MERIDIAN JUNIOR COLLEGE
Preliminary Examination
Higher 1

H1 Physics 8866/1

Paper 1 **24 September 2014**

1 hour

Candidate Name _____ Class | Reg Number

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.

DATA AND FORMULAE

Data

speed of light in free space	c	=	3.00×10^{8} m s^{-1}
elementary charge	e	=	1.60×10^{-19} C
the Planck constant	h	=	6.63×10^{-34} J s
unified atomic mass constant	u	=	1.66×10^{-27} kg
rest mass of electron	m_e	=	9.11×10^{-31} kg
rest mass of proton	m_p	=	1.67×10^{-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	=	ρgh
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 a simple electrical circuit, the current in a resistor is measured as (2.50 ± 0.05) mA. The resistor has a resistance of 4.7 Ω ± 2 %.

If these values were used to calculate the power dissipated in the resistor, what would be the percentage uncertainty of the power?

A 4 % **B** 5 % **C** 6 % **D** 7 %

2 A metal sphere of radius *r* is dropped into a tank of water. As it sinks at speed *v*, it experiences a drag force *F* given by $F = krv$, where *k* is a constant.

What are the SI base units of *k*?

A kg m^2 s^{-1} **B** kg m^{-2} s^{-2} **C** kg m^{-1} s^{-1} **D** kg m s^{-2}

3 Which is the best estimate of the mean kinetic energy of an Olympic athlete during a 200 m race?

A 4×10^2 J **B** 4×10^3 J **C** 4×10^4 J **D** 4×10^5 J

4 A stone is thrown at an angle and follows a parabolic path. The highest point reached is A and the point just before it reaches the ground is B.

Assuming that air resistance is negligible, the vertical acceleration of the stone is

A zero at A.

B greatest at A.

C greatest at B.

D the same at A and B.

5 A car travelling with uniform acceleration along a straight road. The road has marker posts every 100 m. When the car passes one post, it has a speed of 10 m s^{-1}, and when it passes the next one, it has 20 m s^{-1}.

What is the car's acceleration?

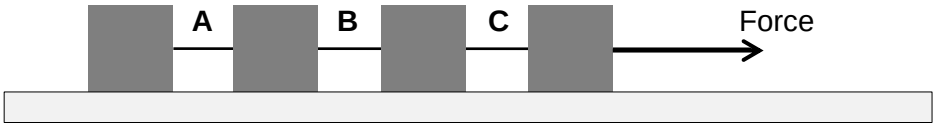
A 0.67 m s^{-2} **B** 1.5 m s^{-2} **C** 2.5 m s^{-2} **D** 6.0 m s^{-2}

6 A stone is dropped from the top of a tower of height 50 m. The stone falls from rest and air resistance is negligible.

What time is taken for the stone to fall the last 15 m to the ground?

A 0.52 s **B** 1.7 s **C** 2.7 s **D** 3.2 s

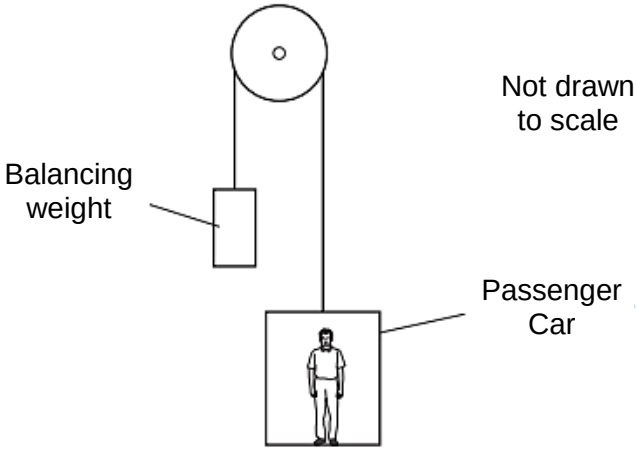
7 The diagram below shows 4 identical wooden blocks connected by inelastic strings, **A, B** and **C**. A constant force accelerates the blocks to the right on a horizontal frictionless table.



Which string has the greatest tension?

A String **A** **B** String **B** **C** String **C** **D** All have the same tension

8 An elevator consists of a passenger car of mass 520 kg, supported by a cable that runs over a light, frictionless pulley to a balancing weight of mass 640 kg. The balancing weight falls as the passenger car rises. The passenger has a mass of 80 kg.



Calculate the magnitude of the acceleration of the passenger car as it rises.

