VICTORIA JUNIOR COLLEGE
2016 JC2 PRELIMINARY EXAMINATIONS

PHYSICS
Higher 1

8866/01
22 Sep 2016
Thursday

Paper 1 Multiple Choice

1 Hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, CT group and index 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 Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

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 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,	$s = ut + (½)\, at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
hydrostatic pressure,	$p = h\rho g$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$

1 A power station generates power of 3.0 GW. What is the energy produced for a time interval of 2.0 ps?

A 6.0×10^{-15} TJ **B** 6.0×10^{-6} MJ
C 6.0×10^{3} nJ **D** 6.0×10^{6} μJ

2 The perpendicular sides of a right angle triangle have lengths (9.0 ± 0.2) cm and (7.0 ± 0.2) cm. The length of the hypotenuse is calculated from these two measurements. What is the uncertainty of the length of the hypotenuse?

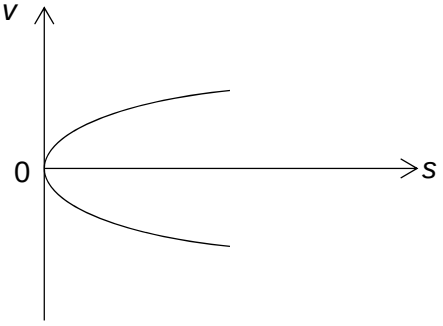
A ± 0.2 cm **B** ± 0.3 cm **C** ± 0.4 cm **D** ± 0.5 cm

3 Ah Seng wanted to measure the period of a pendulum, but he did not have a stopwatch. So he used a wall clock instead. He noted the start time for 20 oscillations to be (12.0 ± 0.5) s, and the stop time to be (57.0 ± 0.5) s. What is the period of the pendulum?

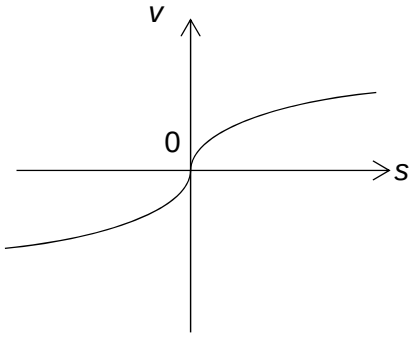
A (2.25 ± 0.03) s **B** (2.25 ± 0.05) s
C (2.3 ± 0.5) s **D** (2 ± 1) s

4 A ball is released from point P, and bounces once on the floor. Which of the following graphs correctly shows how its velocity *v* varies with displacement *s* with respect to P?

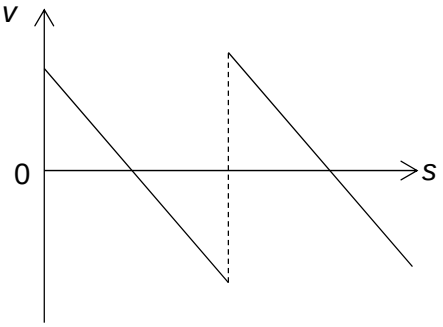
A



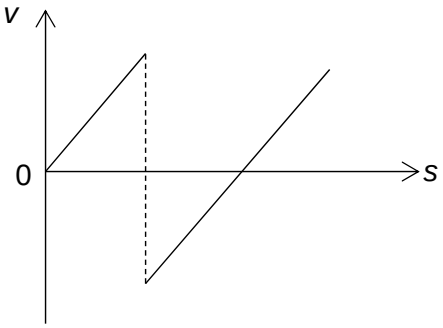
B



C



D



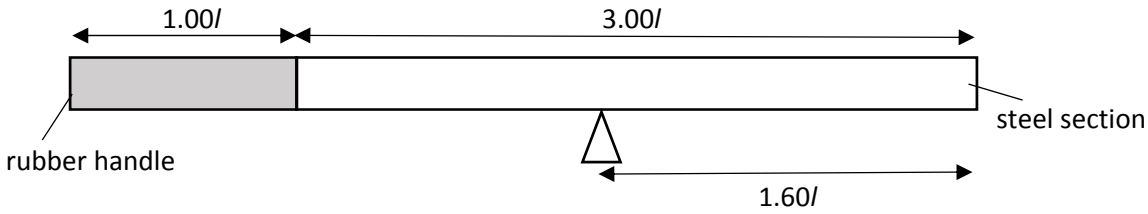
5 A stone is thrown at a velocity of 12 m s^{-1} at an angle of 25° above the horizontal. What is the magnitude of the change in velocity from its starting point to the highest point in its path?

