q, of the same mass, are in circular orbits around the Earth. The radius of the orbit of Q is three times that of P. Which one of the following statements is correct?

A The kinetic energy of P is greater than that of Q.

B The weight of P is three times that of Q.

C The time period of P is greater than that of Q.

D The speed of P is three times that of Q.

15 The force between two point charges is F when they are separated by a distance r. If the separation is increased to $3r$, what is the force between the charges?

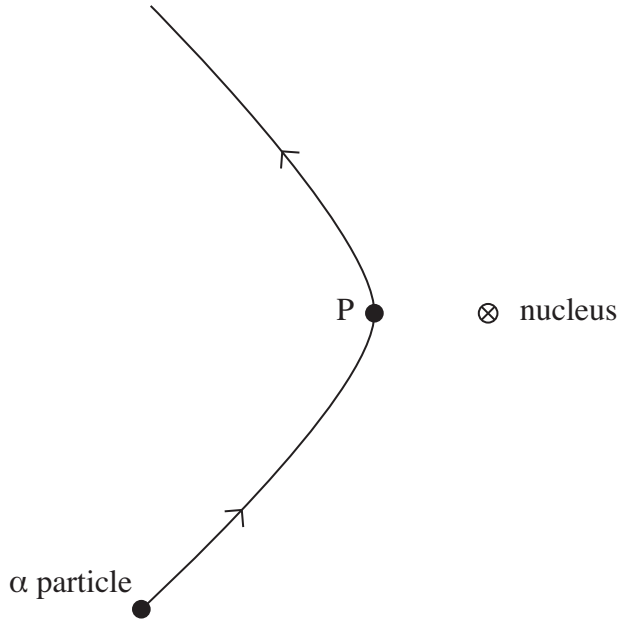
A $\frac{F}{3r}$

B $\frac{F}{9r}$

C $\frac{F}{3}$

D $\frac{F}{9}$

16 The diagram shows the path of an α particle deflected by the nucleus of an atom. Point P on the path is the point of closest approach of the α particle to the nucleus.



Which one of the following statements about the α particle on this path is correct?

A Its acceleration is zero at P.

B Its kinetic energy is greatest at P.

C Its speed is least at P.

D Its potential energy is least at P.

17 A 1000 μF capacitor and a 10 μF capacitor are charged so that they store the same energy. The pd across the 1000 μF capacitor is V_1 and the pd across the other capacitor is V_2.

What is the value of the ratio $\left(\frac{V_1}{V_2}\right)^2$?

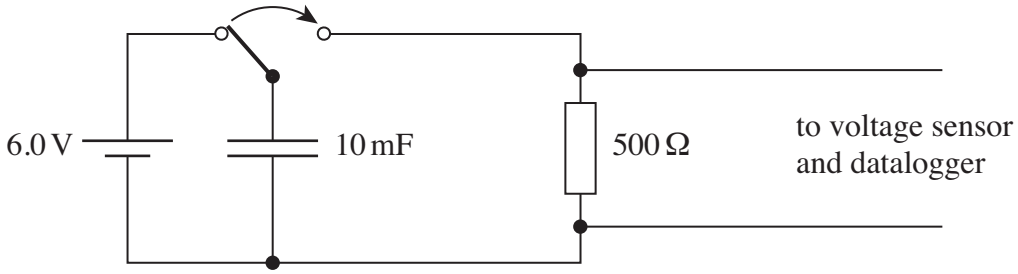
A $\frac{1}{1000}$

B $\frac{1}{100}$

C $\frac{1}{10}$

D 10

18 A voltage sensor and a datalogger are used to record the discharge of a 10 mF capacitor in series with a 500 Ω resistor from an initial pd of 6.0 V. The datalogger is capable of recording 1000 readings in 10 s. Which line, **A** to **D**, in the table gives the pd and the number of readings made after a time equal to the time constant of the discharge circuit?



	potential difference/V	number of readings
A	2.2	50
B	3.8	50
C	3.8	500
D	2.2	500

19 When a 220 μF capacitor is discharged through a resistor R, the capacitor pd decreases from 6.0 V to 1.5 V in 92 s.

What is the resistance of R?

A 210 kΩ

B 300 kΩ

C 420 kΩ

D 440 kΩ

20 A section of current-carrying wire is placed at right angles to a uniform magnetic field of flux density B. When the current in the wire is I, the magnetic force that acts on this section is F.

What force acts when the same section of wire is placed at right angles to a uniform magnetic field of flux density $2B$ when the current is $0.25I$?

