



**HWA CHONG INSTITUTION**  
**JC2 Preliminary Examinations**  
**Higher 1**

**CANDIDATE  
NAME**

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**CT GROUP**

**13S**

**CENTRE  
NUMBER**

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**INDEX  
NUMBER**

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**PHYSICS**

**8866/01**

**Paper 1 Multiple Choice**

**24 September 2014**

**1 hour**

Additional Materials: Optical Mark Sheet

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**INSTRUCTIONS TO CANDIDATES**

Write in soft pencil.

Write your name, CT, NRIC or FIN number on the optical mark sheet (OMS). Shade your NRIC or FIN 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 OMS.

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.

## Data

speed of light in vacuum,  
 $c = 3.00 \times 10^8 \text{ m s}^{-1}$

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,  $p = \rho gh$

resistors in series,  $R = R_1 + R_2 + \dots$

resistors in parallel,  $1/R = 1/R_1 + 1/R_2 + \dots$

- 1 The force  $F$  acting on a wire of length  $L$  carrying a current  $I$  in a magnetic field of magnetic flux density  $B$  is given by  $F = BIL$ . Which of the following represent the base units of **magnetic flux**?

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

- 2 What is the best estimate for the value of the mass of a raindrop?

- A  $4 \mu\text{g}$
- B  $4 \text{ mg}$
- C  $4 \text{ g}$
- D  $4 \text{ kg}$

- 3 A student measures two lengths as follows:

$$X = 15.0 \pm 0.2 \text{ cm}$$

$$Y = 30.0 \pm 0.2 \text{ cm.}$$

The student calculates:

$F_X$  the fractional uncertainty in  $X$

$F_Y$  the fractional uncertainty in  $Y$

$F_{Y-X}$  the fractional uncertainty in  $(Y - X)$

$F_{X+Y}$  the fractional uncertainty in  $(X + Y)$

Which of these uncertainties has the **largest** magnitude?

- A  $F_X$
- B  $F_Y$
- C  $F_{Y-X}$
- D  $F_{X+Y}$

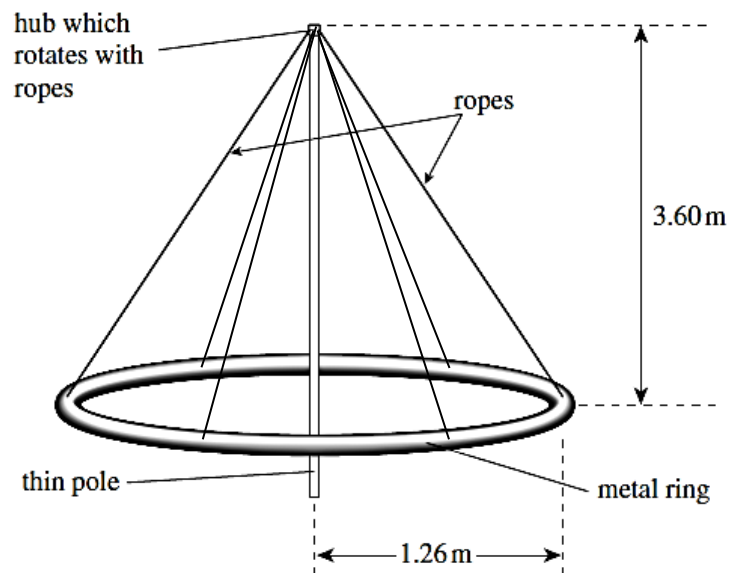
- 4 Two stones, X and Y, of different mass are dropped from the top of a cliff. Stone Y is dropped a short time after stone X. Air resistance is negligible. Whilst the stones are falling, the distance between them will
- A Decrease if the mass of Y is more than the mass of X
- B Increase if the mass of X is more than the mass of Y
- C Decrease whether the mass of X more than or less than the mass of Y.
- D Increase whether the mass of X is more than or less than the mass of Y
- 5 A bullet is aimed directly and horizontally at the centre of a target which is 100 m away. If the bullet is then fired at a speed of  $200 \text{ m s}^{-1}$ , what is the distance the bullet will land from the centre of the target?
- A 0 cm                      B 12 cm                      C 123 cm                      D 196 cm
- 6 A stationary radioactive nucleus decays into two nuclei, one of which is an alpha particle which has a mass of 4 units and the other, the daughter nucleus of mass 40 units. If the daughter nucleus has an initial kinetic energy of 200 eV, what is the kinetic energy of the alpha particle?
- A 20 eV                      B 500 eV                      C 2000 eV                      D 20 000 eV
- 7 A man of mass  $M$  is standing on a weighing scale in an elevator. The elevator undergoes several different motions as described below.