A 1.1 m s^{-1} **B** 5.1 m s^{-1} **C** 5.8 m s^{-1} **D** 12 m s^{-1}

6 Ash was trying to catch a pokemon when he accidentally jumped off a cliff with a velocity of 8.50 m s^{-1} at an angle of 40.0° above the horizontal. The cliff has a height of 15.0 m.
How long does it take before he 'reaches' the bottom of the cliff?

A 1.28 s **B** 2.39 s **C** 2.53 s **D** 2.81 s

7 A uniform rod has a steel section and a solid rubber handle, as shown.

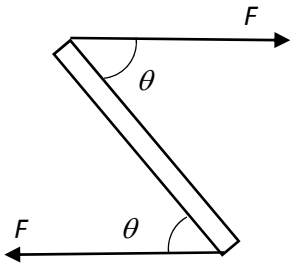


The length of the handle is *l* and the length of the steel section is 3.00*l*. The rod balances a distance 1.60*l* from the steel end.

What is the $\frac{\text{density of steel}}{\text{density of rubber}}$?

A 0.158 **B** 1.90 **C** 3.00 **D** 6.33

8 Equal and opposite forces of magnitude *F* are applied to the ends of a ruler of length *L*, creating a couple as shown in the diagram.



What is the torque of the couple on the ruler when it is in the position shown?

A $FL\cos\theta$
B $FL\sin\theta$
C $2FL\cos\theta$
D $2FL\sin\theta$

9 A helicopter rises vertically with a constant speed. According to Newton's third law, the reaction force to the weight of the helicopter is

A the lift force created by the engine of the helicopter.

B the gravitational force on the Earth due to the helicopter.

C the air resistance on the helicopter as it rises up.

D the upthrust acting on the helicopter due to air around it.

10 Particle X has a mass m and particle Y has a mass $3m$. They travel at equal speed v but in opposite direction along a smooth horizontal surface, and then collide head-on elastically.

Which of the following statements is false?

A The total kinetic energy of the system consisting of the two particles is not conserved throughout the duration of the collision.

B The total energy of the system consisting of the two particles is conserved throughout the duration of the collision.

C The total momentum of the system consisting of the two particles is always conserved except during time of collision due to the presence of collision forces between the two particles.

D The relative speed of separation after the collision is $2v$.

11 The graph in Fig 11 shows how the force *F* acting on a car varies with time *t* while it is traveling for 50 s. The mass of the car is 1000 kg.

