MERIDIAN JUNIOR COLLEGE
Preliminary Examination
Higher 1

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# H1 Physics 8866/1

Paper 1 **22 September 2015**

**1 hour**

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Class Reg Number

Candidate Name _____

## READ THESE INSTRUCTIONS FIRST

**Do not open this booklet until you are told to do so.**

There are **thirty** questions in this section. 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 Optical Mark Sheet (OMS).

**Read very carefully the instructions on the OMS.**

**Write your name and class in the spaces provided on the OMS.**

**Shade your Index Number column using the following format:**

**1) first 2 digits is your index number in class (e.g. 5th student is shaded as "05");**

**2) ignore the last row of alphabets.**

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**This question paper consists of 13 printed pages**

## DATA AND FORMULAE

### Data

| | | | |
|---|---|---|---|
| speed of light in free space | $c$ | = | $3.00 \times 10^{8}$ m s$^{-1}$ |
| elementary charge | $e$ | = | $1.60 \times 10^{-19}$ C |
| the Planck constant | $h$ | = | $6.63 \times 10^{-34}$ J s |
| unified atomic mass constant | $u$ | = | $1.66 \times 10^{-27}$ kg |
| rest mass of electron | $m_e$ | = | $9.11 \times 10^{-31}$ kg |
| rest mass of proton | $m_p$ | = | $1.67 \times 10^{-27}$ kg |
| acceleration of free fall | $g$ | = | 9.81 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 | $R$ | = | $R_1 + R_2 + \ldots$ |
| resistors in parallel | $1/R$ | = | $1/R_1 + 1/R_2 + \ldots$ |

**Answer all 30 questions in this paper and shade your answers on the answer sheet provided.**

**1** In order to determine the relationship between the weights, *W*, of the loads hung on the spring and the extension, *x*, of the spring, Bobby conducted an experiment by hanging masses of different weights on a spring of a fixed spring constant.

The weights of the masses were determined using an electronic balance that has a positive zero error. Without accounting for the zero error, he then plotted a graph of *W* against *x.* What effect does this have on the graph he plotted?

**A** The gradient of the graph will be smaller than the actual value.

**B** The gradient of the graph will be larger than the actual value.

**C** The y-intercept of the graph will occur below the origin.

**D** The y-intercept of the graph will occur above the origin.

**2** A bird has an initial velocity of 20.0 m $s^{-1}$ in the northerly direction as shown in Fig. 2(a) below. At a later time, its velocity is 20.0 m $s^{-1}$ in the westerly direction as shown in Fig. 2(b).

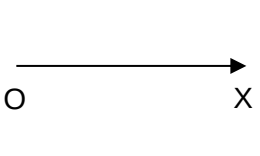



**Fig. 2(a)**


**Fig. 2(b)**

What is the change in velocity that has taken place in this interval, given that directions are indicated by measuring angles anti-clockwise from the direction OX?

**A** 6.32 m $s^{-1}$ at an angle of 135° from OX.

**B** 28.3 m $s^{-1}$ at an angle of 135° from OX.

**C** 28.3 m $s^{-1}$ at an angle of 225° from OX.

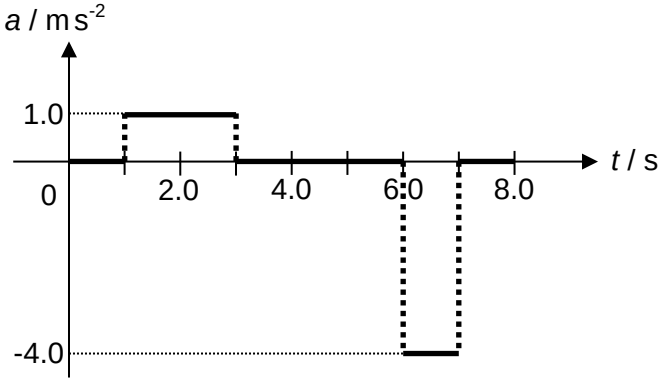
**D** 6.32 m $s^{-1}$ at an angle of 225° from OX.

**3** In a Formula One race, Sebastian Vettel driving the Ferrari race car has to make a pit-stop to re-fuel. After re-fueling, he starts from rest with a constant acceleration of 11.0 m $s^{-2}$ and takes 3.5 s to enter the main speedway from the pit area. At the same instant, another race car on the speedway, driven by Hamilton, traveling at a constant velocity of 69.4 m $s^{-1}$ passes Vettel's car as Vettel enters the speedway.