A 0.032 m s^{-2} **B** 0.32 m s^{-2} **C** 0.65 m s^{-2} **D** 0.75 m s^{-2}

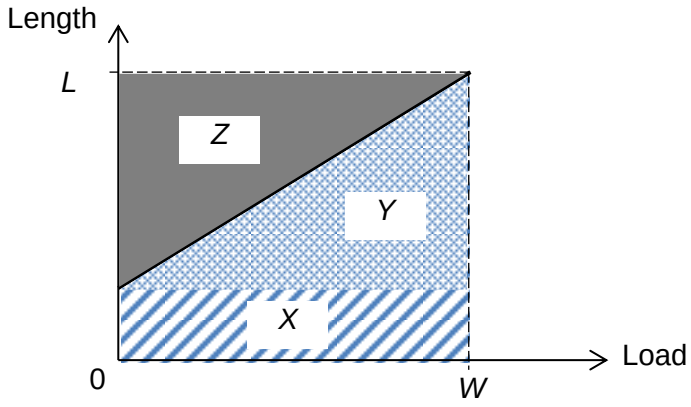
9 A particle of mass *m* travels with a velocity +*u* towards a stationary particle of mass 5*m* and collides elastically with it.

What is the velocity of the particle mass *m* after the collision?

A *u* **B** -0.67 *u* **C** -*u* **D** -1.5 *u*

For questions 10 and 11, refer to the following information and graph.

The graph below shows the variation of the length of a spring with the load attached to it. For a load *W*, the length of the spring is *L*.



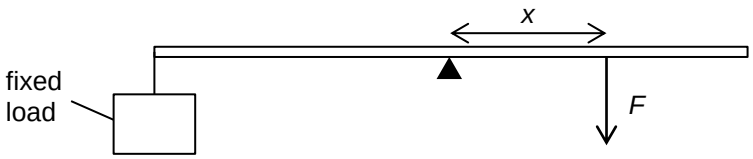
10 Which of the following areas on the graph represents the energy stored in the spring when it is stretched to a length *L*?

A X
B Y - X
C X + Y
D Z

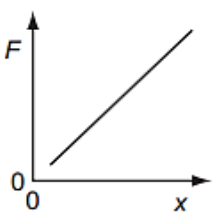
11 The spring constant of the spring is given by

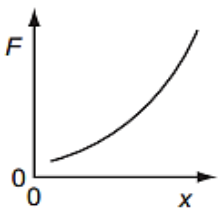
A The gradient of the graph
B The inverse of the gradient of the graph
C ratio of *W* to *L*
D ratio of *L* to *W*

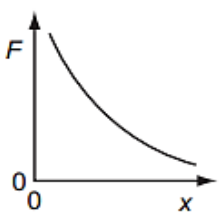
12 A horizontal ruler is supported on a pivot at its centre of gravity. A fixed load is attached to one end. To keep the bar in equilibrium, a force, *F*, is applied at distance, *x,* from the pivot as shown below.

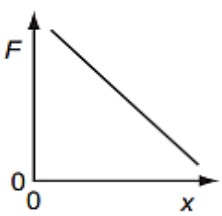


How does *F* vary with *x*?

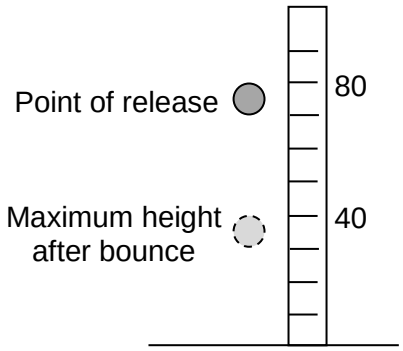
A


B


C


D


13 A rubber ball has a diameter of 10 cm. It is released from rest with the top of the ball 80 cm above a horizontal surface. It falls vertically and then bounces back up so that the maximum height reached by the top of the ball is 40 cm, as shown in the diagram below.



If the kinetic energy of the ball is 0.80 J just before it strikes the surface, what is the kinetic energy just after it leaves the surface?

A 0.34 J **B** 0.37 J **C** 0.40 J **D** 0.46 J

14 The force resisting the motion of a car is taken as being proportional to the square of the car's speed. At a speed of 30 m s^{-1}, the resistive force is 1800 N.

What is the effective power required from the car's engine to maintain a steady speed of 15 m s^{-1}?

