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Other Names										
Candidate Signature										



General Certificate of Education
Advanced Level Examination
January 2011

Physics A

PHYA4/1

Unit 4 Fields and Further Mechanics Section A

Thursday 27 January 2011 1.30pm 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

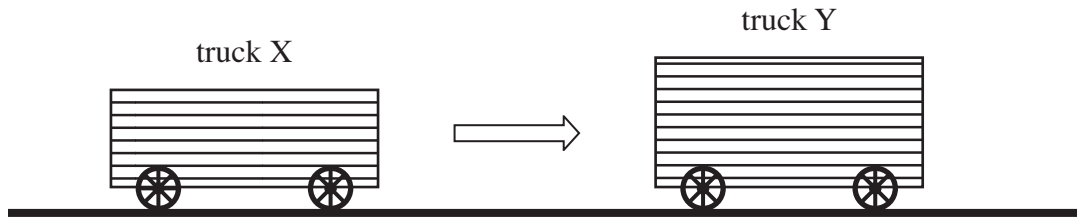
- The maximum mark for this section is 25.
- All questions in Section A carry equal marks. No deductions will be made for incorrect answers.
- A *Data and Formulae Booklet* is provided as a loose insert.
- The question paper/answer book for Section B is enclosed within this question paper.

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 rail truck X travels along a level track and collides with a stationary truck Y. The two trucks move together at the same velocity after the collision.

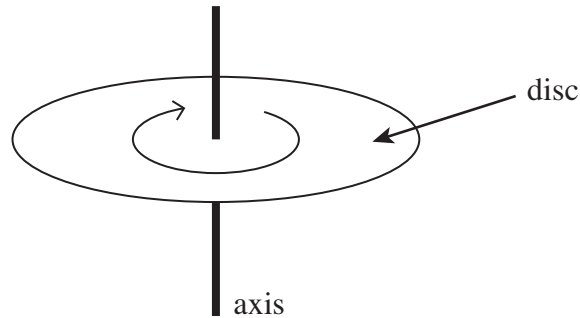


Which line, **A** to **D**, in the table states how the total momentum and the total kinetic energy of the trucks change as a result of the impact.

	total momentum	total kinetic energy
A	unchanged	unchanged
B	unchanged	decreases
C	decreases	decreases
D	decreases	unchanged

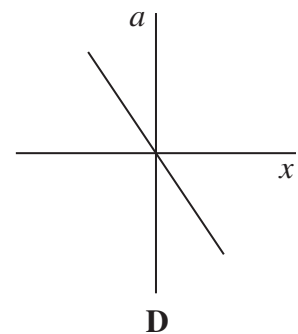
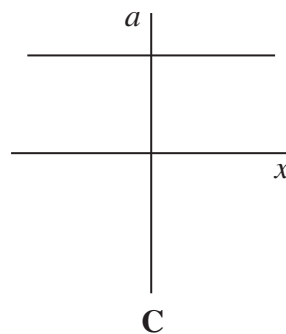
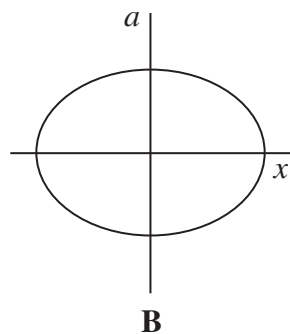
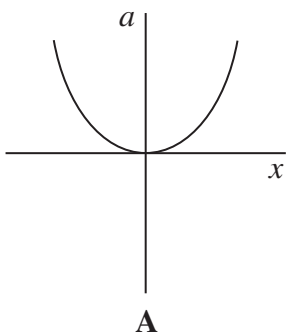


- 2 The diagram shows a disc of diameter 120mm that can turn about an axis through its centre.



The disc is turned through an angle of 30° in 20 ms. What is the average speed of a point on the edge of the disc during this time?