What is the total time required for Vettel's car to catch up with Hamilton from the time he completes re-fueling? Assume that Vettel maintains a constant acceleration throughout this time.

**A** 5.62 s **B** 9.12 s **C** 12.6 s **D** 16.1 s

**4** An object, initially at rest, moves along a straight line path. The graph below shows the variation of its acceleration, $a$, with time, $t$.




What is the total displacement of the object until $t$ = 8.0 s?

**A** 2.0 m **B** 3.0 m **C** 6.0 m **D** 11 m

**5** The diagram below shows two spheres undergoing a head-on elastic collision. Sphere A has mass 2$M$ while sphere B has mass $M$. Both are moving with speed $v$ towards each other.


Which of the following statements is incorrect?

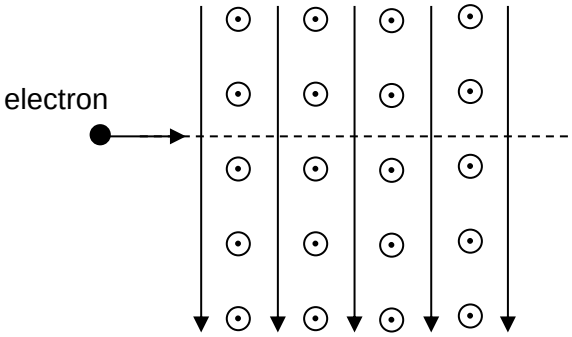
**A** The magnitude of the change in momentum for each sphere is the same after the collision.

**B** The force exerted by sphere A on B is equal and opposite to the force exerted by B on A during the collision.

**C** The total kinetic energy of both spheres is conserved throughout the collision.

**D** The two spheres cannot come to rest at the same time.

**6** An electron is being projected into a cross field. The cross field consists of a unknown field X which points downwards, and a unknown field Y which points out of paper.



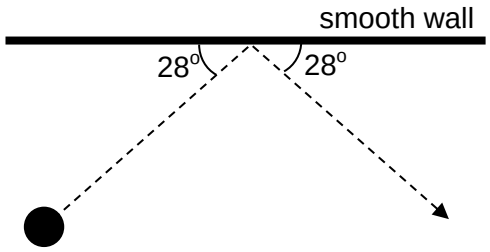

Field X: points downwards

Field Y: points out of paper

If the electron passes through the cross field undeflected, which of the following could be the fields X and Y?

| | Field X | Field Y |
|---|---|---|
| **A** | magnetic | electric |
| **B** | gravitational | electric |
| **C** | electric | magnetic |
| **D** | electric | gravitational |

**7** A sphere of mass 1.2 kg collides elastically with a smooth wall with a speed of 3.2 m $s^{-1}$ at an angle of 28° as shown in the diagram below.




What is the impulse provided by the wall?

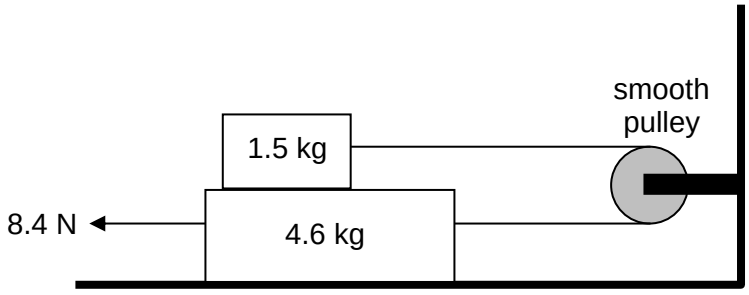
**A** 7.7 N s in a direction towards the wall

