For 2016, only Q1 to Q22 are relevant.

Candidate's Name ………………….…………………………   CTG **1**…........

YISHUN JUNIOR COLLEGE
JC1 PROMOTIONAL EXAMINATION 2014

PHYSICS 9646/1B

HIGHER 2 **15 October 2014**
Paper 1B **Wednesday**
0845h – 0935h
50 minutes

Additional Materials:
Optical Mark Sheet

INSTRUCTIONS TO CANDIDATES

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

Write your name and CTG on the Optical Mark Sheet in the spaces provided.
Shade your NRIC in the space provided.

There are **twenty five** questions in 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 Optical Mark Sheet.

Read the instructions on the Optical Mark Sheet carefully.

INFORMATION FOR CANDIDATES

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.

This question paper consists of **12** printed pages.

Data

speed of light in free space,	c	=	3.00×10^{8} m s^{-1}
permeability of free space,	μ_o	=	$4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space,	ε_0	=	8.85×10^{-12} F m^{-1}
			$(1/(36\pi)) \times 10^{-9}$ F m^{-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
molar gas constant,	R	=	8.31 J K^{-1} mol^{-1}
the Avogadro constant,	N_A	=	6.02×10^{23} mol^{-1}
the Boltzmann constant,	k	=	1.38×10^{-23} J K^{-1}
gravitational constant,	G	=	6.67×10^{-11} N m^{2} kg^{-2}
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	=	$\rho g h$
gravitational potential,	ϕ	=	$-\frac{Gm}{r}$
displacement of particle in s.h.m.	x	=	$x_o \sin \omega t$
velocity of particle in s.h.m.,	v	=	$v_o \cos \omega t$
		=	$\pm \omega \sqrt{(x_o^2 - x^2)}$
mean kinetic energy of a molecule of an ideal gas,	E	=	$\frac{3}{2}kT$
resistors in series,	R	=	$R_1 + R_2 + \ldots\ldots\ldots$
resistors in parallel,	$\frac{1}{R}$	=	$\frac{1}{R_1} + \frac{1}{R_2} + \ldots\ldots$
electric potential,	V	=	$\frac{Q}{4\pi\varepsilon_o r}$
alternating current/voltage,	x	=	$x_o \sin \omega t$
transmission coefficient	T	=	$\exp(-2kd)$
	where k	=	$\sqrt{\frac{8\pi^2 m(U-E)}{h^2}}$
radioactive decay,	x	=	$x_o \exp(-\lambda t)$
decay constant,	λ	=	$\frac{0.693}{t_{\frac{1}{2}}}$

1 Which of the following pair includes a vector quantity and a scalar quantity?

A velocity; momentum

B thermal energy; speed

C force; power

D work; distance

2 A student, wishing to find the density of a cuboid, measures the mass and the linear dimensions of the cuboid. The cuboid was found to have a mass of (50.0 ± 0.1) g, length of (3.00 ± 0.01) cm, breadth of (1.00 ± 0.01) cm and height of (2.00 ± 0.01) cm.

Which measurement gives rise to the smallest percentage uncertainty in the value for its density?

A Mass **B** Length **C** Breadth **D** Height

3 Two small identical objects **P** and **Q** are released from rest from the top of a building 80 m above the ground. **Q** is released 1.0 s after **P**. Neglecting air resistance, what is the maximum vertical separation between **P** and **Q** in the air?

A 5 m **B** 10 m **C** 35 m **D** 45 m

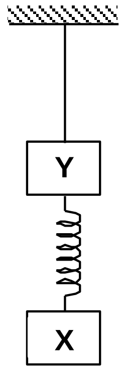
4 A sphere is fired horizontally from the top of a cliff with a speed of 10 m s^{-1}. Assuming that air resistance is negligible, what is its speed 5.0 s after it is fired?