Elevator's motion	Weighing scale reading
Moving downwards and coming to rest with uniform deceleration	$N_1$
Moving downwards and speeding up with constant acceleration	$N_2$
Moving downwards with constant speed	$N_3$

Which of the following is correct?

- A  $N_1 = N_2 = N_3$
- B  $N_1 = N_2 < N_3$
- C  $N_1 < N_3 < N_2$
- D  $N_2 < N_3 < N_1$

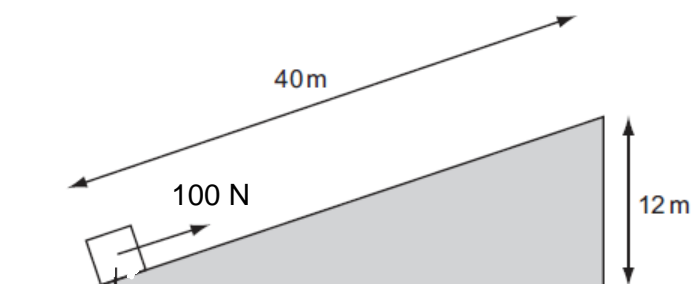
- 8 Newton's third law concerns action and reaction force pairs acting on two bodies. Which of the following statements relating to the third law is **not** correct?
- A The two forces must act on different bodies.
  - B The two forces are always opposite in direction.
  - C The two forces are at all times equal in magnitude.
  - D The two forces are equal and opposite so the bodies are in equilibrium.
- 9 The figure below shows a type of playground roundabout. It consists of a rigid, hollow, metal ring supported by eight ropes arranged symmetrically around the ring. The ring is of average radius of 1.26 m and has a mass of 27.0 kg. The vertical distance from the ring to the hub where the ropes are attached is 3.60 m.



The metal ring is uniform and its weight is distributed evenly amongst the eight ropes. Calculate the tension in one of the ropes when the roundabout is stationary.

- A 35 N                      B 100 N                      C 140 N                      D 281 N

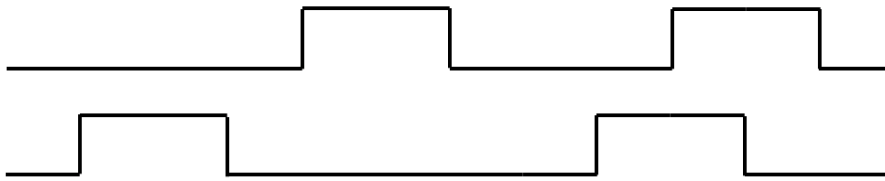
- 10 A constant force of 100 N, parallel to a rough inclined plane, moves a body of mass 20.0 kg at constant speed of  $5.0 \text{ m s}^{-1}$  through a distance of 40 m along the plane. The body gains a height of 12 m. Determine the magnitude of work done by friction that is dissipated as heat.



