Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

General Certificate of Education
Advanced Level Examination
January 2012

Physics A PHYA4/1

Unit 4 Fields and Further Mechanics
Section A

Tuesday 24 January 2012 1.30 pm to 3.15 pm

In addition to this paper you will require:
- an objective test answer sheet
- a black ink or 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 black ink or black ball-point pen. Do **not** use 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.

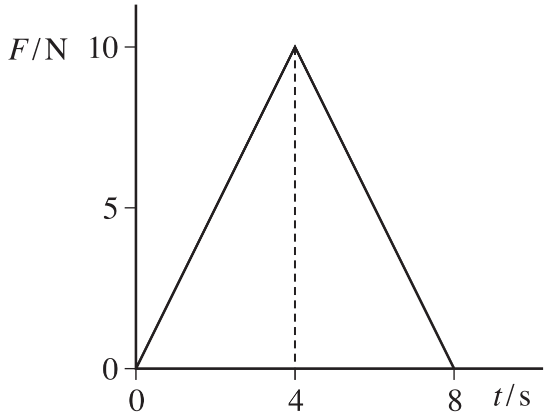
Information
- The maximum mark for this section is 25.
- All questions in Section A carry equal marks. No deductions will be made for incorrect answers.
- A *Data and Formulae Booklet* is provided as a loose insert.
- The question paper/answer book for Section B is enclosed within this question paper.

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 A ball of mass 2.0 kg, initially at rest, is acted on by a force F which varies with time t as shown by the graph.



What is the velocity of the ball after 8.0 s?

A $20\,\mathrm{m\,s^{-1}}$

B $40\,\mathrm{m\,s^{-1}}$

C $80\,\mathrm{m\,s^{-1}}$

D $160\,\mathrm{m\,s^{-1}}$

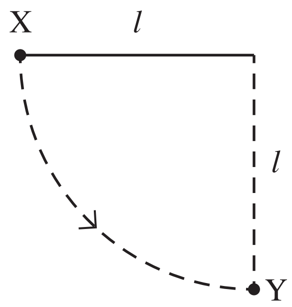
2 A body X moving with a velocity v makes an elastic collision with a stationary body Y of equal mass on a smooth horizontal surface.

Which line, **A** to **D**, in the table gives the velocities of the two bodies after the collision?

	velocity of X	**velocity of Y**
A	$\frac{v}{2}$	$-\frac{v}{2}$
B	$-\frac{v}{2}$	$\frac{v}{2}$
C	v	0
D	0	v

Do not write outside the box

3 A ball of mass m, which is fixed to the end of a light string of length l, is released from rest at X.
It swings in a circular path, passing through the lowest point Y at speed v.



If the tension in the string at Y is T, which one of the following equations represents a correct application of Newton's laws of motion to the ball at Y?

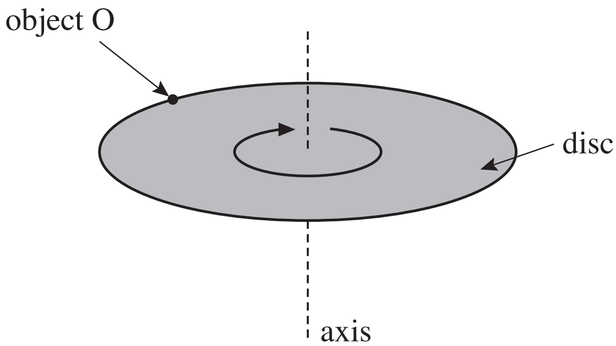
A $T = \frac{mv^2}{l} - mg$

B $mg - T = \frac{mv^2}{l}$

C $T - mg = \frac{mv^2}{l}$

D $T + \frac{mv^2}{l} = mg$

4 A disc of diameter D is turning at a steady angular speed at frequency f about an axis through its centre.



What is the centripetal force on a small object O of mass m on the perimeter of the disc?