A 10 m s^{-1} **B** 49 m s^{-1} **C** 50 m s^{-1} **D** 60 m s^{-1}

5 A stone is projected at an angle of 45^{o} above the horizontal with an initial kinetic energy E. Neglecting air resistance, when the stone is halfway up, its kinetic energy is

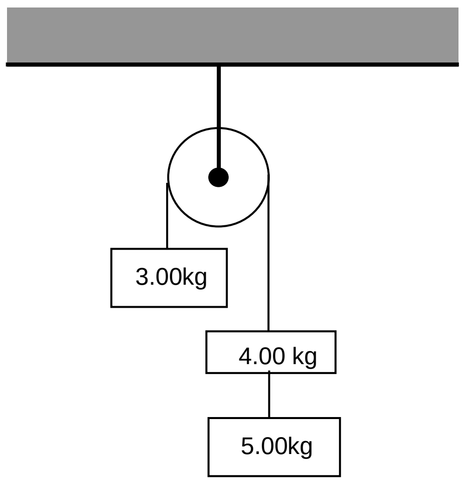
A E/4 **B** E/2 **C** E/√2 **D** 3E/4

6 Two identical blocks **X** and **Y** are connected by a light spring and the system is suspended from a fixed support by a light cord as shown. The system is in static equilibrium. If the cord is suddenly cut, what is the magnitude of the acceleration of each block at that instant?



	Acceleration of **X**	Acceleration of **Y**
A	zero	2*g*
B	zero	*g*
C	*g*	2*g*
D	*g*	*g*

7 The diagram below shows three masses, 3.00 kg, 4.00 kg and 5.00 kg respectively, joined by two light strings. The string connecting the 3.00 kg and 4.00 kg masses passes over a light frictionless pulley.



What is the acceleration of the 5.00 kg mass at the instant the three masses are release?

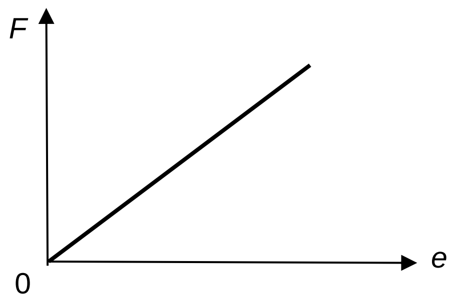
A 4.91 m s^{-2} **B** 9.81 m s^{-2}

C 11.8 m s^{-2} **D** 23.5 m s^{-2}

8 A crate of mass 0.50kg moves down a rough plane inclined at 20° to the horizontal with constant velocity. What is the force, parallel to the inclined plane, needed for pulling the crate up the plane with the same velocity?

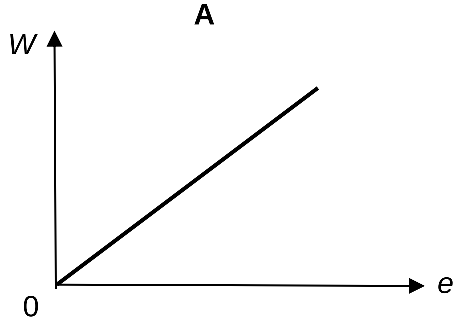
A 1.7 N **B** 3.4 N **C** 4.7 N **D** 9.2 N

9 A typical relation between the pulling force F applied to a spring and its extension e is shown below.

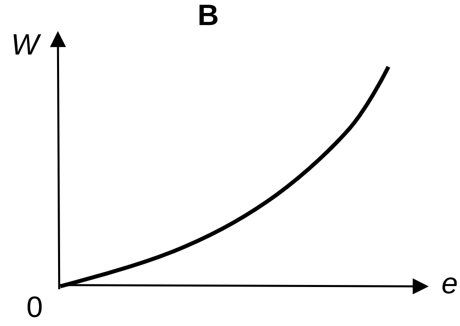


Which graph best shows how the work done W by the force depends on e?