- A 1.6 kJ                      B 2.4 kJ                      C 3.7 kJ                      D 4.0 kJ
- 11 An 80.0 kg sky diver jumps out of a helicopter at an altitude of 1000 m and opens her parachute at an altitude of 200 m. Assuming the total retarding force on the diver is constant at 50.0 N with the parachute closed and constant at 3600 N with the parachute open. What is the amount of heat produced in the jump?
- A 50 kJ                      B 720 kJ                      C 760 kJ                      D 780 kJ
- 12 A man pulls a block of mass 200 kg up a plane inclined at  $30^\circ$ . The resistance of the plane to motion is 500 N and the man can deliver a maximum power of 3 kW.  
What is the maximum speed he can maintain up the incline?
- A  $1 \text{ m s}^{-1}$                       B  $2 \text{ m s}^{-1}$                       C  $3 \text{ m s}^{-1}$                       D  $6 \text{ m s}^{-1}$
- 13 A car of mass  $m$  has an engine that exerts a force of  $F$  on it. In a time  $t$ , the car travels a distance  $s$  and its speed increases from  $u$  to  $v$ . What is the useful output power of the engine?
- A  $\frac{Fs}{t}$                       B  $F(v - u)$                       C  $Ft$                       D  $\frac{m(v^2 - u^2)}{2t}$
- 14 A sound wave of frequency 50 Hz is travelling through air at a speed of  $314 \text{ m s}^{-1}$ . What is the phase difference between two points of the sound wave separated by 1.0 m in the direction of travel?
- A 0.5 rad                      B 1.0 rad                      C 2.0 rad                      D  $\pi$  rad

- 15 Which of the following gives four regions of the electromagnetic spectrum in order of increasing frequency?
- A Radio waves, microwaves,  $\gamma$ -rays, x-rays.
  - B Radio waves, microwaves, x-rays,  $\gamma$ -rays.
  - C Microwaves, radio waves,  $\gamma$ -rays, x-rays.
  - D Microwaves, radio waves, x-rays,  $\gamma$ -rays.

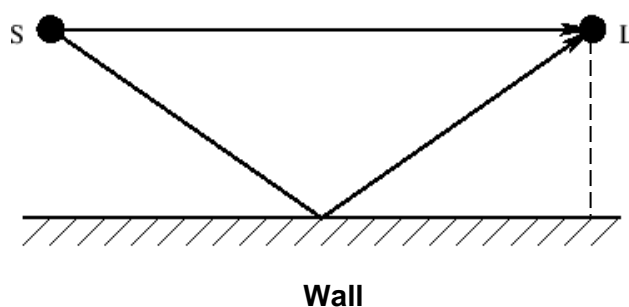
- 16 Two wave profiles are shown below.



A possible result of superposing these two waves is

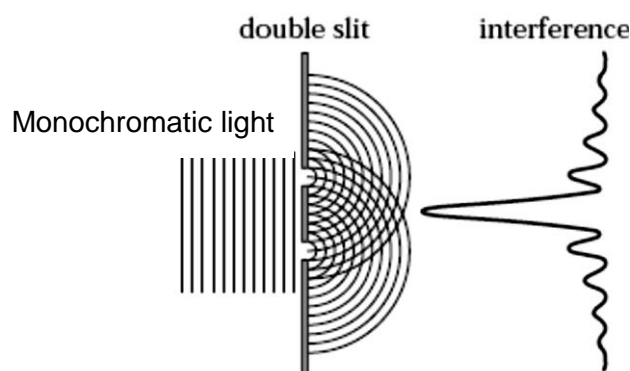
- A
- B
- C
- D

- 17 A loudspeaker at position S emits a sound of a single frequency. The sound travels to Leo who is at position L, both through a straight path and after reflection from a wall as shown.

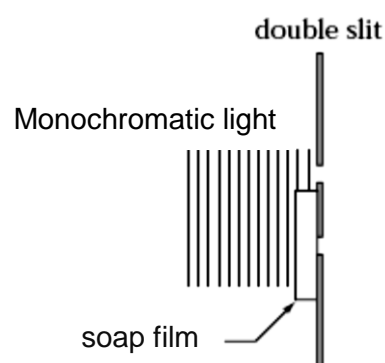


As Leo walks directly towards the wall (along the dotted line), the sound alternates between loud and soft. Which of the following changes would result in an increase in the distance between loud and soft sounds?

