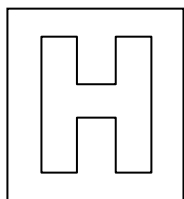


Candidate Name: \_\_\_\_\_

Class

Adm No

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## 2015 Preliminary Examination 2

### Pre-university 2

**H1 PHYSICS**

**8866/01**

**Wednesday**

**23 September 2015**

**1 hour**

Additional Materials: OMR Answer Sheet

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#### **READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class and admission number on the Answer Sheet in the spaces provided.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate OMR Answer Sheet.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

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**This question paper consists of 13 printed pages and 1 blank page.**

**[Turn over**

**Data**

speed of light in free space,	$c$	$=$	$3.00 \times 10^8 \text{ m s}^{-1}$
elementary charge,	$e$	$=$	$1.60 \times 10^{-19} \text{ C}$
the Planck constant,	$h$	$=$	$6.63 \times 10^{-34} \text{ J s}$
unified atomic mass constant,	$u$	$=$	$1.66 \times 10^{-27} \text{ kg}$
rest mass of electron,	$m_e$	$=$	$9.11 \times 10^{-31} \text{ kg}$
rest mass of proton,	$m_p$	$=$	$1.67 \times 10^{-27} \text{ kg}$
acceleration of free fall,	$g$	$=$	$9.81 \text{ m s}^{-2}$

**Formulae**

uniformly accelerated motion,	$s$	$=$	$ut + \frac{1}{2}at^2$
	$v^2$	$=$	$u^2 + 2as$
work done on/by a gas,	$W$	$=$	$p\Delta V$
hydrostatic pressure,	$p$	$=$	$\rho g h$
resistors in series	$R$	$=$	$R_1 + R_2 + \dots$
resistors in parallel	$1/R$	$=$	$1/R_1 + 1/R_2 + \dots$

(30 marks)

1. What is the pascal, the SI unit of pressure, expressed in SI base units?

A  $\text{kg m}^{-1} \text{s}^{-1}$       B  $\text{kg m}^{-1} \text{s}^{-2}$       C  $\text{kg m}^3 \text{s}^{-1}$       D  $\text{kg m}^3 \text{s}^{-2}$

2. A student uses an ammeter. The ammeter has a needle which moves above a horizontal scale. There are three sources of error in the readings.

1 The ammeter has an incorrectly set zero.

2 The ammeter always gives a reading which is 5% lower than the true current.

3 The student's eye is not always vertically above the ammeter needle.

Which row correctly classifies these sources of error?

	random error	systematic error
A	1	2, 3
B	1, 3	2
C	2, 3	1
D	3	1, 2

3. Diagram 1 shows the path of a ball that bounces on a wall, continuing at the same speed. Diagram 2 is a vector diagram showing the initial velocity  $u$  and the final velocity  $v$  of the ball.

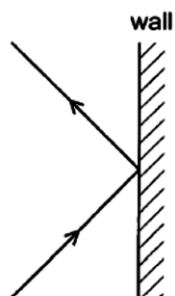
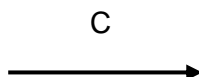
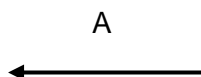


diagram 1

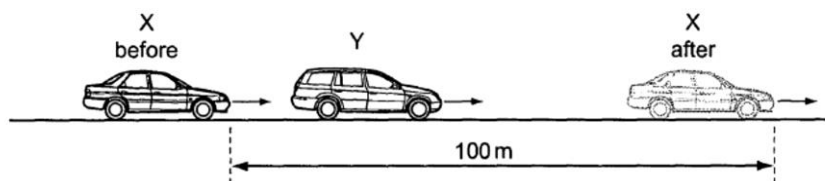


diagram 2

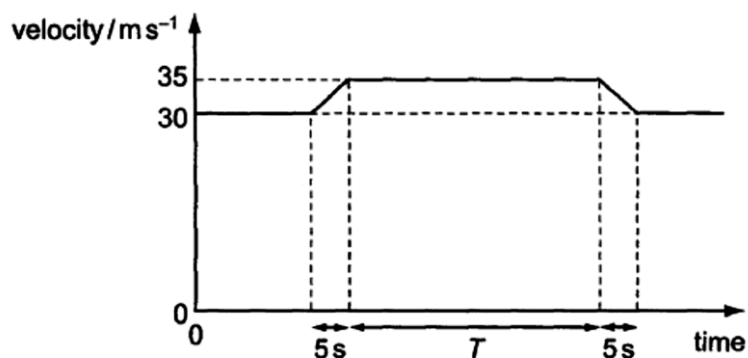
Which vector represents the change in velocity of the ball?