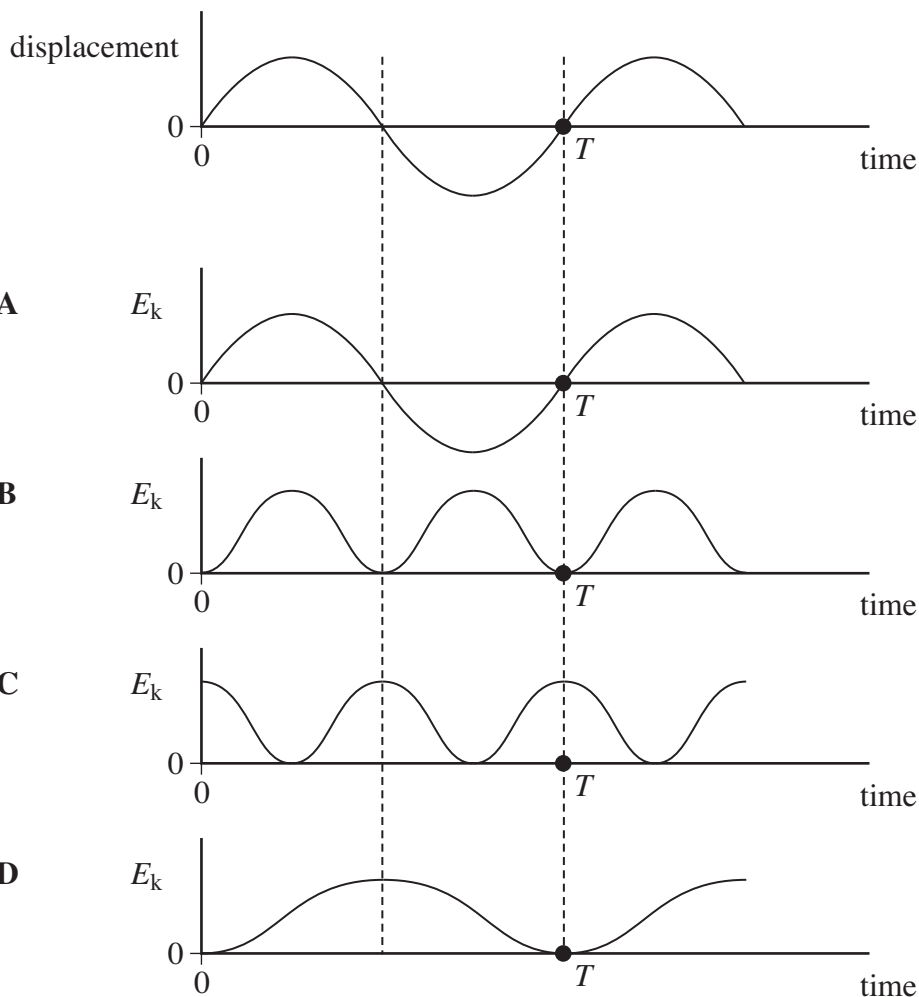
- A $0.5\pi \text{ m s}^{-1}$
 B $\pi \text{ m s}^{-1}$
 C $1.5\pi \text{ m s}^{-1}$
 D $2\pi \text{ m s}^{-1}$
- 3 A particle of mass m moves in a circle of radius r at a uniform speed with frequency f . What is the kinetic energy of the particle?
- A $\frac{mf^2r^2}{4\pi^2}$
 B $\frac{mf^2r}{2}$
 C $2\pi^2 mf^2r^2$
 D $4\pi^2 mf^2r^2$
- 4 Which one of the following graphs shows how the acceleration, a , of a body moving with simple harmonic motion varies with its displacement, x ?



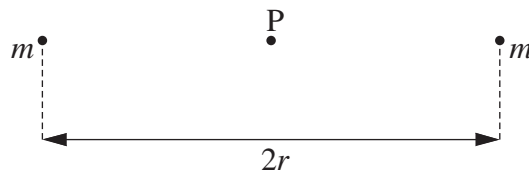
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- 5 A body moves with simple harmonic motion of amplitude A and frequency $\frac{b}{2\pi}$.
What is the magnitude of the acceleration when the body is at maximum displacement?
- A zero
B $4\pi^2 Ab^2$
C Ab^2
D $\frac{4\pi^2 A}{b^2}$
- 6 An object oscillating in simple harmonic motion has a time period T . The first graph shows how its displacement varies with time. Which of the subsequent graphs, A to D, show how the kinetic energy, E_k , of the object varies with time?