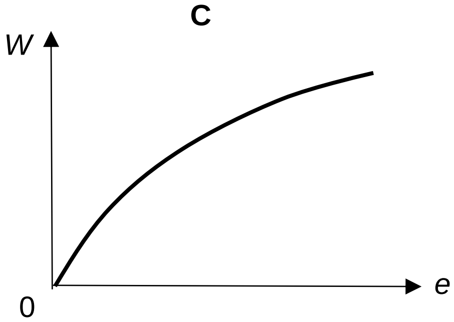
A



B



C



D

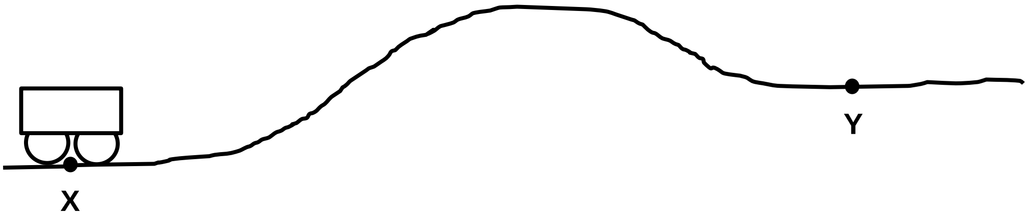
10 A cylindrical block has a cross-sectional area A and weight W. It is totally immersed in water with its axis vertical. The block experiences pressures p_1 and p_2 at its top and bottom surfaces respectively.

Which of the following expressions is equal to the buoyant force on the block?

A $(p_2 - p_1)\,A$ **B** $(p_2 - p_1)\,A + W$

C $(p_1 - p_2)\,A$ **D** $(p_2 - p_1)\,A - W$

11 A trolley runs from **X** to **Y** along a track as shown below. Its gravitational potential energy at **Y** is 50 kJ more than that at **X**.



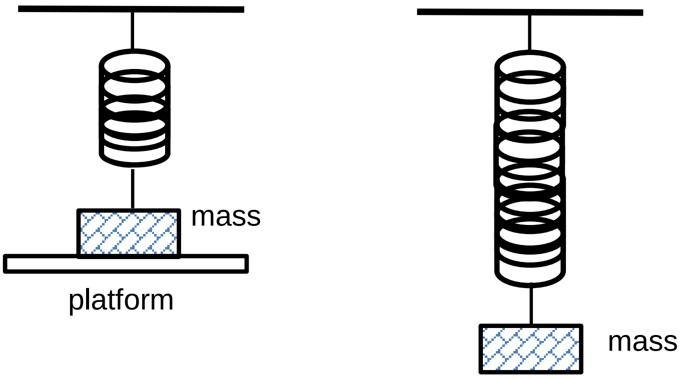
At **X**, the kinetic energy of the trolley is 75 kJ. The work done by the trolley against friction from **X** to **Y** is 10 kJ.

How much kinetic energy does the trolley have at **Y**?

A 5 kJ **B** 15 kJ **C** 25 kJ **D** 115 kJ

12 A mass, attached to one end of an unstretched spring, is initially supported by a platform, as shown in the figure on the left.

The platform is then removed and the mass comes to rest at the position shown in the figure on the right.



Which of the following word equations relates the changes in the types of energy which may occur during the process described above?

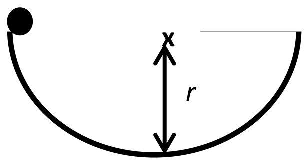
A decrease in gravitational potential energy = increase in elastic potential energy

B decrease in gravitational potential energy =
increase in elastic potential energy + energy dissipated as heat

C decrease in gravitational potential energy + increase in elastic potential energy =
energy dissipated as heat

D decrease in gravitational potential energy + energy dissipated as heat =
increase in elastic potential energy

13 A small object of weight *mg* is released from rest at the rim of a smooth semi-spherical bowl of radius *r*. What is the magnitude of the normal force (in terms of *mg*) acting on the object when it passes the bottom of the bowl?



A *mg*

B 2.0 *mg*

C 2.5 *mg*

D 3.0 *mg*

14 A car of weight *mg*, travels over a hump of radius *r*. When it is at the highest point of the hump, the driver whose safety belt is not secured, becomes weightless for an instant. What is the speed of the car, in terms of *r* and *g*, at this particular instant?