4. Two cars X and Y are initially travelling at  $30 \text{ m s}^{-1}$  on a straight motorway. X overtakes Y by accelerating for  $5 \text{ s}$  to  $35 \text{ m s}^{-1}$ , remaining at  $35 \text{ m s}^{-1}$  for a time  $T$  and then decelerating for  $5 \text{ s}$  to  $30 \text{ m s}^{-1}$ . X advances by  $100 \text{ m}$  relative to Y during overtaking.

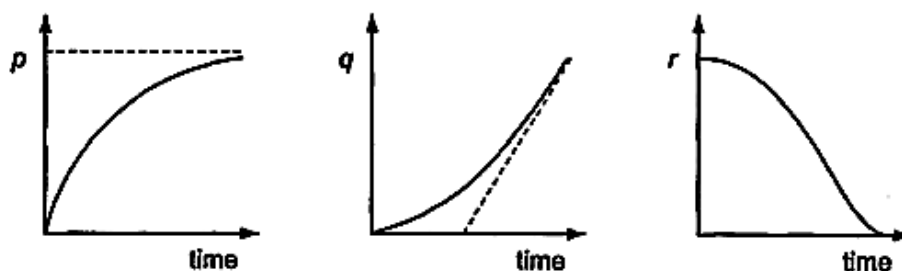


The diagram shows the velocity-time graph for X.



What is time  $T$ ?

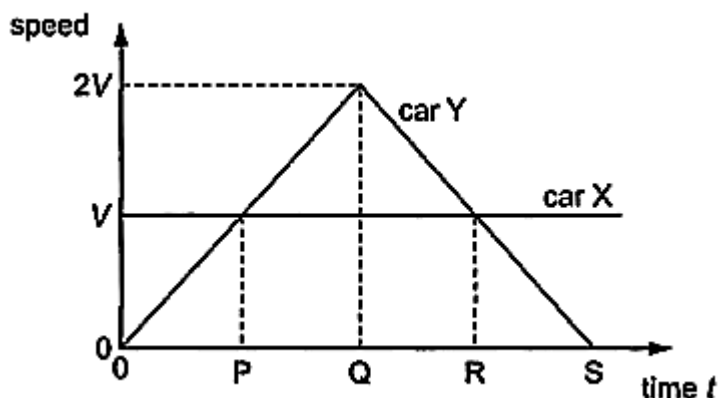
- A 10 s                      B 15 s                      C 20 s                      D 25 s
5. A stone is released from rest at a great height in air and falls owing to gravity. Each of the three graphs represents the variation with time of one of three variables  $p$ ,  $q$  and  $r$ .



Which row correctly identifies the three variables  $p$ ,  $q$  and  $r$ ?

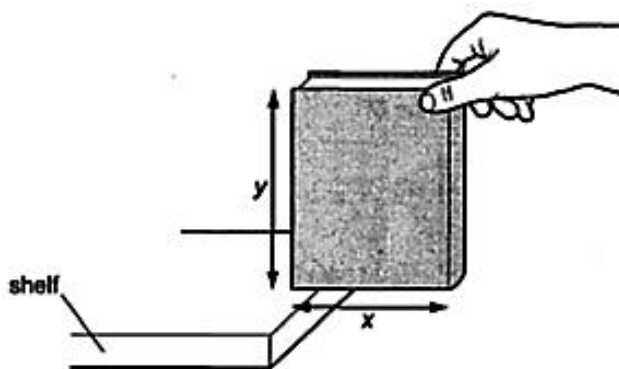
	$p$	$q$	$r$
A	acceleration	displacement	velocity
B	displacement	velocity	acceleration
C	velocity	acceleration	displacement
D	velocity	displacement	acceleration

6. Car X travels at a constant speed  $V$  along a motorway. At a time  $t = 0$ , it passes car Y which immediately accelerates uniformly from rest to speed  $2V$ . Car Y then decelerates uniformly to rest. (Time  $OQ = \text{time } QS$ .)