- 7 The period of vertical oscillation of a mass-spring system is T when the spring carries a mass of 1.00 kg. What mass should be added to the 1.00 kg if the period is to be increased to $1.50 T$?
- A 0.25 kg
B 1.00 kg
C 1.25 kg
D 2.00 kg
- 8 The gravitational force between two uniform spheres is $3.1 \times 10^{-9} \text{ N}$ when the distance between their centres is 150 mm. If the mass of one sphere is 2.5 kg, what is the mass of the other?
- A 0.043 kg
B 0.42 kg
C 2.8 kg
D 4.1 kg
- 9 The diagram shows two point masses each of mass m separated by a distance $2r$.



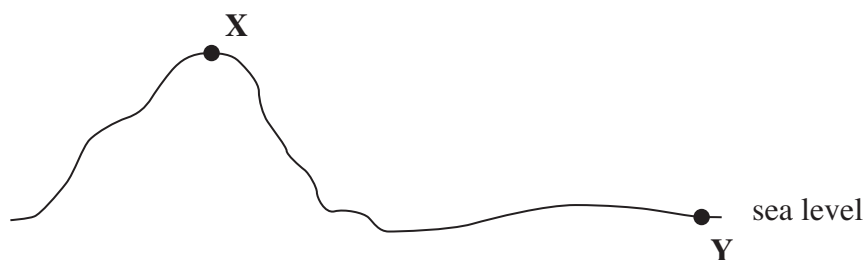
What is the value of the gravitational field strength at the mid-point, P , between the two masses?

- A $\frac{4Gm}{r^2}$
B $\frac{2Gm}{r^2}$
C $\frac{Gm}{2r^2}$
D zero

Turn over ►



- 10 The diagram shows two positions, **X** and **Y**, on the Earth's surface.



Which line, **A** to **D**, in the table gives correct comparisons at **X** and **Y** for gravitational potential and angular velocity?

	gravitational potential at X compared with Y	angular velocity at X compared with Y
A	greater	greater
B	greater	same
C	greater	smaller
D	same	same

- 11 What would the period of rotation of the Earth need to be if objects at the equator were to appear weightless?

$$\text{radius of Earth} = 6.4 \times 10^6 \text{ m}$$

- A** 4.5×10^{-2} hours
B 1.4 hours
C 24 hours
D 160 hours
- 12 As a comet orbits the Sun the distance between the comet and the Sun continually changes. As the comet moves towards the Sun this distance reaches a minimum value. Which one of the following statements is **incorrect** as the comet approaches this minimum distance?
- A** The potential energy of the comet increases.
B The gravitational force acting on the comet increases.
C The direction of the gravitational force acting on the comet changes.
D The kinetic energy of the comet increases.



13 The repulsive force between two small negative charges separated by a distance r is F .

What is the force between the charges when the separation is reduced to $\frac{r}{3}$?

- A $\frac{F}{9}$
- B $\frac{F}{3}$
- C $3F$
- D $9F$

14 What is the acceleration of an electron at a point in an electric field where the field strength is $1.5 \times 10^5 \text{ Vm}^{-1}$?

- A $1.2 \times 10^6 \text{ ms}^{-2}$
- B $1.4 \times 10^{13} \text{ ms}^{-2}$
- C $2.7 \times 10^{15} \text{ ms}^{-2}$
- D $2.6 \times 10^{16} \text{ ms}^{-2}$

15 At a distance R from a fixed charge, the electric field strength is E and the electric potential is V . Which line, **A** to **D**, in the table gives the electric field strength and electric potential at a distance $2R$ from the charge?

	electric field strength	electric potential
A	$\frac{E}{2}$	$\frac{V}{4}$
B	$\frac{E}{2}$	$\frac{V}{2}$
C	$\frac{E}{4}$	$\frac{V}{2}$
D	$\frac{E}{4}$	$\frac{V}{4}$