A $\sqrt{\frac{rg}{2}}$

B $\frac{\sqrt{rg}}{2}$

C $\sqrt{rg}$

D rg

15 Which of the following statements about Newton's Law of Gravitation is correct?

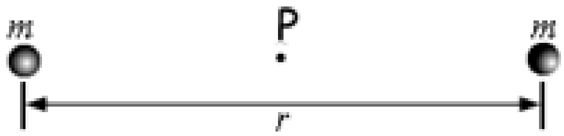
A The gravitational force between two particles is inversely proportional to the square of the distance between them.

B The gravitational force between two particles is inversely proportional to the product of their masses.

C The gravitational force between two particles is directly proportional to the square of the distance between them.

D The gravitational force between two particles is directly proportional to the sum of their masses.

16 The diagram shows two objects of equal mass m separated by a distance r.



What are the values of the gravitational field strength and gravitational potential at the mid-point **P** between the two objects?

	Gravitational field strength	Gravitational potential
A	$-\dfrac{8Gm}{r^2}$	$-\dfrac{4Gm}{r}$
B	$-\dfrac{8Gm}{r^2}$	0
C	0	$-\dfrac{4Gm}{r}$
D	0	0

17 A planet of mass M and radius R rotates about its own axis so rapidly that loose material at the equator only just remains on the surface. What is the period of rotation of the planet?

A $2\pi\sqrt{\dfrac{R}{GM}}$

B $2\pi\sqrt{\dfrac{R^2}{GM}}$

C $2\pi\sqrt{\dfrac{GM}{R^3}}$

D $2\pi\sqrt{\dfrac{R^3}{GM}}$

18 A particle performs simple harmonic motion and makes n complete oscillations in one second. What is its angular frequency?

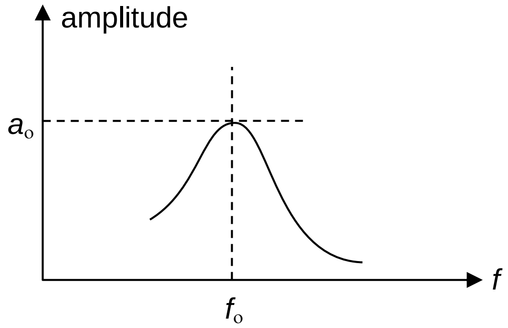
A n rad s^{-1}

B $\dfrac{2\pi}{n}$ rad s^{-1}

C $\dfrac{1}{n}$ rad s^{-1}

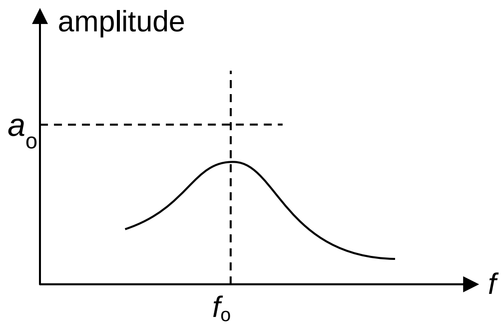
D $2\pi n$ rad s^{-1}

19 A pendulum is constructed from a fixed length of light thread and a spherical pendulum bob. It is forced to oscillate in air at different frequencies f. The following diagram shows how the amplitude of its oscillation varies with f.

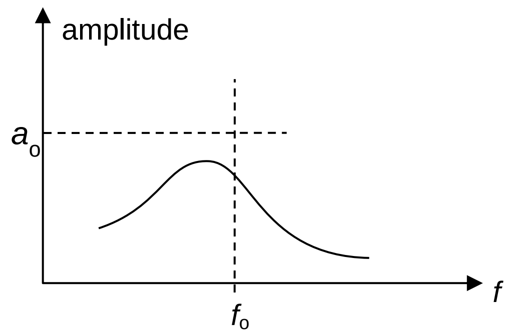


If the experiment is repeated in a partial vacuum, which graph best represents the variation with f of the amplitude?