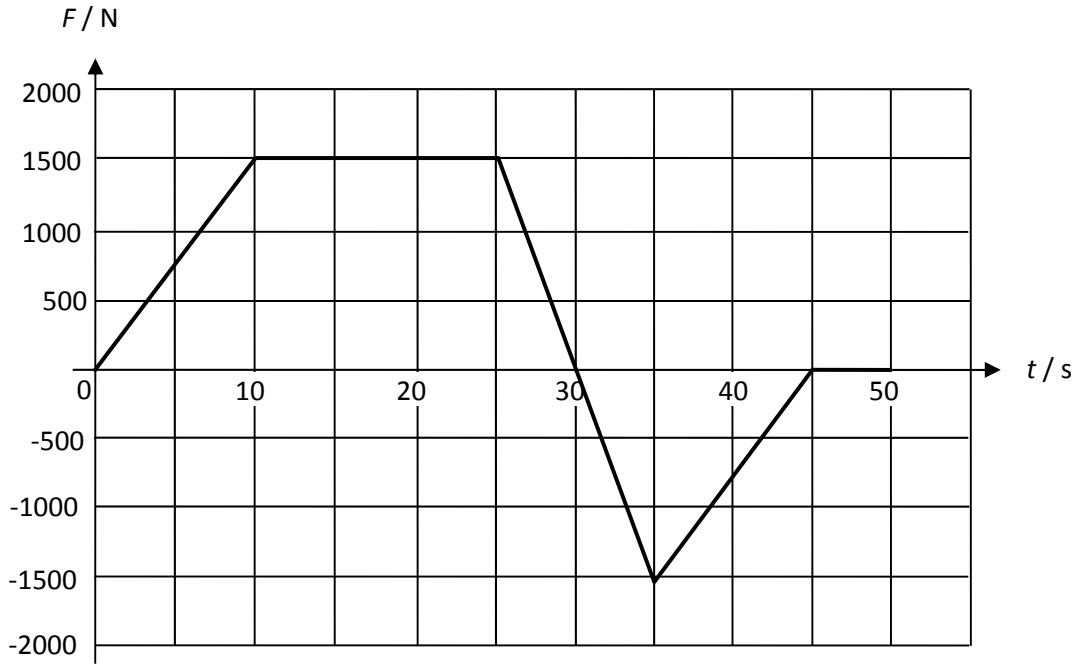


Fig 11

What is the velocity of the car at t = 50 s if it had an initial velocity of 10 m s^{-1} at t = 0 s?

A 10.8 m s^{-1}
B 22.5 m s^{-1}
C 32.5 m s^{-1}
D 55.0 m s^{-1}

12 An object of weight 50 N is dragged up an inclined plane at constant speed of 5.0 m s^{-1}, through a vertical height of 12 m. The total work done is 1500 J.

The work done against friction is

A 600 J **B** 840 J **C** 900 J **D** 1500 J

13 A speed-boat with two engines, each of power output 30 kW, can travel at a maximum speed of 10 m s^{-1}. The total drag *D* on the boat is related to the speed *v* of the boat by the equation shown.

$$D \propto v^2$$

What is the maximum speed of the boat when only one engine is working?

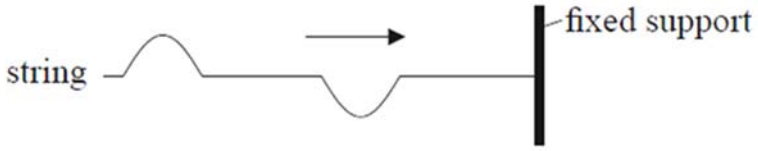
A 2.5 m s^{-1} **B** 5.0 m s^{-1} **C** 7.1 m s^{-1} **D** 7.9 m s^{-1}

14 An electric railway locomotive has a maximum mechanical output power of 4.0 MW. Electrical power is delivered at 25 kV from overhead wires. The overall efficiency of the locomotive in converting electrical power to mechanical power is 80%.

What is the current from the overhead wires when the locomotive is operating at its maximum power?

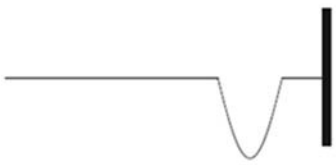
A 130 A **B** 160 A **C** 200 A **D** 250 A

15 A string is held horizontally with one end attached to a fixed support. Two pulses are created at the free end of the string. The pulses are moving towards the fixed support as shown in the diagram below.



Which one of the following diagrams is a possible subsequent picture of the string?