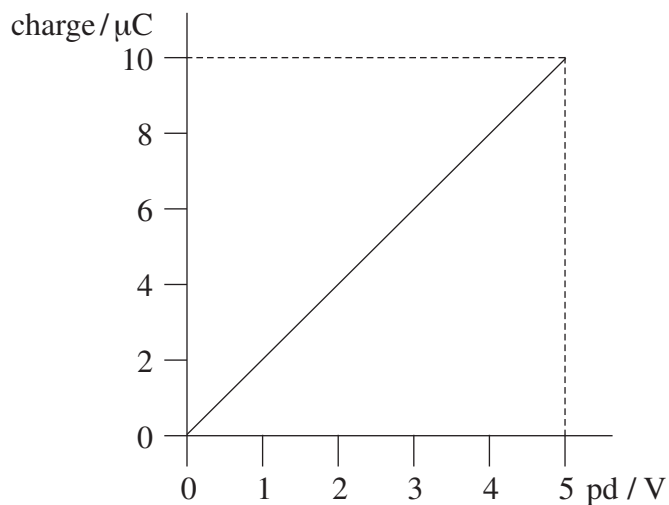
16 Two protons are $1.0 \times 10^{-14} \text{ m}$ apart. Approximately how many times is the electrostatic force between them greater than the gravitational force between them?
(Use the Data and Formulae booklet)

- A 10^{23}
- B 10^{30}
- C 10^{36}
- D 10^{42}

Turn over ►



- 17 The graph shows how the charge stored by a capacitor varies with the pd applied across it.



Which line, **A** to **D**, in the table gives the capacitance and the energy stored when the potential difference is 5.0 V?

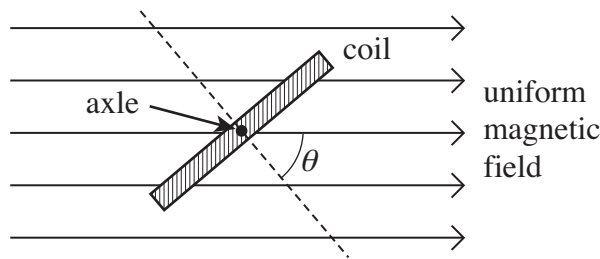
	capacitance/ μF	energy stored/ μJ
A	2.0	25
B	2.0	50
C	10.0	25
D	10.0	50

- 18 A 10 mF capacitor is charged to 10 V and then discharged completely through a small motor. During the process, the motor lifts a weight of mass 0.10 kg. If 10% of the energy stored in the capacitor is used to lift the weight, through what approximate height will the weight be lifted?
- A** 0.05 m
- B** 0.10 m
- C** 0.50 m
- D** 1.00 m



- 19 A negatively charged particle moves at right angles to a uniform magnetic field. The magnetic force on the particle acts
- A in the direction of the field.
 - B in the opposite direction to that of the field.
 - C at an angle between 0° and 90° to the field.
 - D at right angles to the field.
- 20 An electron moving with a constant speed enters a uniform magnetic field in a direction perpendicular to the magnetic field. What is the shape of the path that the electron would follow?
- A parabolic
 - B circular
 - C elliptical
 - D a line parallel to the magnetic field

21



A coil of 50 turns has a cross-sectional area of $4.2 \times 10^{-3} \text{ m}^2$. It is placed at an angle to a uniform magnetic field of flux density $2.8 \times 10^{-2} \text{ T}$, as shown in the diagram, so that angle $\theta = 50^\circ$.