A $2\pi mfD$

B $2\pi mf^2D$

C $2\pi^2 mf^2D$

D $2\pi mf^2D^2$

Turn over ▶

5 What is the angular speed of a car wheel of diameter 0.400 m when the speed of the car is 108 km h^{-1}?

A 75 rad s^{-1}

B 150 rad s^{-1}

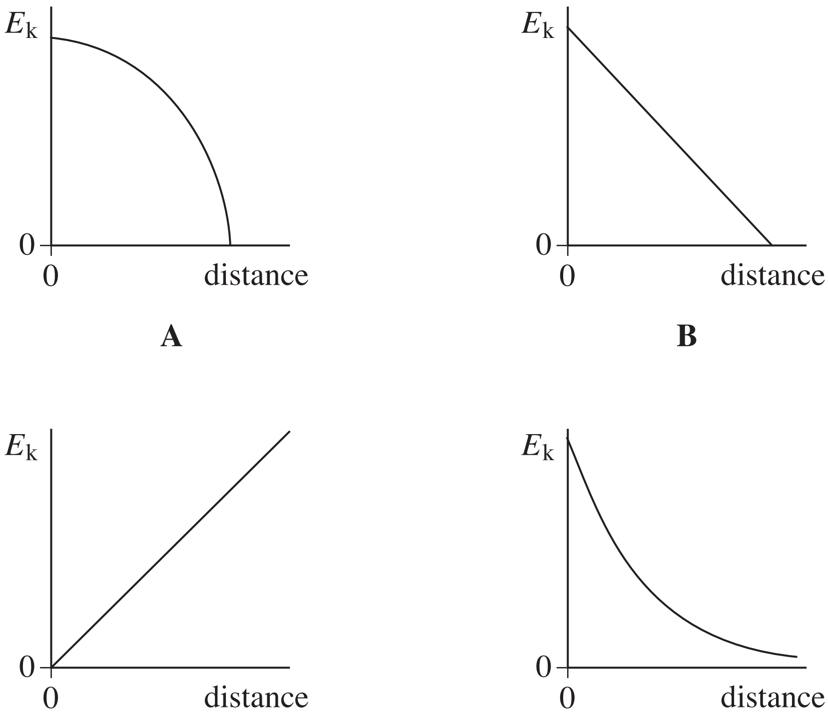
C 270 rad s^{-1}

D 540 rad s^{-1}

6 Which one of the following statements is true when an object performs simple harmonic motion about a central point O?

A The acceleration is always directed away from O.
B The acceleration and velocity are always in opposite directions.
C The acceleration and the displacement from O are always in the same direction.
D The graph of acceleration against displacement is a straight line.

7 A body executes simple harmonic motion. Which one of the graphs, **A** to **D**, best shows the relationship between the kinetic energy, E_k, of the body and its distance from the centre of oscillation?



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

8 A mechanical system is oscillating at resonance with a constant amplitude. Which one of the following statements is **not** correct?

A The applied force prevents the amplitude from becoming too large.
B The frequency of the applied force is the same as the natural frequency of oscillation of the system.
C The total energy of the system is constant.
D The amplitude of oscillations depends on the amount of damping.

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9 Which one of the following statements about Newton's law of gravitation is correct?

Newton's law of gravitation explains

A the origin of gravitational forces.
B why a falling satellite burns up when it enters the Earth's atmosphere.
C why projectiles maintain a uniform horizontal speed.
D how various factors affect the gravitational force between two particles.

10 If an electron and proton are separated by a distance of 5×10^{-11} m, what is the approximate gravitational force of attraction between them?

A 2×10^{-57} N

B 3×10^{-47} N

C 4×10^{-47} N

D 5×10^{-37} N

11 A spherical planet of uniform density ρ has radius R.

Which line, **A** to **D**, in the table gives correct expressions for the mass of the planet and the gravitational field strength at its surface?

	mass of planet	**gravitational field strength at surface**
A	$\dfrac{4\pi R^2\rho}{3}$	$\dfrac{4\pi GR\rho}{3}$
B	$\dfrac{4\pi R^3\rho}{3}$	$\dfrac{4\pi GR\rho}{3}$
C	$\dfrac{4\pi R^2\rho}{3}$	$\dfrac{4\pi G\rho}{3}$
D	$\dfrac{4\pi R^3\rho}{3}$	$\dfrac{4\pi G\rho}{3}$

Turn over ▶

12 The gravitational potential at the surface of the Earth, of radius R, is V. What is the gravitational potential at a point at a height R above the Earth's surface?

A $\frac{V}{4}$

B $\frac{V}{2}$

C V

D $2V$

13 A satellite is in orbit at a height h above the surface of a planet of mass M and radius R. What is the velocity of the satellite?

A $\sqrt{\frac{GM}{(R+h)}}$

B $\frac{\sqrt{GM\,(R+h)}}{R}$

C $\sqrt{\frac{GM\,(R+h)}{R}}$

D $\frac{\sqrt{GM}}{(R+h)}$

14 A repulsive force F acts between two positive point charges separated by a distance r. What will be the force between them if each charge is doubled and the distance between them is halved?

A F

B $2F$

C $4F$

D $16F$

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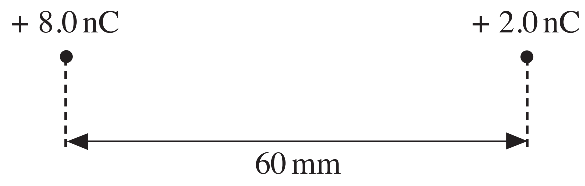
15 The distance between two point charges of + 8.0 nC and + 2.0 nC is 60 mm.



At a point between the charges, on the line joining them, the resultant electric field strength is zero. How far is this point from the + 8.0 nC charge?

