

Centre Number						Candidate Number				
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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

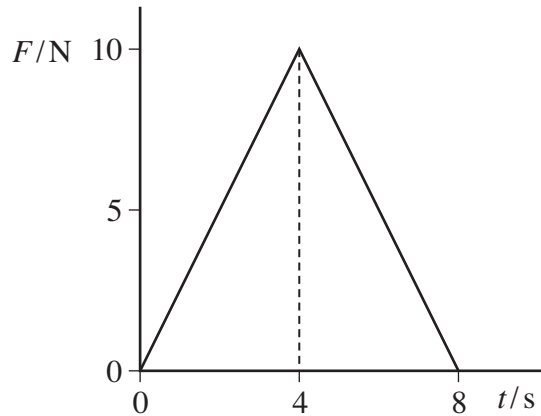
- The maximum mark for this section is 25.
- All questions in Section A carry equal marks. No deductions will be made for incorrect answers.
- A *Data and Formulae Booklet* is provided as a loose insert.
- The question paper/answer book for Section B is enclosed within this question paper.

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 m s^{-1}
B 40 m s^{-1}
C 80 m s^{-1}
D 160 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.

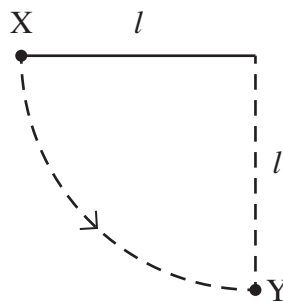


Which line, **A** to **D**, in the table gives the velocities of the two bodies after the collision?

	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



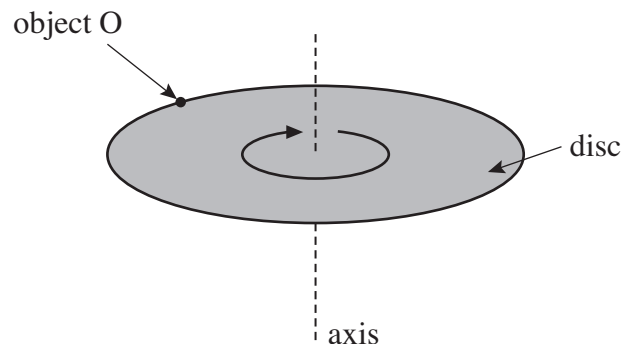
- 3** A ball of mass m , which is fixed to the end of a light string of length l , is released from rest at X. It swings in a circular path, passing through the lowest point Y at speed v .



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 $2\pi mf^2D^2$

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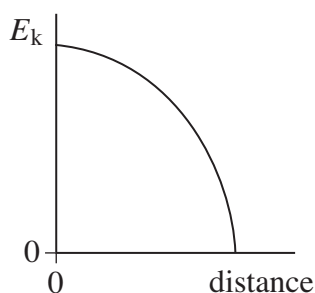
5 What is the angular speed of a car wheel of diameter 0.400 m when the speed of the car is 108 km h^{-1} ?

- A 75 rad s^{-1}
- B 150 rad s^{-1}
- C 270 rad s^{-1}
- D 540 rad s^{-1}

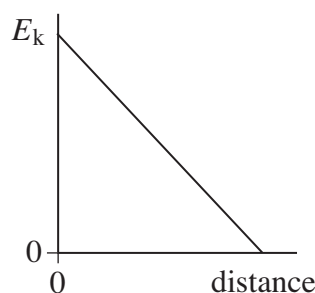
6 Which one of the following statements is true when an object performs simple harmonic motion about a central point O?

- 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.

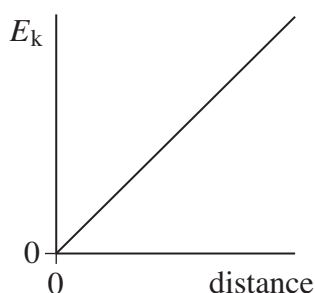
7 A body executes simple harmonic motion. Which one of the graphs, **A** to **D**, best shows the relationship between the kinetic energy, E_k , of the body and its distance from the centre of oscillation?



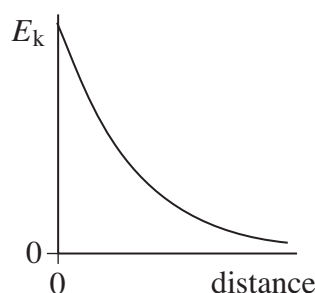
A



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.



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 $5 \times 10^{-11} \text{ m}$, what is the approximate gravitational force of attraction between them?