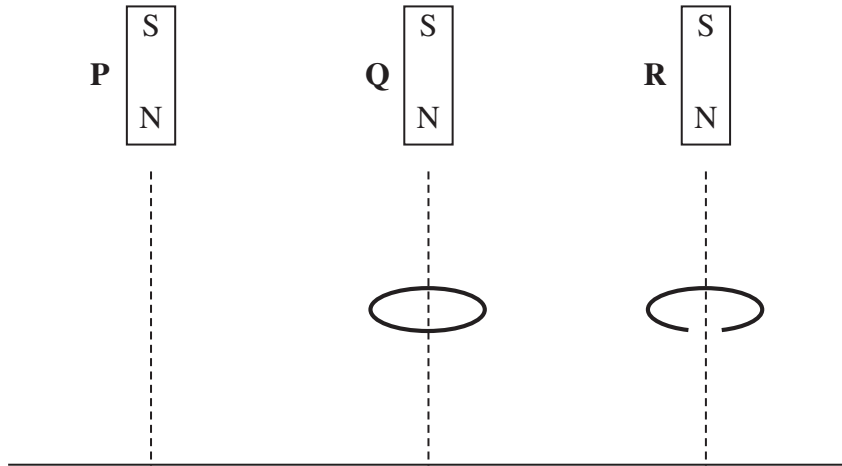
What is the change in flux linkage when the coil is rotated anticlockwise until $\theta = 0^\circ$?

- A The flux linkage decreases by $2.1 \times 10^{-3} \text{ Wb turns}$.
 - B The flux linkage increases by $2.1 \times 10^{-3} \text{ Wb turns}$.
 - C The flux linkage decreases by $3.8 \times 10^{-3} \text{ Wb turns}$.
 - D The flux linkage increases by $3.8 \times 10^{-3} \text{ Wb turns}$.
- 22 An aircraft, of wing span 60 m, flies horizontally at a speed of 150 m s^{-1} . If the vertical component of the Earth's magnetic field in the region of the plane is $1.0 \times 10^{-5} \text{ T}$, what is the magnitude of the magnetic flux cut by the wings in 10 s?
- A $1.0 \times 10^{-5} \text{ Wb}$
 - B $1.0 \times 10^{-4} \text{ Wb}$
 - C $9.0 \times 10^{-2} \text{ Wb}$
 - D $9.0 \times 10^{-1} \text{ Wb}$

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23

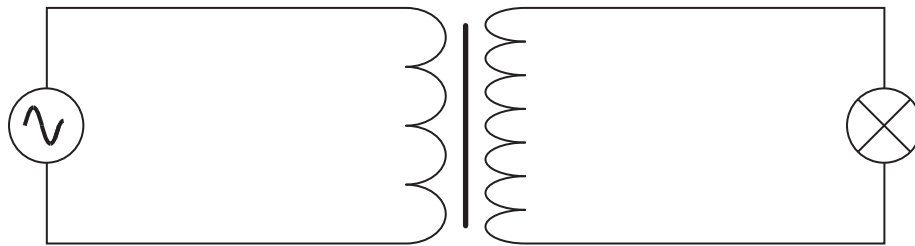


Three identical magnets **P**, **Q** and **R** are released simultaneously from rest and fall to the ground from the same height. **P** falls directly to the ground, **Q** falls through the centre of a thick conducting ring and **R** falls through a ring which is identical except for a gap cut into it. Which one of the statements below correctly describe the sequence in which the magnets reach the ground?

- A **P** and **R** arrive together followed by **Q**.
- B **P** and **Q** arrive together followed by **R**.
- C **P** arrives first, follow by **Q** which is followed by **R**.
- D All three magnets arrive simultaneously.

24

The primary coil of a step-up transformer is connected to a source of alternating pd. The secondary coil is connected to a lamp.



Which line, **A** to **D**, in the table correctly describes the flux linkage and current through the secondary coil in relation to the primary coil?

	$\frac{\text{secondary magnetic flux linkage}}{\text{primary magnetic flux linkage}}$	$\frac{\text{secondary current}}{\text{primary current}}$
A	>1	<1
B	<1	<1
C	>1	>1
D	<1	>1



- 25** A transformer has 1200 turns on the primary coil and 500 turns on the secondary coil. The primary coil draws a current of 0.25 A from a 240 V ac supply. If the efficiency of the transformer is 83%, what is the current in the secondary coil?
- A** 0.10 A
 - B** 0.21 A
 - C** 0.50 A
 - D** 0.60 A

END OF QUESTIONS



There are no questions printed on this page

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**