**B** 7.7 N s in a direction away from the wall

**C** 3.6 N s in a direction towards the wall

**D** 3.6 N s in a direction away from the wall

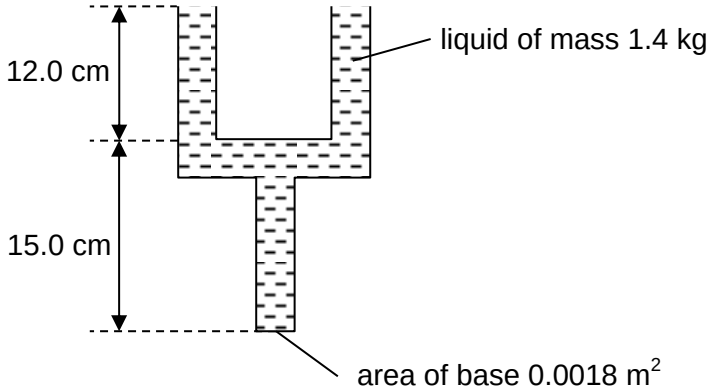
**8** The diagram below shows 2 blocks connected together via a light inextensible string over a smooth pulley. The top block has a mass of 1.5 kg and the bottom block 4.6 kg. The bottom block is pulled with a force of 8.4 N. Assume that all surfaces (except pulley) have a constant frictional force of 1.8 N.




What is the acceleration of the top block?

**A** 0.49 m $s^{-2}$ **B** 0.79 m $s^{-2}$ **C** 1.1 m $s^{-2}$ **D** 1.4 m $s^{-2}$

**9** The diagram shows a special glass tube, filled to the brim with a liquid of mass 1.4 kg and density 650 kg $m^{-3}$. The liquid exerts a pressure on the base of the tube.




What is the pressure exerted due to the liquid on the base of the tube?

**A** $9.6 \times 10^2$ Pa **B** $1.7 \times 10^3$ Pa

**C** $7.6 \times 10^3$ Pa **D** $1.7 \times 10^5$ Pa

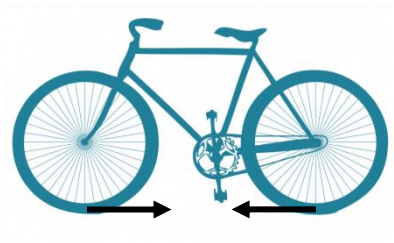
**10** A man peddles on a bicycle along a horizontal road with a constant speed.

Which of the following correctly shows the forces acting on the front and rear wheels due to the road?

**A**

**B**

**C**

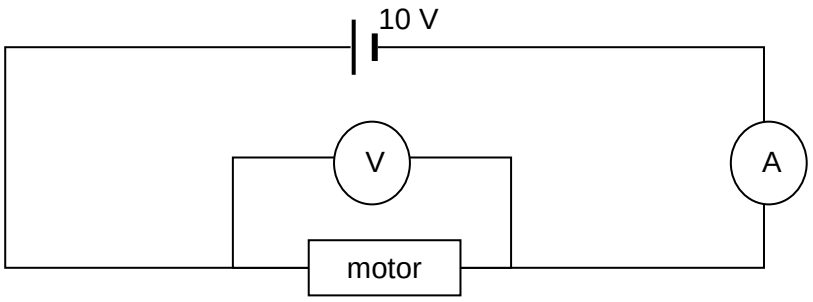


**D**

**11** For an average human, 20 g of blood are pushed into the main arteries in one heartbeat, increasing the speed from 0.20 m $s^{-1}$ to 0.36 m $s^{-1}$. For a heart pulsing at 80 beats per minute, the average power of the heart pump is

**A** 0.34 mW **B** 0.53 mW **C** 1.2 mW **D** 1.7 mW

**12** A motor was powered by a 10 V cell connected in a circuit shown below.

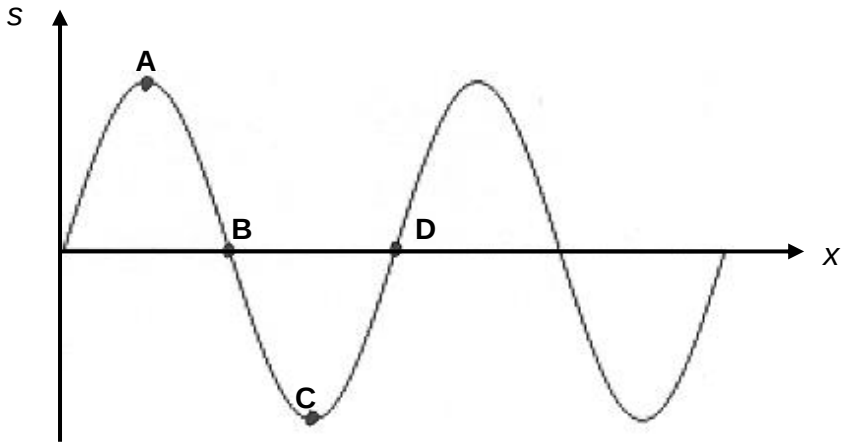



When the voltmeter and ammeter read 9.5 V and 0.50 A respectively, the motor was able to lift a 0.25 kg toy vertically at a speed of 1.0 m $s^{-1}$ with an acceleration of 1.0 m $s^{-2}$.