- A $2 \times 10^{-57} \text{ N}$
- B $3 \times 10^{-47} \text{ N}$
- C $4 \times 10^{-47} \text{ N}$
- D $5 \times 10^{-37} \text{ N}$

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	$\frac{4\pi R^2 \rho}{3}$	$\frac{4\pi GR\rho}{3}$
B	$\frac{4\pi R^3 \rho}{3}$	$\frac{4\pi GR\rho}{3}$
C	$\frac{4\pi R^2 \rho}{3}$	$\frac{4\pi G\rho}{3}$
D	$\frac{4\pi R^3 \rho}{3}$	$\frac{4\pi G\rho}{3}$

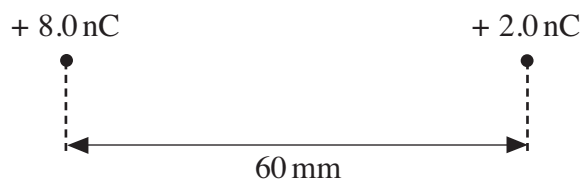
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- 12** The gravitational potential at the surface of the Earth, of radius R , is V . What is the gravitational potential at a point at a height R above the Earth's surface?
- A** $\frac{V}{4}$
- B** $\frac{V}{2}$
- C** V
- D** $2V$
- 13** A satellite 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** $16F$



- 15 The distance between two point charges of $+ 8.0 \text{ nC}$ and $+ 2.0 \text{ nC}$ is 60 mm .



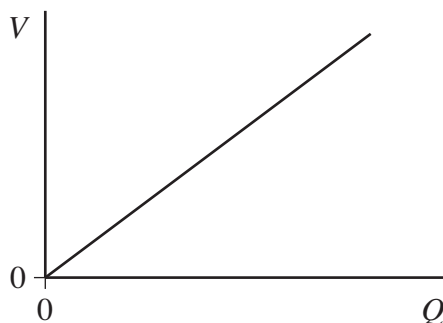
At a point between the charges, on the line joining them, the resultant electric field strength is zero. How far is this point from the $+ 8.0 \text{ nC}$ charge?

- 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 $\text{J m}^{-1} \text{C}^{-1}$
B $\text{J A}^{-1} \text{s}^{-1} \text{m}^{-1}$
C $\text{N A}^{-1} \text{s}^{-1}$
D J C m^{-1}
- 17 A capacitor stores a charge of $600 \mu\text{C}$ 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

Turn over ►

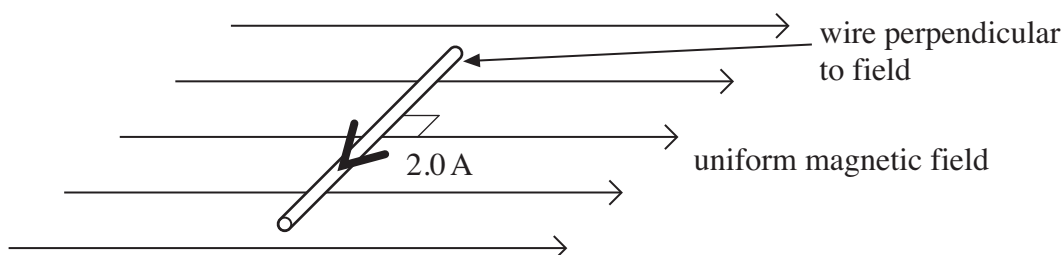


- 18 The graph shows the results of an experiment which was carried out to investigate the relationship between the charge Q stored by a capacitor and the pd V across it.



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 $10\ \mu\text{F}$ capacitor is fully charged to a pd of $3.0\ \text{kV}$. The energy stored in the capacitor can be used to lift a load of $5.0\ \text{kg}$ through a vertical height h . What is the approximate value of h ?
- A $0.03\ \text{mm}$
- B $0.9\ \text{mm}$
- C $0.3\ \text{m}$
- D $0.9\ \text{m}$
- 20 A horizontal straight wire of length $0.30\ \text{m}$ carries a current of $2.0\ \text{A}$ perpendicular to a horizontal uniform magnetic field of flux density $5.0 \times 10^{-2}\ \text{T}$. The wire 'floats' in equilibrium in the field.



What is the mass of the wire?

- A $8.0 \times 10^{-4}\ \text{kg}$
- B $3.1 \times 10^{-3}\ \text{kg}$
- C $3.0 \times 10^{-2}\ \text{kg}$
- D $8.2 \times 10^{-1}\ \text{kg}$



- 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 $0.2 F$
B $0.4 F$
C $0.8 F$
D $4.0 F$
- 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 $\frac{BQ}{2\pi m}$
B $\frac{BQ}{m}$
C $\frac{BQ}{\pi m}$
D $\frac{2\pi BQ}{m}$
- 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 $3.0 \times 10^{-6} \text{ Wb turns}$
B $1.5 \times 10^{-3} \text{ Wb turns}$
C 0.19 Wb turns
D 94 Wb turns

Turn over ►



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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