- A Increasing the frequency emitted by the loudspeaker.
  - B Moving the loudspeaker closer to the wall.
  - C Moving the loudspeaker towards L.
  - D Increasing the loudness of the sound emitted by the loudspeaker.
- 18 A collimated beam of monochromatic light is incident on two slits. An interference pattern is produced on a screen behind the slits, as indicated in Fig. 18a. One of the slits is now covered with a soap film as indicated in Fig. 18b.



**Fig. 18a** (not to scale)

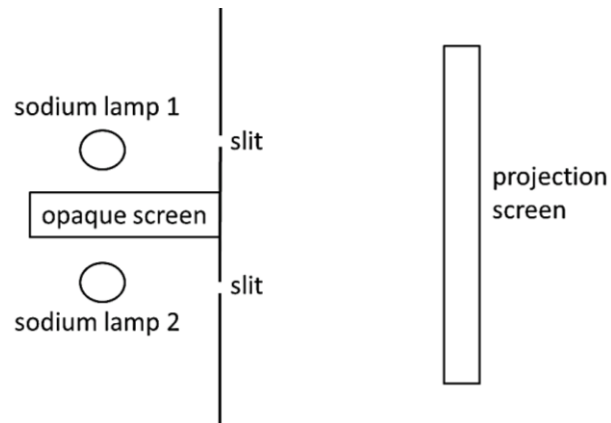


**Fig. 18b** (not to scale)

How is the interference pattern on the screen altered by adding the film?

- A The fringe separation increases.
- B The fringe separation decreases.
- C The interference pattern is displaced.
- D The interference pattern is unchanged.

- 19** A sodium lamp produces two distinct yellow lines in the visible part of the spectrum, at 589.0 nm and 589.6 nm. Two such lamps are separated by a screen. The light of both lamps is then to pass through a slit each, as indicated in the figure. It turns out that no interference pattern can be obtained on the projection screen.

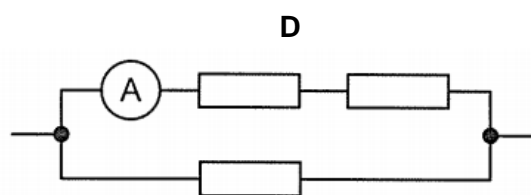
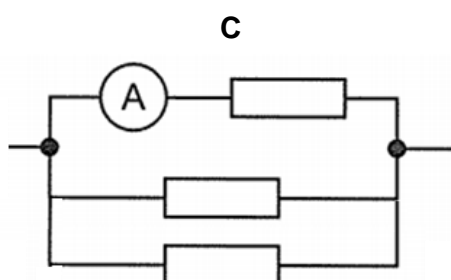
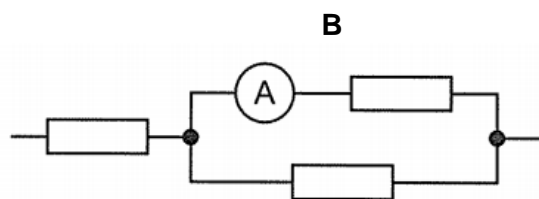
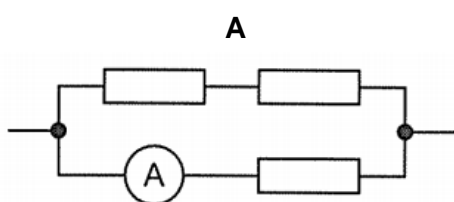


Which of the following explains the observation?