What is the efficiency of the motor at this instant?

**A** 46 % **B** 52 % **C** 57 % **D** 62 %

**13** The variation of the displacement *s* with position *x* of air molecules along a sound wave is shown below. Taking rightwards as positive, at which position is a rarefaction at the instant shown?




**14** The distance between 2 points of a progressive transverse wave having a phase difference of $\frac{\pi}{3}$ is 40 cm. If the frequency of the wave is 200 Hz, what is the speed of the wave?

**A** 240 m $s^{-1}$ **B** 480 m $s^{-1}$ **C** 24000 m $s^{-1}$ **D** 48000 m $s^{-1}$

**15** When a two-slit arrangement was set up to produce a superposition pattern on a screen using a monochromatic source of green light, the fringes were found to be too close together for accurate observation. It would be possible to increase the separation of the fringes by

**A** replacing the light source with a monochromatic source of red light.

**B** increasing the distance between the source and the slits.

**C** decreasing the distance between the slits and the screen.

**D** increasing the distance between the two slits.

**16** The principle of superposition applies

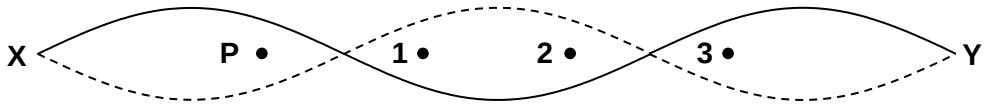
**A** in all cases when similar waves overlap.

**B** only if the waves have the same frequency.

**C** only if the sources of the waves are coherent.

**D** only if the waves are travelling in opposite direction.

**17** A standing wave is set up on a stretched string **XY** as shown in the diagram below.




At which point(s) will the oscillation be out of phase with that at **P**?

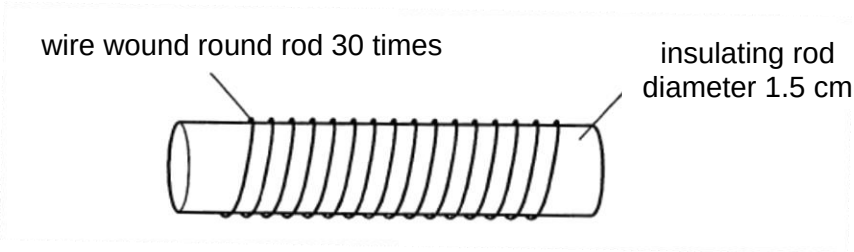
**A** 1, 2 and 3

**B** 1 and 2 only

**C** 1 and 3 only

**D** 2 only

**18** The material of a wire has resistivity 1.3 x $10^{-8}$ Ω m. The wire has diameter 0.50 mm and its length is just enough to enable it to be wound tightly round an insulating rod 30 times. The rod has diameter 1.5 cm.




What is the resistance of the wire?

**A** 1.1 x $10^{1}$ Ω **B** 9.4 x $10^{-2}$ Ω **C** 7.0 x $10^{-4}$ Ω **D** 1.1 x $10^{-5}$ Ω

**19** When a 4.0 Ω resistor is connected between the terminals of a certain cell, a 2.0 A current flows. When the 4.0 Ω resistor is replaced by one of 2.0 Ω, the current is 3.0 A.