A 0.45 kW **B** 6.8 kW **C** 7.2 kW **D** 14 kW

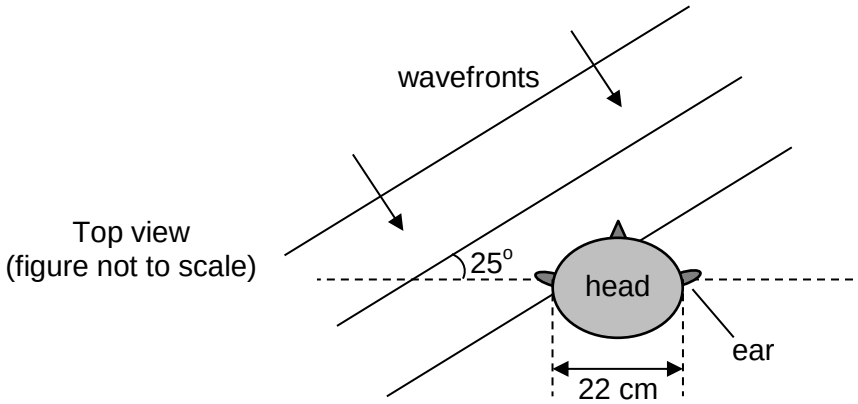
15 Alice is standing 15 m away from a speaker listening to a music broadcast. Due to a technical fault, the power of the speaker is suddenly reduced by 25%.

How far away from the speaker should Alice stand now in order for the music to be as loud as before? Assume that the speaker is a point source of sound.

A 13 m **B** 11 m **C** 7.5 m **D** 3.8 m

16 Humans are able to detect the general direction of a sound source because sound from the source reaches the ear at slightly different times.

The figure below shows a human head with the ears 22 cm apart. Sound waves of wavelength 1.7 m from a distant source reach the head at an angle of 25°.



What is the phase difference between the waves reaching the left and right ear?

A 0.34 rad **B** 0.58 rad **C** 0.74 rad **D** 0.81 rad

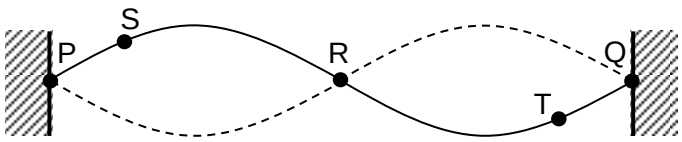
17 A sound source is placed several metres from a plane reflecting wall in a large chamber containing a gas. A microphone connected to a cathode-ray oscilloscope (CRO) is used to detect nodes and antinodes along the line from the source to the wall. The microphone is moved from one node through 15 antinodes to another node, a distance of 1.2 m.

On the CRO, the time-base is set to 0.50 ms cm^{-1}, and the distance between 5 consecutive crests is 8.5 cm.

What is the speed of sound in this gas?

A 150 m s^{-1} **B** 300 m s^{-1} **C** 320 m s^{-1} **D** 400 m s^{-1}

18 The figure below shows a string with ends fixed to P and Q. The string is made to vibrate transversely so that P, Q and the mid-point R are the only points that are nodes.



Which of the following statements is true?

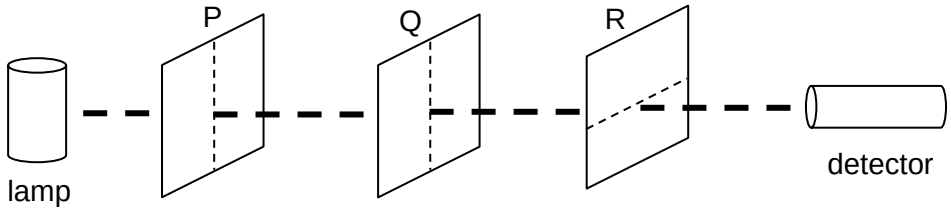
A All the points on the string between P and R have the same amplitude.

B The phase difference between S and T is more than π but less than 2π.

C The distance between P and R gives the wavelength of the wave.

D It is possible to set up another standing wave of a lower frequency between P and Q.

19 Three polaroid sheets P, Q and R are placed along a straight line with a lamp and a detector as shown. Initially the axes of polarisation of P and Q are parallel but are both perpendicular to that of R.



What happens to the intensity I recorded by the detector when Q is being rotated slowly through 90° until its axis of polarisation is parallel to that of R?

A I remains unchanged throughout.

B I increases throughout.

C I decreases then increases.

D I increases then decreases.