A

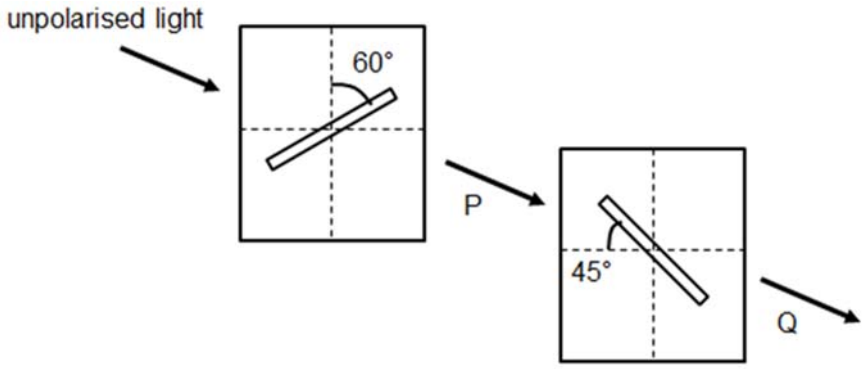


B

C

D

16 A beam of unpolarised light with amplitude *A* and intensity *I* is passed through two optical polarisers. The first polariser's transmission axis is oriented at 60° to the vertical, while the second polariser's transmission axis is oriented at 45° to the horizontal.



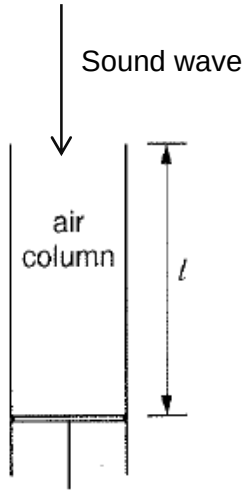
What is the intensity of the light at P and amplitude of the light at Q?

	Intensity of light at P	**Amplitude of light at Q**
A	$\frac{1}{\sqrt{2}}I$	$\frac{1}{2}A\sin 15^\circ$
B	$\frac{1}{\sqrt{2}}I$	$\frac{1}{2}A\cos 15^\circ$
C	$\frac{1}{2}I$	$\frac{1}{\sqrt{2}}A\cos 15^\circ$
D	$\frac{1}{2}I$	$\frac{1}{\sqrt{2}}A\sin 15^\circ$

17 A point source of sound emits energy equally in all directions at a constant rate and a detector placed 3.0 m from the source measures an intensity of 5.0 W m^{-2}. The amplitude at the source is then doubled. What intensity, in W m^{-2}, would the detector measure if it is now placed at a distance 4.0 m from the source?

A 0.45 **B** 0.56 **C** 11 **D** 15

18 A sound wave of constant wavelength is continuously transmitted into an air column. The length *l* of the air column is slowly increased from zero.

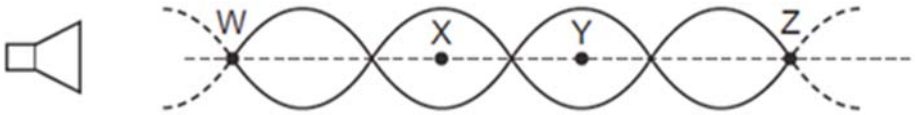


When *l* reaches certain values, the sound heard from the air column increases greatly in volume. *l* is found to be 15 cm when the sound increases greatly for the third time.

What is the wavelength of the sound wave?

A 7.5 cm **B** 10 cm **C** 12 cm **D** 20 cm

19 The diagram represents a stationary wave formed by the superposition of sound waves from a loudspeaker and their reflection from a metal sheet (not shown).



W, X, Y and Z are four points on the line through the centre of this wave.

Which statement about this stationary wave is correct?

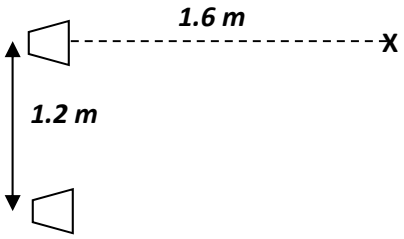
A A displacement antinode is formed at the surface of the metal sheet.

B A node is a quarter of a wavelength from an adjacent antinode.

C The oscillations at X are in phase with those at Y.