The e.m.f. and internal resistance of the cell are respectively

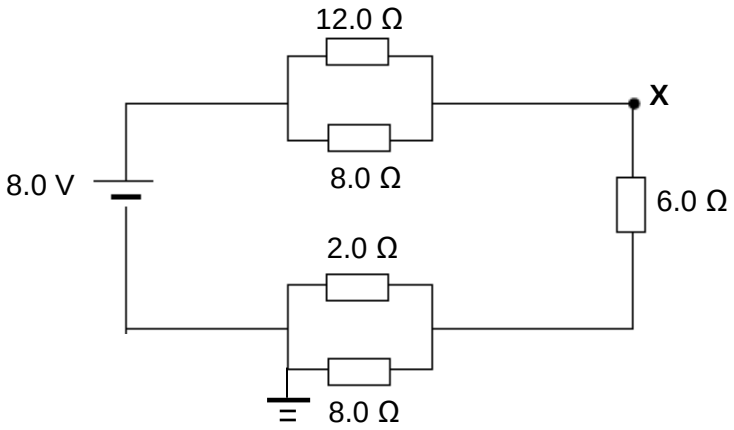
**A** 15 V, 4.0 Ω **B** 12 V, 2.0 Ω **C** 10 V, 1.0 Ω **D** 8.0 V, zero

**20** The potential difference across a bulb is 20 V. During a time of 15 s, the amount of electrical energy converted to other forms of energy is 12 J.

What is the current flowing in the bulb during this time?

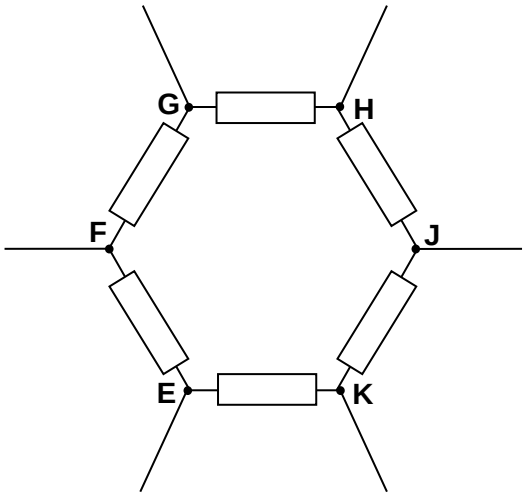
**A** 0.040 A **B** 0.11 A **C** 9.0 A **D** 25 A

**21** What is the value of the potential at point **X** in the circuit below?




**A** 3.1 V **B** − 3.9 V **C** 4.9 V **D** − 7.0 V

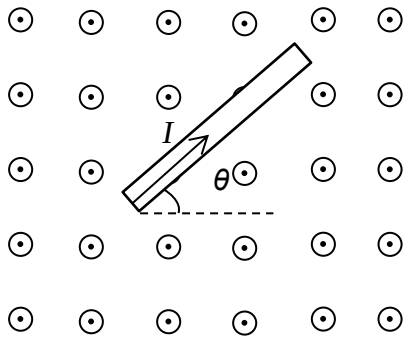
**22** Six identical resistors, each of resistance *R*, are connected as shown in the diagram below.




What is the effective resistance across the points **FH**?

**A** $\frac{R}{6}$ **B** $\frac{3R}{4}$ **C** $\frac{5R}{6}$ **D** $\frac{4R}{3}$

**23** A wire of length 3.5 cm is placed on a vertical plane in a region of magnetic field. Uniform magnetic field of flux density 0.080 T is directed out of the plane as shown. The wire makes an angle $\theta$ with the horizontal and carries a current $I$ of 4.0 A in the direction as shown.




Which of the following is true about the magnitude of the force which the field exerts on the wire at different angles of $\theta$ from 0° to 360°? (assuming that the rod remains in the magnetic field throughout)

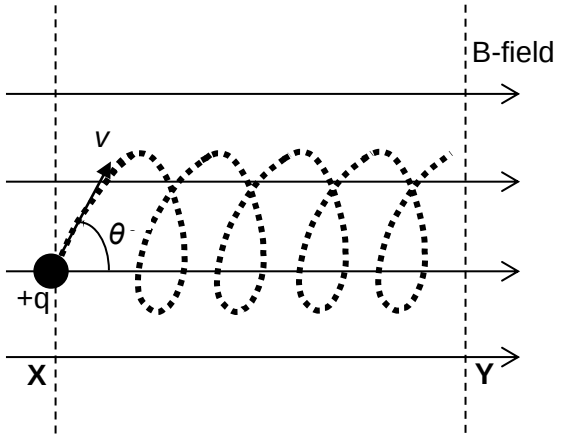
**A** The force is constant at 0 N.