20 A high electric potential is applied between two electrodes of a mercury discharge tube so that the gas is ionised. Electrons then move towards the positive electrode and protons towards the negative electrode. In each second, 7.0×10^{18} electrons and 2.0×10^{18} protons pass a cross-sectional area of the tube.

What is the current flowing in the discharge tube?

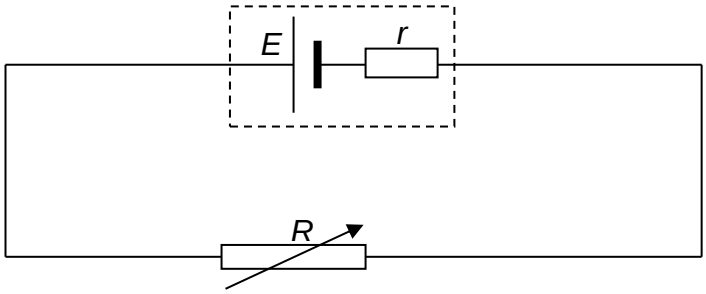
A 0.32 A **B** 0.80 A **C** 1.12 A **D** 1.44 A

21 Two rods of different material, copper and tungsten are designed to have the same length and same resistance. The resistivity of tungsten is three times that of copper and its density is twice that of copper. What is the ratio of the mass of the tungsten rod to the mass of the copper rod?

A 1/6 **B** 2/3 **C** 3/2 **D** 6

For questions 22 and 23, refer to the diagram below.

A battery of e.m.f *E* and internal resistance *r* is connected to a variable resistor *R* as shown below. When *R* = 16 Ω, the current in the circuit is 0.50 A. It is found that the battery supplies 4500 J of energy for a duration of 1.0×10^3 s.



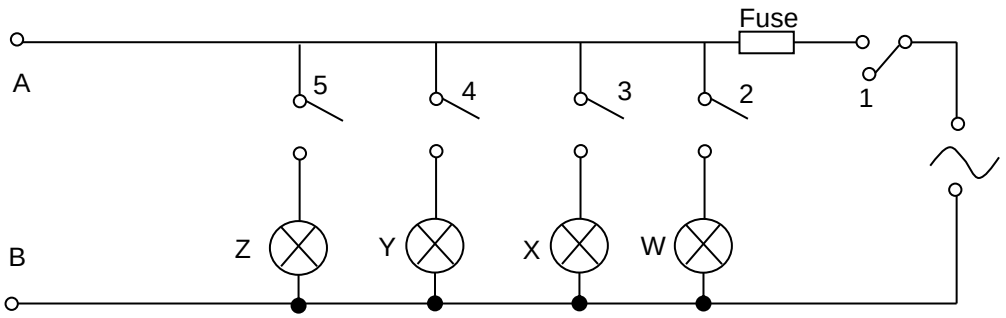
22 What is the emf of the battery?

A 9.0 V **B** 10.0 V **C** 11.0 V **D** 12.0 V

23 What is the internal resistance *r* ?

A 1.0 Ω **B** 2.0 Ω **C** 4.5 Ω **D** 9.0 Ω

24 A lighting circuit consists of four lamps connected as shown in the figure below. The resistance of each lamp is 120 Ω.



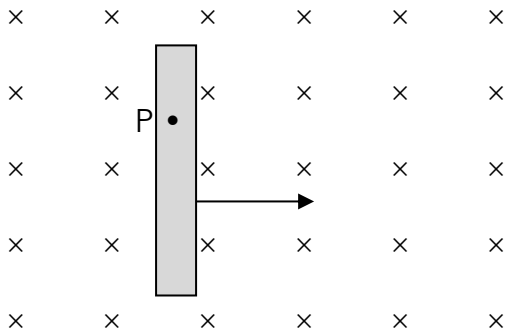
A fault is discovered in the circuit, so switch 1 is opened and the fuse is removed for safety. A resistance meter is connected between the point A and B and the following readings are obtained for different switch positions.

Switches					**Resistance Meter Reading/ Ω**
1	**2**	**3**	**4**	**5**	
open	open	open	open	open	14600000
open	close	open	open	close	0.4
open	open	open	close	close	60
open	open	close	close	open	60
open	close	close	close	open	0.2

Which of the lamp is most likely faulty?

A Z **B** Y **C** X **D** W

25 A metal rod is moving at a steady speed perpendicular to magnetic field as shown. An electron in the rod is represented by the dot marked P.