Which statement is correct?

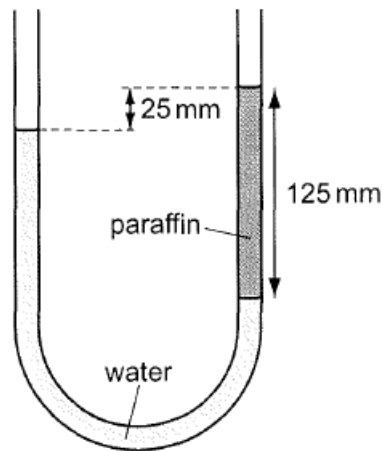
- A At time Q, car Y overtakes car X.
  - B At time R, car X overtakes car Y.
  - C At time Q, car Y has travelled twice as far as car X.
  - D At time S, car X has travelled twice as far as car Y.
7. A student pulls a book by its top corner from a shelf, holding it between his forefinger and thumb. The book has weight  $W$  and dimensions  $x$  and  $y$  as shown.



What moment must the student provide at the corner of the book to stop it from rotating as it leaves the shelf?

- A  $\frac{Wy}{2}$  anticlockwise
- B  $\frac{Wx}{2}$  anticlockwise
- C  $\frac{W(y-x)}{2}$  clockwise
- D  $Wx$  anticlockwise

8. Paraffin floats on water. Some paraffin is poured into one arm of a U-tube containing water. The diagram below shows a difference of 25 mm in the surface levels of the water and paraffin in the two arms. The length of the paraffin column in the tube is 125 mm.

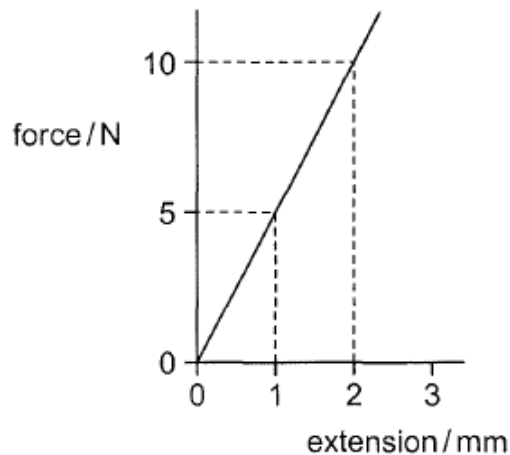


A small volume of paraffin is added to the right-hand arm increasing the length of the paraffin column in the tube to 150 mm.

What is the new difference between the surface levels of the water and paraffin in the two arms?

- A 25 mm      B 30 mm      C 38 mm      D 50 mm

9. The diagram shows the force-extension graph for a stretched wire.



What is the value of the ratio

$$\frac{\text{Increase in elastic potential energy when the wire is stretched from 1.0 mm to 2.0 mm}}{\text{Increase in elastic potential energy when the wire is stretched from 0 to 1.0 mm}} \quad ?$$

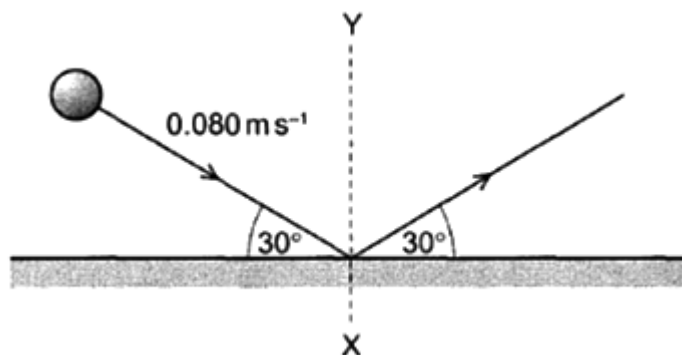
- A 1      B 2      C 3      D 4

10. The diagram shows a particle X, with kinetic energy  $E_k$  about to collide with a stationary particle Y. Both particles have the same mass.



After colliding, X and Y travel onwards together as a single larger particle.  
How much kinetic energy is lost in the collision?