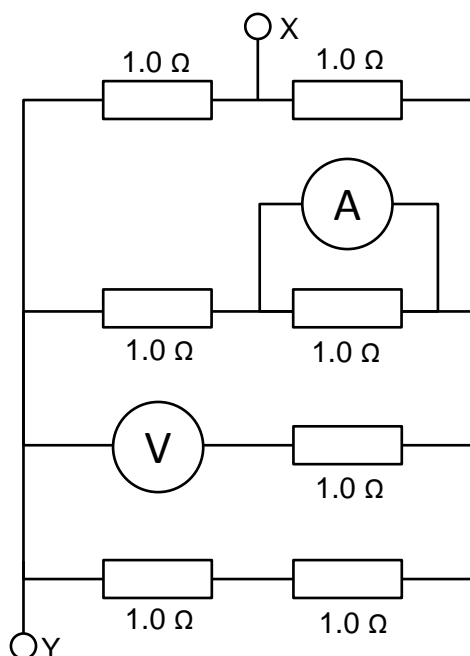
- A** The lamps are not point sources.
  - B** The light from the lamps do not have exactly the same amplitude.
  - C** The light from the lamps is not coherent.
  - D** The light from the lamps is not monochromatic.
- 20** Two samples of guitar strings, one 60.0 cm long and the other 30.0 cm long are plucked in the presence of a tuning fork of frequency 256 Hz. The wave velocity  $v$  is  $153.5 \text{ m s}^{-1}$  in both strings. Which of the following is true?
- A** Only the 30.0 cm string causes the tuning fork to vibrate.
  - B** Only the 60.0 cm string causes the tuning fork to vibrate.
  - C** Both strings cause the tuning fork to vibrate.
  - D** Neither strings cause the tuning fork to vibrate.

- 21 Four different arrangements of identical resistors are connected to the same constant voltage power supply. An ammeter of negligible resistance is connected as shown in each arrangement.

In which arrangement will the ammeter show the minimum reading?

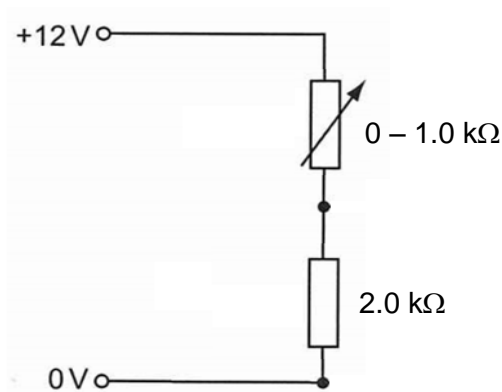


- 22 For the bizarre circuitry shown below, what is the effective resistance between points X and Y? Assume all components are ideal.



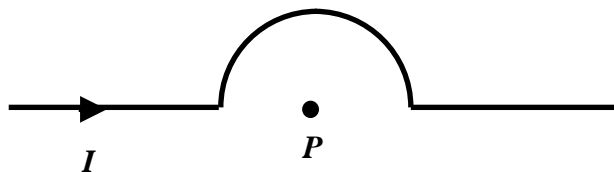
- A 0.750  $\Omega$   
 B 0.625  $\Omega$   
 C 0.600  $\Omega$   
 D 0.500  $\Omega$

- 23** A cell with substantial internal resistance is connected in series to a resistive load. Which of the following statements is true when the resistance of the load is halved?
- A** The current through the load must decrease.
  - B** The potential difference across the load must increase.
  - C** The total power delivered by the cell must decrease.
  - D** The efficiency of energy transfer to the loads must decrease.
- 24** A potential divider circuit is set up across a 12 V supply with a fixed 2.0 k $\Omega$  load resistor and a variable 0-1.0 k $\Omega$  resistor.