D The particles of the waves oscillate at right angles to the line WZ

20 Two loudspeakers are placed 1.2 m apart as shown below. Both speakers are operating in phase and are giving out a steady frequency of 400 Hz. Point X is 1.6 m from one speaker. The speed of sound can be taken as 320 ms^{-1}



Which of the following is correct about point X?

A It has maximum intensity.

B It has intensity between minimum and maximum.

C It has minimum intensity.

D It has intensity that varies from minimum to maximum periodically.

21 The electrical potential difference between two points in a wire carrying a current may be defined as

A the product of the current squared and the resistance between the two points.

B the ratio of the energy expended to the current between the points.

C the ratio of the power supplied to the current between the points.

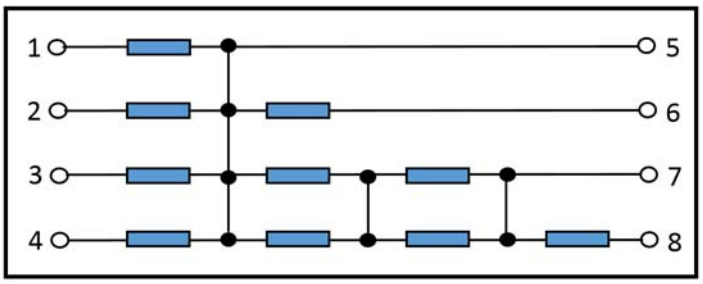
D the ratio of the power supplied to the charge moved between the points.

22 The resistivity of aluminium is 2.0 times that of silver. An aluminium wire of length *L* and diameter *d* has resistance *R*.

What is the diameter of a silver wire, also of length *L* and resistance *R*?

A 0.50*d* **B** 0.71*d* **C** 1.4*d* **D** 2.0*d*

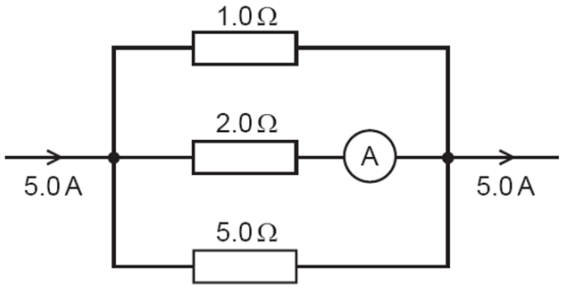
23 The diagram below shows an 8-pin resistor package consisting of 10 identical resistors, each of resistance 1.00 Ω, connected together.



What is the effective resistance across pins 4 and 7?

A 0.333 Ω **B** 1.25 Ω **C** 2.00 Ω **D** 5.00 Ω

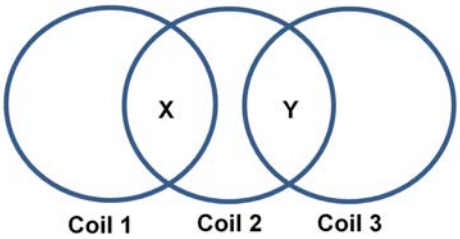
24 The diagram shows part of a current-carrying circuit. The ammeter has negligible internal resistance.



What is the reading on the ammeter?

A 0.70 A **B** 1.3 A **C** 1.5 A **D** 1.7 A

25 Three insulated coils of wires are placed on top of one another such that there are overlapping regions. Each of the coils carries identical current but their directions are unknown. Region X is found to have a resultant magnetic field pointing out of the paper while region Y is found to have a magnetic flux density of near zero.

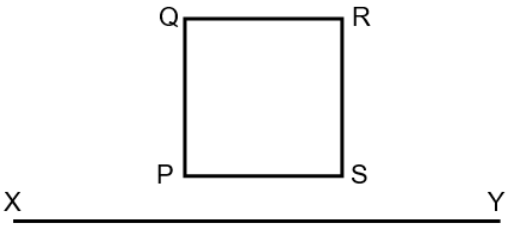


Which of the following is a possible configuration of the direction of flow of the currents in the coils?