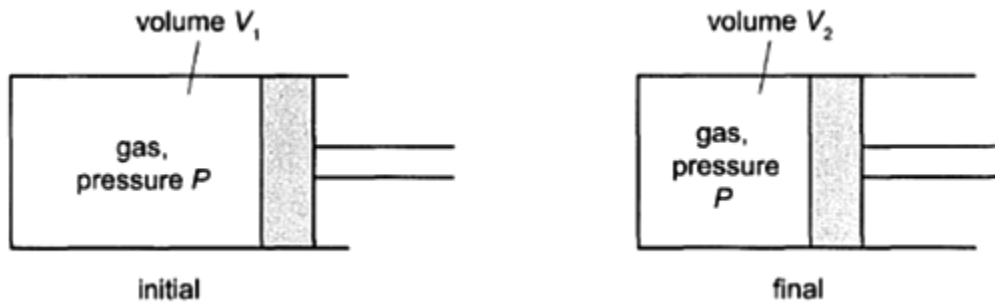
- A 0                      B  $\frac{E_k}{4}$                       C  $\frac{E_k}{2}$                       D  $\frac{3E_k}{4}$
11. Two asteroids deep in space are involved in an inelastic collision.  
Which of the quantities, kinetic energy and momentum, are conserved?
- A Kinetic energy and momentum are both conserved.  
B Kinetic energy is conserved but momentum is not conserved.  
C Kinetic energy is not conserved but momentum is conserved.  
D Neither kinetic energy nor momentum is conserved.
12. A snooker ball of mass 0.40 kg moving at  $0.080 \text{ m s}^{-1}$  collides with the side of a table at an angle of  $30^\circ$ . The ball is in contact with the side for 0.20 s. It bounces off at the same angle with the same speed.



What is the average force on the ball from the side in the direction XY?

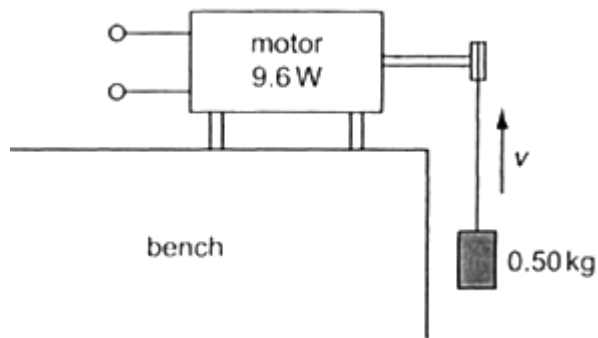
- A 0.080 N                      B 0.14 N                      C 0.16 N                      D 0.28 N
13. A mass of 5.0 kg is moving in a straight line with a constant speed of  $4.0 \text{ m s}^{-1}$ . A force of 10 N is then applied to the mass along the direction of motion and removed after the mass has travelled a distance of 2.5m.  
What is the increase in the kinetic energy of the mass due to the action of the force?
- A 15 J                      B 25 J                      C 45 J                      D 65 J

14. A gas is enclosed in a cylinder fitted with a piston. Initially the volume of the gas is  $V_1$ . The gas is then cooled and the piston moves inwards in order to keep the pressure of the gas constant. The volume of the gas is reduced to  $V_2$ .



Which represents the amount of work done on the gas?

- A  $PV_1$                       B  $PV_2$                       C  $P(V_1 - V_2)$                       D  $P(V_2 - V_1)$
15. A small electric motor is 20% efficient. Its input power is 9.6 W when it is lifting a mass of 0.50 kg at a steady speed  $v$ .

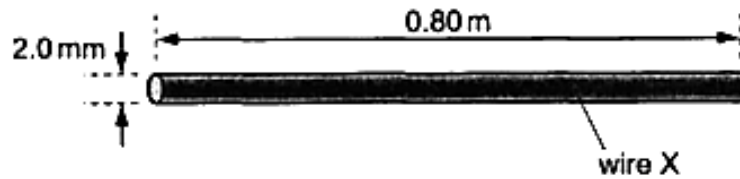


What is the value of  $v$ ?

- A  $0.39 \text{ m s}^{-1}$                       B  $2.0 \text{ m s}^{-1}$                       C  $2.8 \text{ m s}^{-1}$                       D  $3.0 \text{ m s}^{-1}$
16. The resistance of an electric filament lamp is far greater at its working temperature than when cold.  
Which statement explains this?
- A Fewer conduction electrons are available at higher temperatures.  
B Ionic vibrations within the filament are greater at higher temperatures.  
C The emission of light absorbs electrical energy.  
D The length of the filament increases with temperature.
17. A  $1.0 \text{ k}\Omega$  resistor has a maximum power rating of 0.25 W.  
What is the maximum rate of flow of electrons that can pass through this resistor?