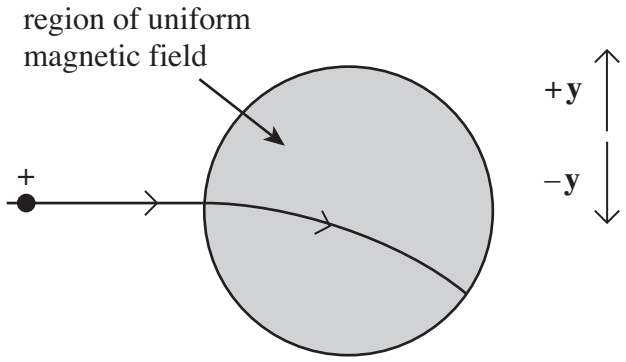
A $\frac{F}{4}$

B $\frac{F}{2}$

C F

D $2F$

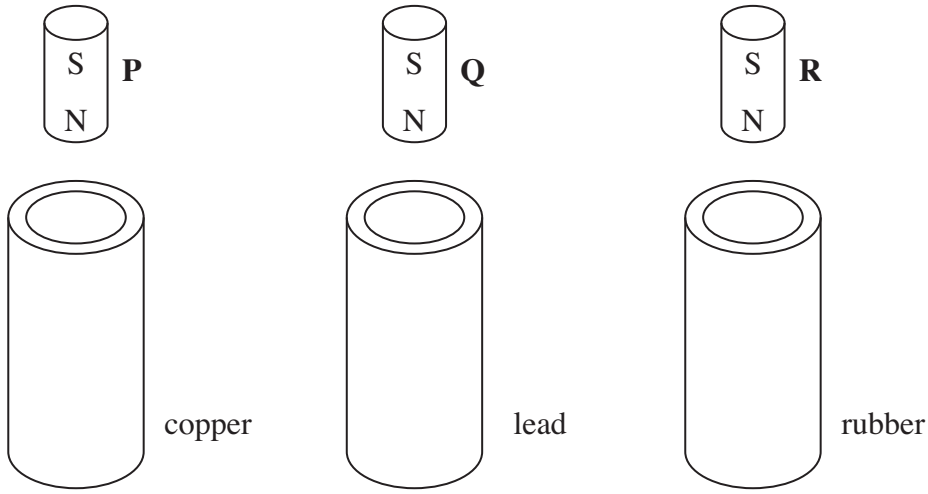
21 A beam of positive ions enters a region of uniform magnetic field, causing the beam to change direction as shown in the diagram.



What is the direction of the magnetic field?

A out of the page and perpendicular to it
B into the page and perpendicular to it
C in the direction indicated by **+y**
D in the direction indicated by **–y**

22 Three vertical tubes, made from copper, lead and rubber respectively, have identical dimensions. Identical, strong, cylindrical magnets **P**, **Q** and **R** are released simultaneously from the same distance above each tube. Because of electromagnetic effects, the magnets emerge from the bottom of the tubes at different times.

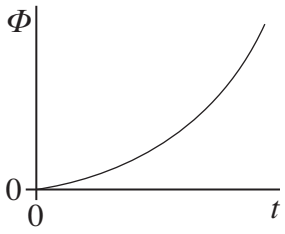


Which line, **A** to **D**, in the table shows the correct order in which they will emerge?

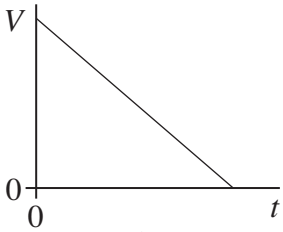
resistivity of copper = $1.7 \times 10^{-8} \Omega m$
resistivity of lead = $22 \times 10^{-8} \Omega m$
resistivity of rubber = $50 \times 10^{13} \Omega m$

	emerges first	**emerges second**	**emerges third**
A	**P**	**Q**	**R**
B	**R**	**P**	**Q**
C	**P**	**R**	**Q**
D	**R**	**Q**	**P**

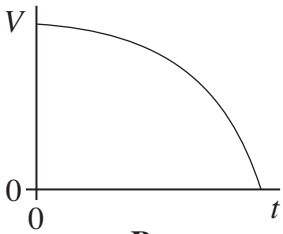
23 The graph shows how the magnetic flux, Φ, passing through a coil changes with time, t.



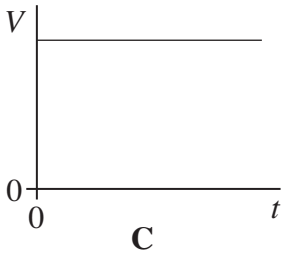
Which one of the following graphs could show how the magnitude of the emf, V, induced in the coil varies with t?



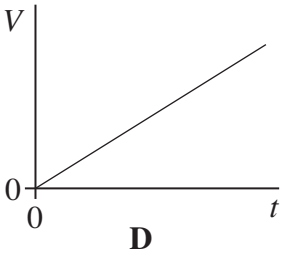
A



B

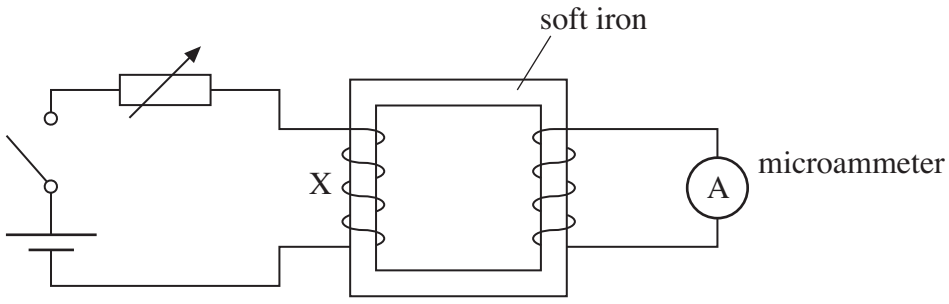


C



D

24 Using the circuit shown, and with the switch closed, a small current was passed through the coil X. The current was slowly increased using the variable resistor. The current reached a maximum value and was then switched off.



The maximum reading on the microammeter occurred when

A the small current flowed at the start.
B the current was being increased.
C the current was being switched off.
D the current in X was zero.

25 When a mobile phone is being recharged, the charger heats up. The efficiency of the transformer in the charger can be as low as 15% when drawing a current of 50 mA from a 230 V mains supply. If the charging current required is 350 mA, what is the approximate output voltage at this efficiency?

A 4.9 V
B 11 V
C 28 V
D 33 V

END OF QUESTIONS

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