A 20 mm

B 25 mm

C 40 mm

D 45 mm

16 Which one of the following **cannot** be used as a unit for electric field strength?

A $\mathrm{J\,m^{-1}\,C^{-1}}$

B $\mathrm{J\,A^{-1}\,s^{-1}\,m^{-1}}$

C $\mathrm{N\,A^{-1}\,s^{-1}}$

D $\mathrm{J\,C\,m^{-1}}$

17 A capacitor stores a charge of 600 μC when charged to a potential difference (pd) of 6.0 V. What will be the pd across the plates if the charge stored increases by 50%?

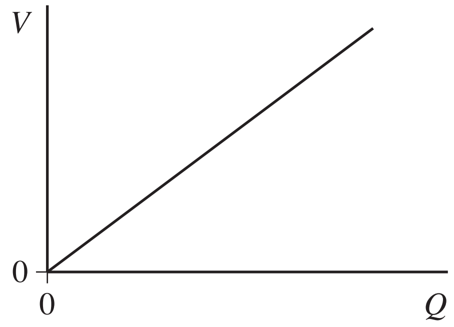
A 3.0 V

B 4.5 V

C 9.0 V

D 12.0 V

18 The graph shows the results of an experiment which was carried out to investigate the relationship between the charge Q stored by a capacitor and the pd V across it.



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

A The energy stored can be calculated by finding the area under the line.

B If a capacitor of smaller capacitance had been used the gradient of the graph would be steeper.

C If Q were doubled, the energy stored would be quadrupled.

D The gradient of the graph is equal to the capacitance of the capacitor.

19 A 10 μF capacitor is fully charged to a pd of 3.0 kV. The energy stored in the capacitor can be used to lift a load of 5.0 kg through a vertical height h. What is the approximate value of h?

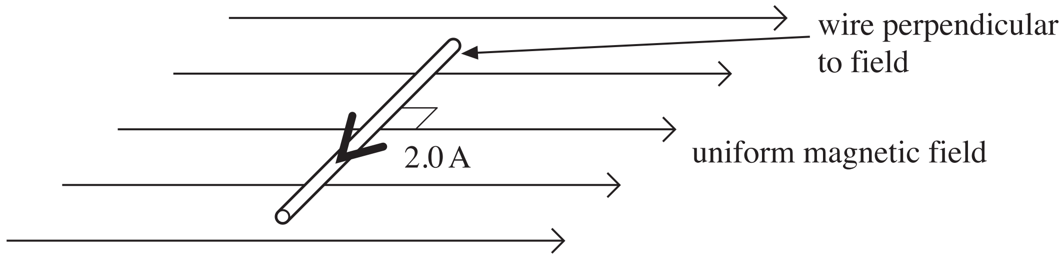
A 0.03 mm

B 0.9 mm

C 0.3 m

D 0.9 m

20 A horizontal straight wire of length 0.30 m carries a current of 2.0 A perpendicular to a horizontal uniform magnetic field of flux density 5.0×10^{-2} T. The wire 'floats' in equilibrium in the field.



What is the mass of the wire?

A 8.0×10^{-4} kg

B 3.1×10^{-3} kg

C 3.0×10^{-2} kg

D 8.2×10^{-1} kg

21 When a β particle moves at right angles through a uniform magnetic field it experiences a force F. An α particle moves at right angles through a magnetic field of twice the magnetic flux density with velocity one tenth the velocity of the β particle. What is the magnitude of the force on the α particle?

A $0.2F$
B $0.4F$
C $0.8F$
D $4.0F$

22 Charged particles, each of mass m and charge Q, travel at a constant speed in a circle of radius r in a uniform magnetic field of flux density B. Which expression gives the frequency of rotation of a particle in the beam?

A $\dfrac{BQ}{2\pi m}$

B $\dfrac{BQ}{m}$

C $\dfrac{BQ}{\pi m}$

D $\dfrac{2\pi BQ}{m}$

23 A 500 turn coil of cross-sectional area $4.0 \times 10^{-3}\,\text{m}^2$ is placed with its plane perpendicular to a magnetic field of flux density $7.5 \times 10^{-4}\,\text{T}$. What is the value of the flux linkage for this coil?

A 3.0×10^{-6} Wb turns
B 1.5×10^{-3} Wb turns
C 0.19 Wb turns
D 94 Wb turns

24 The output electromotive force (emf) of a simple ac generator can be increased by any of the four factors listed.

Which one of these factors should **not** be changed if the frequency of the output is to remain unaffected when the emf is increased?

A the area of the coil
B the number of turns on the coil
C the speed of rotation
D the strength of the magnetic field

25 Which one of the following would **not** reduce the energy losses in a transformer?

A using thinner wire for the windings
B using a laminated core instead of a solid core
C using a core made from iron instead of steel
D using a core that allows all the flux due to the primary coil to be linked to the secondary coil

END OF QUESTIONS

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