- A  $1.0 \times 10^{13} \text{ s}^{-1}$   
B  $1.0 \times 10^{15} \text{ s}^{-1}$   
C  $1.0 \times 10^{17} \text{ s}^{-1}$   
D  $1.0 \times 10^{19} \text{ s}^{-1}$

18. A metal wire X has a diameter of 2.0 mm and a length of 0.80 m.



Which wire, made of the same metal, would have the same resistance as wire X?

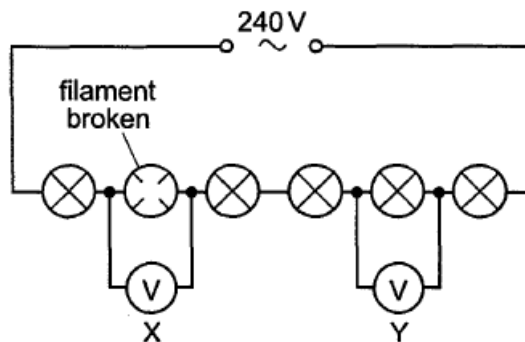
	Diameter / mm	Length / m
A	1.0	0.20
B	1.0	0.40
C	4.0	0.40
D	4.0	0.64

19. A 240 V electric heater uses a current of 4.00 A. It is to be rewound with resistance wire of diameter  $4.00 \times 10^{-4}$  m.

At working temperature, the resistance wire has resistivity  $1.10 \times 10^{-6} \Omega \text{ m}$ .  
What length of wire is required?

- A 2.18 m      B 6.85 m      C 10.8 m      D 27.4 m

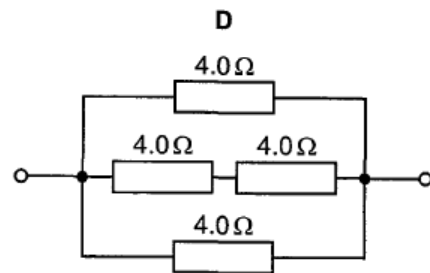
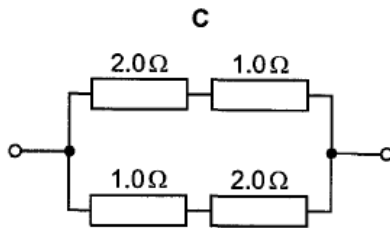
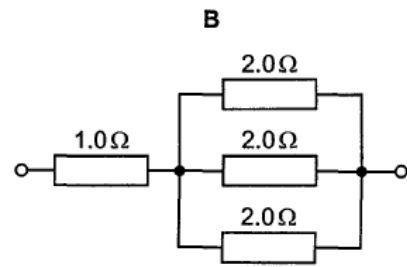
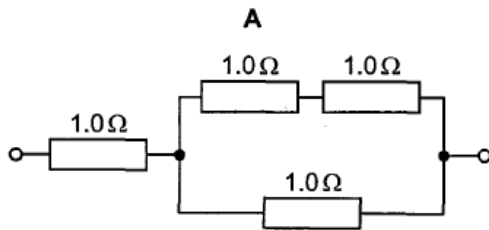
20. A mains circuit contains six similar lamps connected in series. One of the lamps has a broken filament. Voltmeters X and Y of infinite resistance are placed in the circuit as shown.



What are the voltmeter readings?

	X reading / V	Y reading / V
A	0	0
B	0	240
C	40	40
D	240	0

21. Four resistors, with resistances as shown, are connected in series and parallel combinations. Which combination has the **lowest** total resistance?