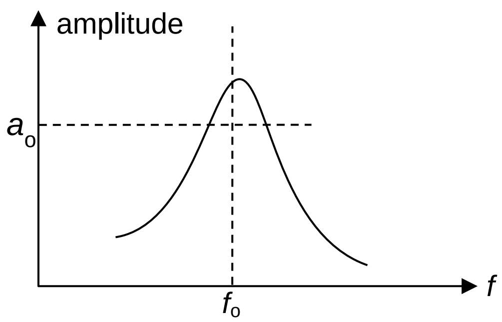
A



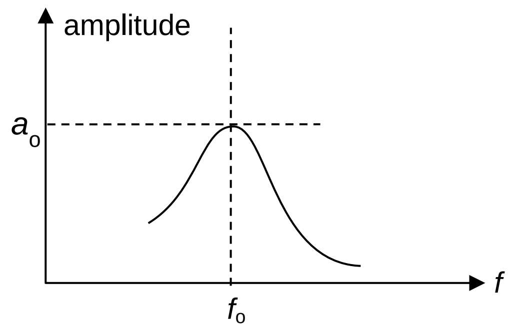
B



C



D



20 The distance between two points of a progressive transverse wave having a phase difference of $\frac{\pi}{3}$ rad is 40 cm. If the frequency of the wave is 300 Hz, what is the speed of the wave?

A 360 m s^{-1} **B** 720 m s^{-1} **C** 36000 m s^{-1} **D** 72000 m s^{-1}

21 Which of the following effects provides direct experimental evidence that light is a transverse, rather than a longitudinal wave?

A Light is diffracted by a narrow slit.

B Two coherent light waves can be made to interfere.

C Light is refracted by a glass prism.

D Light can be polarised by reflection at a glass surface.

22 A plane wave is incident on a surface placed perpendicular to the direction of travel of the wave. The energy per unit time intercepted by the surface is E. If the amplitude of the wave is doubled and the area of the surface is halved, how much energy per unit time is intercepted by this smaller surface?

A $4E$ **B** $2E$ **C** E **D** E / 2

23 A wave passes through an opening in a barrier. What does the amount of diffraction that the wave undergoes depend upon?

A Wavelength of the incident wave and the size of the opening

B Frequency and amplitude of the incident wave

C Amplitude of the incident wave and the size of the opening

D Wavelength and speed of the incident wave

24 If one of the slits of a standard Young's Double Slit experiment is painted over so that it transmits only half the light intensity of the other slit, which of the following statements is correct?

A Both the dark and bright fringes would have reduced intensities.

B The bright fringes would have increased intensities and the dark fringes would have reduced intensities.

C The bright fringes would have reduced intensities and the dark fringes would have increased intensities.

D Both the dark and bright fringes would have increased intensities.

25 Two sources, S_1 and S_2, emit coherent waves of amplitude *A* and 2*A* respectively. **X** is a point 4.0 m from S_1 and 2.0 m from S_2. If the two sources operate in anti-phase, and the resultant amplitude at point **X** is *A*, which of the following is not a possible wavelength of the waves?