While the rod moves steadily, the electron experiences

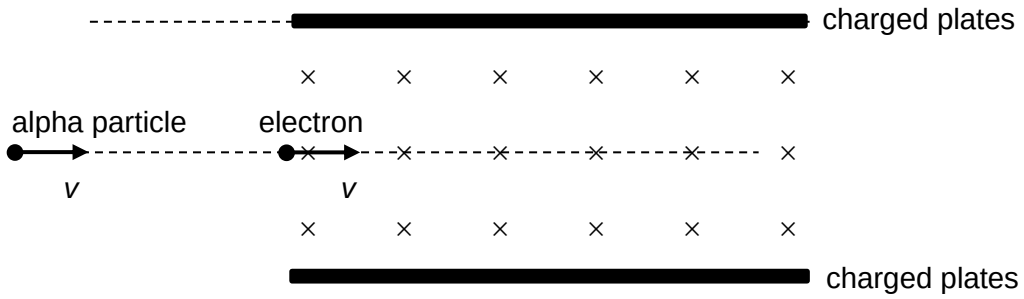
A gravitational force only

B magnetic force only

C gravitational and magnetic force

D gravitational, magnetic and electrostatic force

26 An electron enters the vacuum between two oppositely charged plates with velocity v. The electron is followed by an alpha particle moving with the same initial velocity as the electron. A uniform magnetic field is directed into the plane of the paper.



The electron's path is undeflected. The path of the alpha particle will be

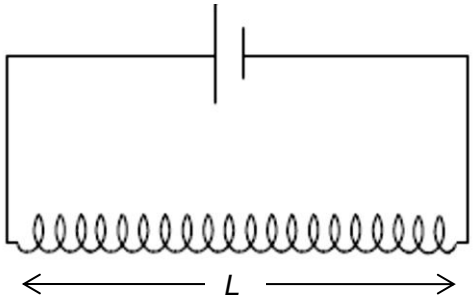
A undeflected

B deflected upward

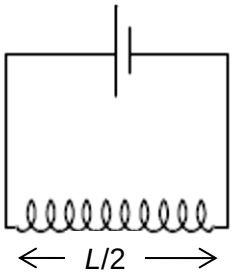
C deflected downward

D deflected into the plane of the paper

27 The diagram shows a long solenoid of length *L* connected to a battery of negligible internal resistance. The magnetic field strength at the centre of the solenoid is *T*.



The solenoid is now disconnected from the battery and cut in half and one of the halves is reconnected to the same battery as shown below.

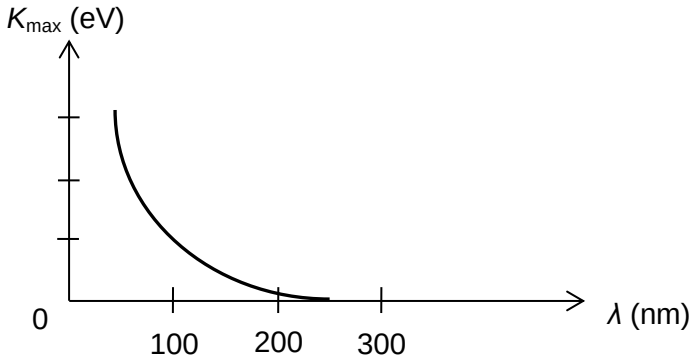


Given that the magnetic field strength at the centre of a solenoid is equal to $\mu_0 nI$, where *n* is the number of turns per unit length and I is the current through the coil.

The field strength of this solenoid is

A *T*/2 **B** *T* **C** 2*T* **D** 4*T*

28 In a photoelectric experiment, the maximum kinetic energy of the ejected photoelectrons is measured for various wavelength of incident electromagnetic radiation. A graph of this maximum kinetic energy, K_{max}, as a function of the wavelength λ of the incident electromagnetic radiation falling on the surface of a metal is shown below. What is the work function for this metal?



A 4.97 eV **B** 6.22 eV **C** 7.96 eV **D** 24.9 eV

29 A hypothetical atom has three energy levels: the ground level and 2.00 eV and 3.00 eV above the ground level. A gas of these atoms was heated. Which of the following wavelengths of the emission spectral lines would not be detected?

A 414 nm **B** 622 nm **C** 1034 nm **D** 1240 nm

30 What is the kinetic energy of a proton that has a de Broglie wavelength of 0.200 nm?

A 3.29×10^{-21} J **B** 6.58×10^{-21} J **C** 3.29×10^{-27} J **D** 6.58×10^{-27} J

End of Paper