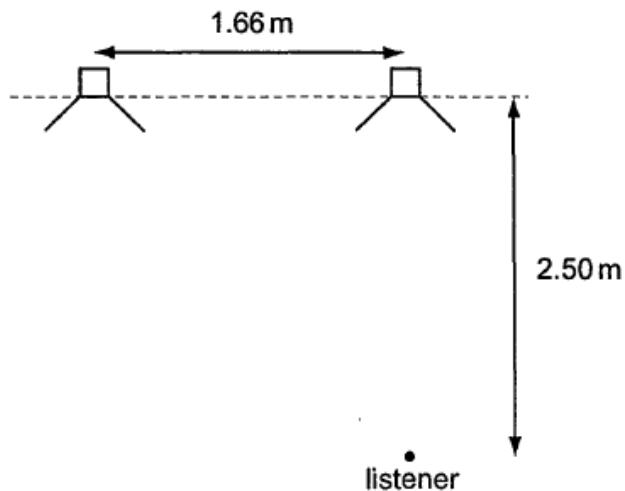
22. Stationary waves may be set up in air columns in pipes. The pipes may be open at one or both ends.  
Which combination of nodes and antinodes **cannot** occur in any pipe?

	node	antinode
A	1	1
B	1	2
C	2	1
D	2	3

23. Two sound waves, both of frequency 200 Hz but with a phase difference of  $30.0^\circ$ , travel along the same path. What is the smallest separation of the compressions of these waves? The speed of sound is  $324 \text{ m s}^{-1}$ .

A 0.135 m      B 0.270 m      C 0.540 m      D 1.49 m

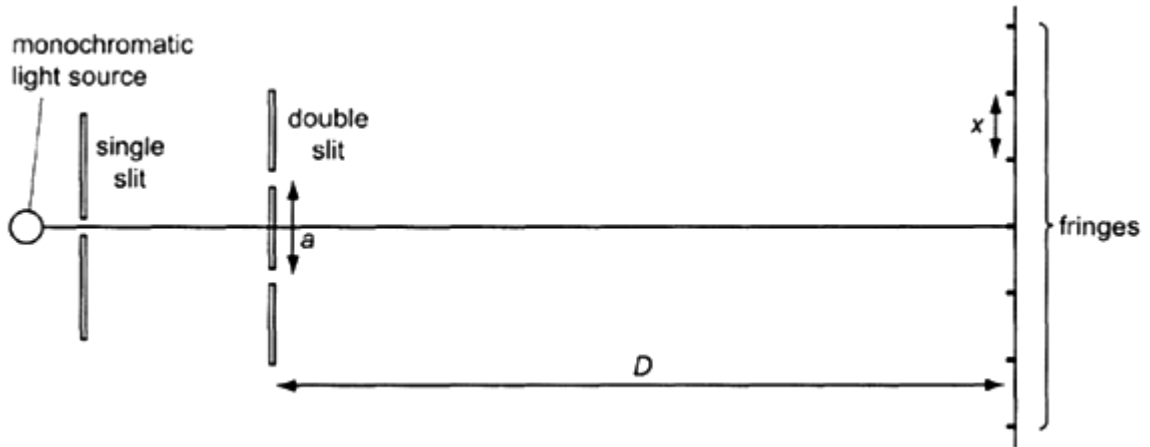
24. Which phenomenon provides conclusive proof that light waves are transverse?
- A diffraction
  - B interference
  - C polarisation
  - D refraction
25. The equation  $\lambda = \frac{ax}{D}$  for double-slit interference is an approximation which can be used to determine the wavelength of light. Which of the following conditions is necessary?
- A  $a$  is equal to  $x$ .
  - B  $a$  is much greater than  $x$ .
  - C  $D$  is much greater than  $a$ .
  - D  $\lambda$  is much greater than  $x$ .
26. Two loudspeakers are placed on a horizontal line 1.66 m apart. A listener is standing 2.50 m from, and directly in front of, the right-hand loudspeaker.



Both loudspeakers emit sound of frequency 330 Hz. The speed of the sound is  $330 \text{ m s}^{-1}$ . What is the phase difference between the sound waves reaching the listener from the two loudspeakers?