A 0.5 m　　**B** 1.0 m

C 2.0 m　　**D** 4.0 m

END OF PAPER

2014 JC 1 H2 Paper 1 MCQs Suggested Solution

S/N	Answer	Explanation
1	C	
2	A	$\rho = \frac{M}{L \times B \times H}$ $\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + \frac{\Delta L}{L} + \frac{\Delta B}{B} + \frac{\Delta H}{H}$ $\frac{\Delta\rho}{\rho} = 0.002 + 0.003 + 0.01 + 0.005$
3	C	Time for P to reach the ground: 80 = 0 + 0.5(9.81)t^2 ➔ t = 4.04 s Displacement of Q in (t-1)s = 0 + 0.5(9.81)$(3.04)^2$ ➔ s = 45.3 m Distance required = 80 – 45.3 = 35 m
4	C	$u_x = v_x = 10$ m s^{-1} $(\downarrow) v_y = u_y + a_y t$ $v_y = 0 + 9.81 \times 5.0 = 49.05$ m s^{-1} $v = \sqrt{(10^2 + 49.05^2)} = 50$ m s^{-1}
5	D	KE for horizontal motion remains unchanged = *E*/2 (because KE vertical motion = KE horizontal motion = ½ *m* (*v*cos45°)^2) Since vertical motion gains half the max height➔ GPE gains half the max value (not E)➔ KE lost half value. Hence remaining KE in vertical motion = *E*/4 Total KE half-way up = 3*E*/4.
6	A	For X: Before string cut, Tension in spring = mg (so that X remains in equilibrium) At the instant string is cut, forces acting on X remains the same (Tension = mg since spring is instantaneously at the same extension, and weight = mg). Hence net force = zero, a = 0. For Y: At the instant string is cut, the only force acting on Y will be the downward tension from spring (Tension =mg) and weight. Hence resultant force = 2mg. ➔a = 2g
7	A	$F_{net} = ma$ $4.00g + 5.00g - 3.00g = (3.00 + 4.00 + 5.00)a$ $a = 4.91$ m s^{-2}
8	B	Friction along slope = mgsin20°

		Hence required force upslope to maintain constant velocity = component of weight along slope + friction = 2mgsin20°
9	**B**	
10	**A**	
11	**B**	By Conservation of Energy, $KE_X + PE_X = KE_Y + PE_Y + WD_{friction}$ $\Rightarrow 75 + PE_X = KE_Y + (PE_X + 50) + 10$ (all values are in kJ) $\Rightarrow KE_Y = 15$ kJ
12	**B**	
13	**D**	Gain in KE = Loss in GPE $½\, m\, v^2 = mgr$ $mv^2/\mathrm{r} = 2.0\, mg$ --- (1) $\Sigma F = mv^2/r$ $N – mg = 2.0\, mg$ $N = 3.0\, mg$
14	**C**	$\Sigma F = mv^2/r$ $mg – N = mv^2/r$ $mg = mv^2/r$ [$N = 0$] $v = \sqrt{rg}$
15	**A**	
16	**C**	Gravitational field strength, *g*, is a vector. At point P, the gravitational pull due to the each mass are equal in magnitude but opposite in direction. Thus, net *g* at P is zero. Gravitational potential is a scalar. The gravitational potential due to each mass at P is $\phi = -\frac{GM}{r/2} = -\frac{2GM}{r}$ Total $\phi = -\frac{2GM}{r} + (-\frac{2GM}{r}) = -\frac{4GM}{r}$
17	**D**	For an object on the equator, by Newton's second law,

		$F_{net} = ma_c$ $F_g - N = mR\omega^2$ When object loses contact, N = 0 $\frac{GMm}{R^2} = mR\omega^2$ $\frac{GM}{R^2} = R(\frac{2\pi}{T})^2$ $T = 2\pi\sqrt{\frac{R^3}{GM}}$
18	**D**	$\omega = 2\pi f = 2\pi n$ rad s^{-1}
19	**C**	Damping is decreased in partial vacuum. The resonance occurs with a greater amplitude but natural frequency remains the same
20	**B**	$\Delta\phi = \frac{\pi}{3} = (40/\lambda) \times 2\pi$ $\lambda = 2.40$ m Thus, speed = $f\lambda = 300 \times 2.40 = 720$ m s^{-1}
21	**D**	Longitudinal waves cannot be polarised
22	**B**	Energy per unit time intercepted = intensity x area intercepted Intensity is proportional to square of amplitude. When amplitude is doubled, intensity is 4 times the original intensity Also, area is ½ of the original. Hence the energy per unit time intercepted = (4 x ½) times the original = 2*E*
23	**A**	
24	**C**	There would be reduced contrast, since there are no longer complete destructive or constructive interferences.
25	**D**	Path difference = $S_1X - S_2X = 2$ m Since resultant amplitude is A, point X is a point of destructive interference Thus, $2 = n\lambda$ Since n are positive integers, λ could never be 4 m