	Coil 1	**Coil 2**	**Coil 3**
A	Clockwise	Clockwise	Counterclockwise
B	Clockwise	Counterclockwise	Counterclockwise
C	Counterclockwise	Clockwise	Clockwise
D	Counterclockwise	Counterclockwise	Clockwise

A long straight wire XY lies in the same plane as a square loop of wire PQRS which is free to move. T

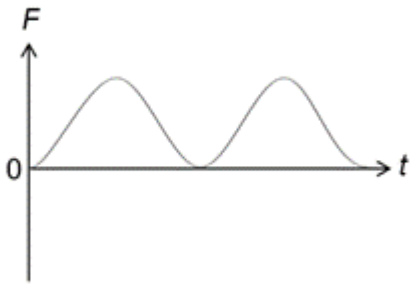
26 A long straight wire XY lies in the same plane as a square loop of wire PQRS which is free to move. The sides PS and QR are parallel to XY.



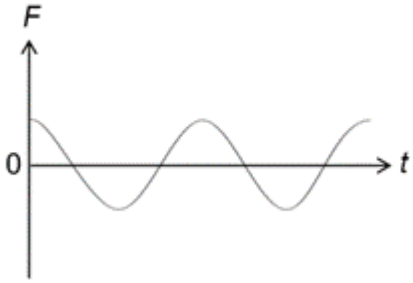
Both the wire and loop carry equal sinusoidal alternating currents. The currents in XY and side QR differ in phase by π rad.

Which one of the following graphs shows the variation with time *t* of the *resultant force of attraction F* between the wire and the loop?

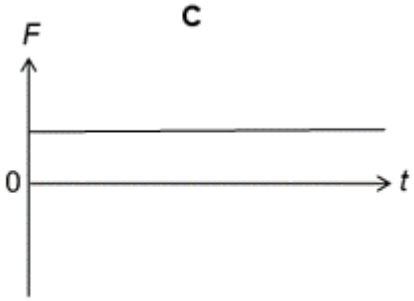
A



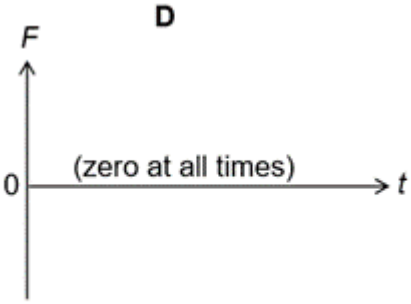
B



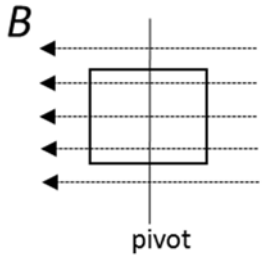
C



D



27 A 20-turns square coil of side 8.0 mm is pivoted at its centre and placed in a magnetic field of flux density, B = 0.010 T such that two sides of the coil are parallel to the field and two sides of the coil are perpendicular to the field as shown below. A current of 5.0 mA is passed through the coil.



What is the magnitude of the torque acting on the square coil?

A 1.6×10^{-9} N m

B 3.2×10^{-8} N m

C 6.4×10^{-8} N m

D 3.2×10^{-5} N m

28 What is the de Broglie wavelength of a proton moving with a speed of 1.5×10^{7} m s^{-1}?

A 1.3×10^{-15} m
B 2.6×10^{-14} m
C 4.9×10^{-11} m
D 8.0×10^{-6} m

29 When a metal is irradiated with monochromatic radiation, electrons are emitted. Which of the following will increase if the frequency of the radiation is increased?

A The threshold frequency of the metal.
B The rate of emission of electrons.
C The stopping potential of the electrons.
D The maximum speed of the photons.

30 A mercury vapour lamp is rated at 60 W. Of the power supplied, 15% is emitted as blue light of wavelength 4.4×10^{-7} m.

How many quanta of the blue light are emitted per second from this lamp?

A 1.4×10^{19}
B 2.0×10^{19}
C 1.3×10^{20}
D 5.0×10^{20}