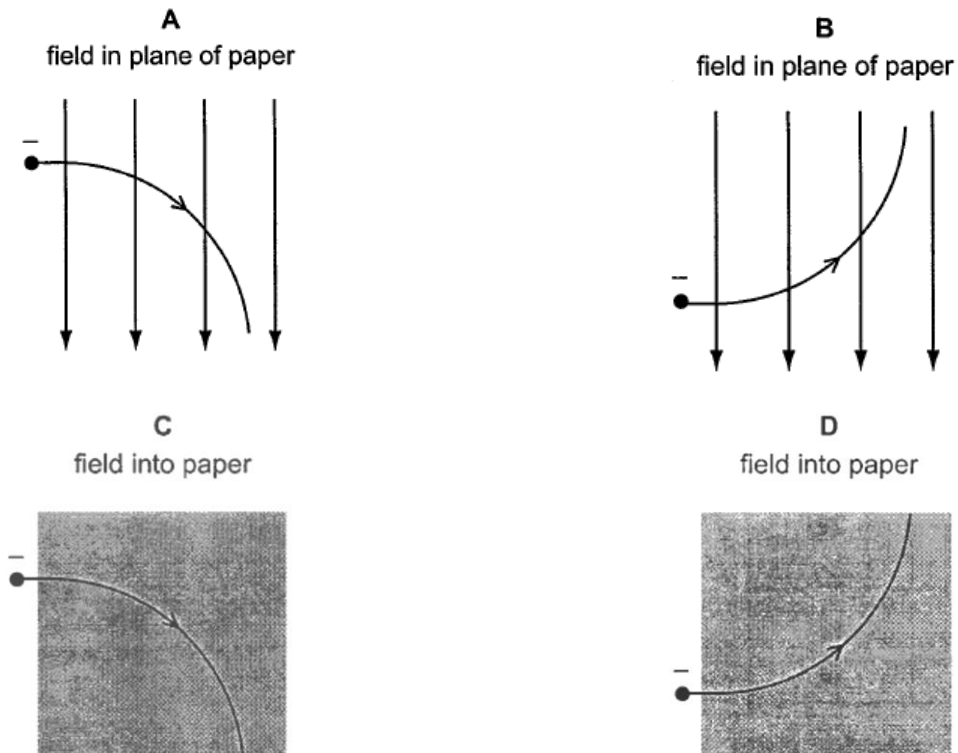
- A  $0^\circ$
- B  $90^\circ$
- C  $180^\circ$
- D  $360^\circ$

27. A monochromatic light source of wavelength  $\lambda$ , a single slit, and a double slit of separation  $a$  are set up in order to produce interference fringes of separation  $x$  at a distance  $D$  from the double slit.

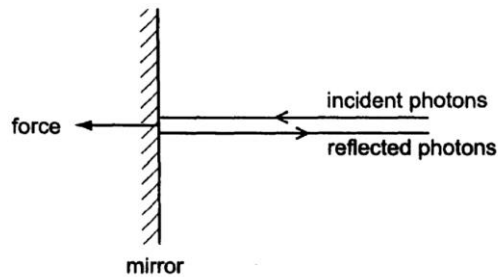


Which pair of adjustments could be made **without** altering the fringe separation  $x$ ?

- A decrease  $D$  and decrease  $a$
  - B decrease  $D$  and increase  $a$
  - C decrease  $\lambda$  and decrease  $D$
  - D increase  $\lambda$  and increase  $D$
28. A negatively-charged particle enters a uniform magnetic field.  
Which diagram represents the path of the particle in the magnetic field?

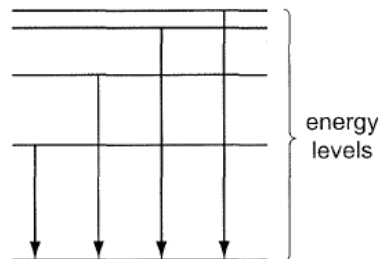


29. Photons strike a mirror normally and are reflected back along their initial path. The change in momentum of the photons as they are reflected from the mirror causes a small force to act on the mirror, as shown in the diagram.



The wavelength of the photons is halved and the intensity of the photon beam remains the same. Which quantity is halved?

- A the energy of each photon striking the mirror  
 B the number of photons striking the mirror each second  
 C the momentum of each photon striking the mirror  
 D the force acting on the mirror
30. Electrons can move from a higher energy level to a lower energy level in an atom, emitting a quantum of electromagnetic radiation. The diagram shows five energy levels in an atom and some transitions between them.



The line spectrum produced is in the visible spectrum and can be represented on a wavelength scale or a frequency scale.

Which diagram could represent the light emitted by the four transitions shown above?

	increasing wavelength →	increasing frequency →
<b>A</b>		
<b>B</b>		
<b>C</b>		
<b>D</b>		

**End of Paper**

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