**B** The force varies between 0 N and 0.0112 N.

**C** The force is constant at 0.0112 N.

**D** The force varies between 0.0112 N and 0.0224 N.

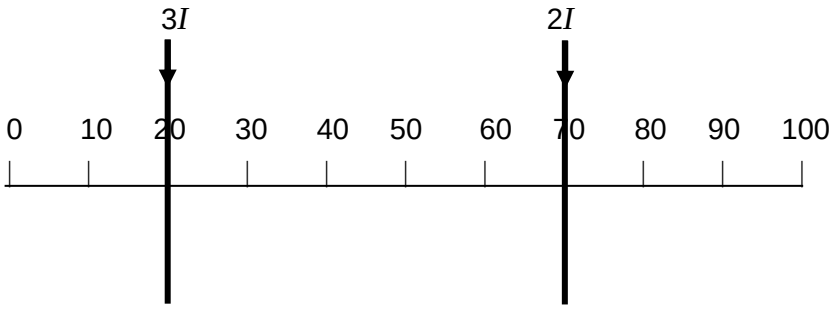
**24** A positively charged particle enters a region of magnetic field at an angle $\theta$ as shown.




How will the time taken for the particle to move from point **X** to **Y** change when the following changes are made independent of one another?

| | B field increased | angle $\theta$ increased |
|---|---|---|
| **A** | unchanged | increase |
| **B** | decrease | unchanged |
| **C** | increase | decrease |
| **D** | unchanged | decrease |

**25** Two parallel, straight conductors, placed at right angles to a metre rule, carry currents of $3I$ and $2I$ flowing in the same direction.




At which marking on the ruler is the resultant magnetic field zero? You may assume that the Earth's magnetic field is negligible.

(Magnetic flux density *B* at a distance *r* from a long, straight conductor is given by $B = \frac{\mu_o I}{2\pi r}$ where $\mu_o$ is the permeability of free space and $I$ is the current in the conductor.)

**A** 0 cm mark

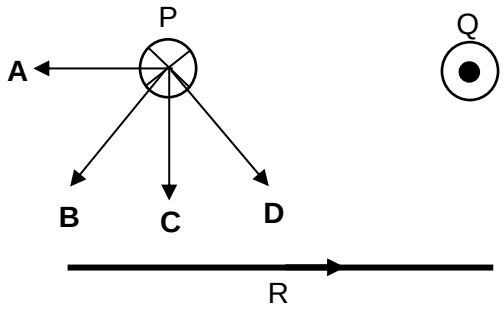
**B** 40 cm mark

**C** 50 cm mark

**D** 90 cm mark

**26** The diagram shows two long straight wires P and Q normal to the plane of the paper and a third wire R that is lying horizontal on the paper. Wires P and Q carry currents directed into the plane of the paper and out of the paper respectively. Wire R carries a current flowing towards the right. All three currents have the same magnitude.

Which arrow best represents the resultant force acting on wire P?




**27** Electrons are emitted from a metal surface when a beam of monochromatic light is incident on it. The intensity of the beam of light is then doubled.

Which one of the following statement is true?

**A** The maximum kinetic energy of the emitted electrons doubles.

**B** Photons of other frequencies are emitted.

**C** The change in momentum of each photon absorbed remains the same.

**D** The number of electrons emitted remains the same.

**28** The work function of a metal is 2.7 eV. Electromagnetic radiation of frequencies ranging from $1.0 \times 10^{14}$ Hz to $9.0 \times 10^{14}$ Hz is incident on the surface of the metal.

What is the maximum kinetic energy of the electrons ejected from the surface of the metal?

**A** 1.0 eV **B** 2.3 eV **C** 3.1 eV **D** 6.4 eV

**29** Which of the following provides evidence for the wave nature of particles?

**A** cathode-ray oscilloscope

**B** vibration of air particles in the transmission of sound

**C** photoelectric effect

**D** electron diffraction

**30** When a parallel beam of white light passes through a cool vapour of mercury, dark lines appear in the spectrum of the emergent light. This is principally because the energy is absorbed and

**A** is not re-radiated at all.

**B** is re-radiated as ultra-violet radiation.

**C** is re-radiated gradually over a long period of time.

**D** is re-radiated uniformly in all directions.

**End of Paper**