The power delivered to the load resistor can be varied between

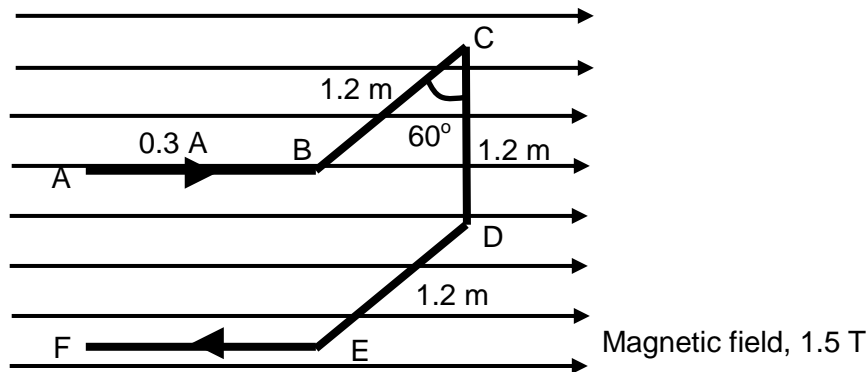
- A** 48 mW and 72 mW
  - B** 32 mW and 72 mW
  - C** 4.0 mW and 6.0 mW
  - D** 4.0 mW and 8.0 mW
- 25** A wire consists of two straight sections with a semicircular section between them.



If current flows in the wire as shown, the direction of the magnetic field at the centre of the semi-circle,  $P$ , due to the current is

- A** to the right
- B** to the left
- C** out of the plane of the figure
- D** into the plane of the figure

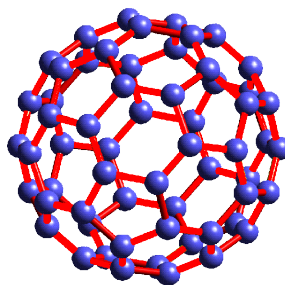
- 26 A current of 0.3 A flows in a conductor that lies on the plane of the paper as shown in the figure below.



The conductor is inside a region of space containing a uniform magnetic field of 1.5 T. AB and FE are parallel to the magnetic field. BC and ED are parallel to each other. Angle BCD is  $60^\circ$ . The lengths of segments BC, CD and DE are 1.2 m long each. Segment CD is perpendicular to the magnetic field. The magnitude of the resultant force on the conductor is

- A 0.27 N  
 B 0.47 N  
 C 0.54 N  
 D 1.08 N
- 27 A negatively charged cosmic ray particle falls vertically downwards from sky in a region where the magnetic field vector points toward the north. What is the direction of the magnetic force on this particle due to the field?
- A toward the north  
 B toward the south  
 C toward the east  
 D toward the west
- 28 In a photoelectric experiment, a 100 W point light source emits light of wavelength 600 nm to illuminate a small metal target of area  $4.00 \text{ cm}^2$ . If the light source is placed 50.0 cm away from the metal target, how many photons are incident upon the metal target every second?
- A  $3.84 \times 10^{16}$       B  $1.51 \times 10^{20}$       C  $3.02 \times 10^{20}$       D  $3.20 \times 10^{37}$
- 29 In a hypothetical one-electron atom, the emission spectrum consists of lines of wavelength 75.80 nm, 79.94 nm and 94.75 nm, 379.00 nm, 511.57 nm and 1462.50 nm. If it takes 17.50 eV to ionize the atom, what is the energy of the atom in the first excited state?
- A -1.10 eV      B -4.38 eV      C -13.12 eV      D -16.65 eV

- 30** Buckyballs are spherical molecules consisting entirely of carbon (see diagram). C60 and C70 buckyballs are composed of 60 and 70 carbon atoms respectively. They are one of the largest objects to have been shown to exhibit wave-particle duality.



In a diffraction experiment, C60 and C70 buckyballs possess the same kinetic energy. A collimated beam of Buckyballs with the same kinetic energy is targeted at a slit to form an interference pattern. The C60 buckyballs are shown to have a de Broglie wavelength of 2.5 pm. What would be the de Broglie wavelength of the C70 buckyballs?

- A** 2.1 pm                      **B** 2.3 pm                      **C** 2.5 pm                      **D** 2.7 pm

**End of Paper**