Parent's Signature …………………..

Candidate's Name ………………………………………………. CTG ……….….

YISHUN JUNIOR COLLEGE
2015 JC 1 BLOCK TEST

PHYSICS **9646/2**

HIGHER 2 **11 June 2015**

Thursday

Paper 2 **1 hour 30 minutes**

INSTRUCTIONS TO CANDIDATES

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

Write your name and CTG in the spaces provided above.

Write in dark blue or black pen on both sides of the paper.

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

The use of approved scientific calculator is expected, where appropriate.

Answer **all** questions.

All working must be shown clearly in the spaces provided.

Paper 1	
	/20
Paper 2	
Q1	**/5**
Q2	**/13**
Q3	**/16**
Q4	**/16**
Q5	**/10**
Penalty	
Total	
	/60
Final Total	
	/80
	%

This question paper consists of **15** 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_o	=	8.85×10^{-12} 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	=	$-\dfrac{Gm}{r}$
Displacement of particle in s.h.m.	x	=	$x_o \sin \omega t$
velocity of particle in s.h.m.,	v	=	$v_o \cos \omega t$
		=	$\pm \omega \sqrt{(x_o^2 - x^2)}$
resistors in series,	R	=	$R_1 + R_2 + \ldots\ldots\ldots\ldots$
resistors in parallel,	$\dfrac{1}{R}$	=	$\dfrac{1}{R_1} + \dfrac{1}{R_2} + \ldots\ldots$
electric potential,	V	=	$\dfrac{Q}{4\pi\varepsilon_o r}$
alternating current/voltage,	x	=	$x_o \sin \omega t$
transmission coefficient	T	=	$\exp(-2kd)$, where $k = \sqrt{\dfrac{8\pi^2 m(U-E)}{h^2}}$
radioactive decay,	x	=	$x_o \exp(-\lambda t)$
decay constant,	λ	=	$\dfrac{0.693}{t_{\frac{1}{2}}}$

Answer all questions. Show your workings clearly in the spaces provided.

1 (a) If $X = 2\ C - D$ where $C = (2.3 \pm 0.3)$ and $D = (1.8 \pm 0.1)$, determine X with its associated uncertainty.

$X \pm \Delta X$ = ………… ± …………. [2]

(b) If $A = \dfrac{\sqrt{B^3}}{2C - D}$ where $B = (1.3 \pm 0.1)$, use the given expression of X in **(a)** to determine A with its associated uncertainty.

$A \pm \Delta A$ = ……..…… ± …………. [3]

2 **(a)** A car travelling at 8.0 m s^{-1}, passes by a stationary train at time, t = 0. The variations with time of the velocity v of the train and car are shown in Fig. 2.1.

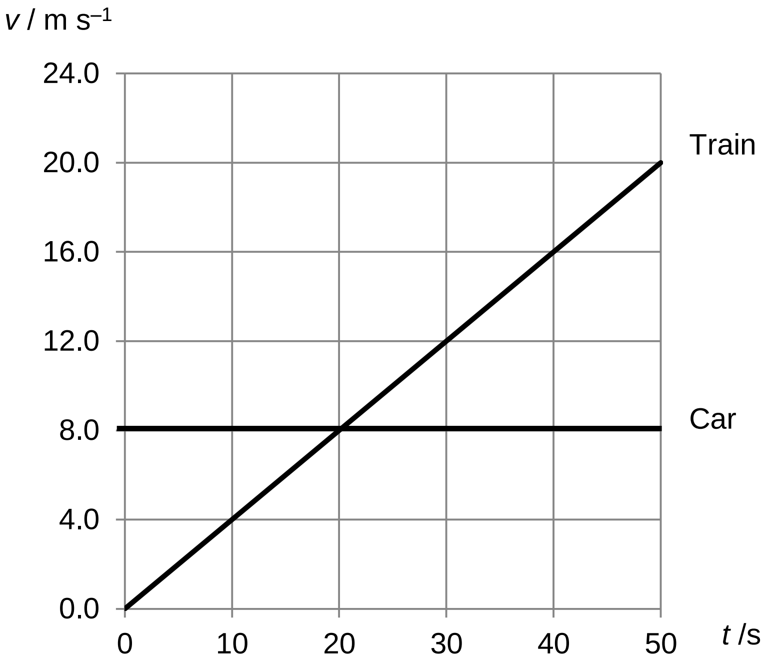

Fig. 2.1

(i) Calculate the acceleration of the train.

acceleration = ………………………….. m s^{-2} [1]

(ii) Calculate the distance travelled by the train when it passes by the car again.

distance = ………………….. m [3]

2 **(b)** A ball is projected at an angle of 30° above the ground with a speed of 40 m s^{-1} as shown in Fig. 2.2. A vertical wall of infinite height is placed 120 m away from the point where the ball is launched.

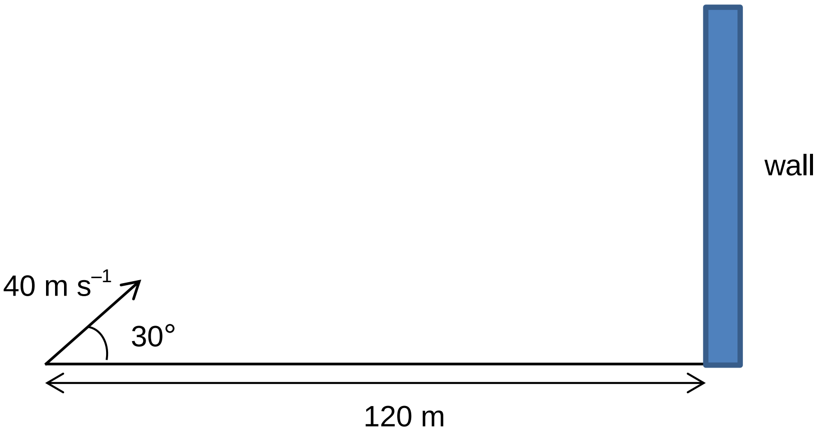

Fig. 2.2

(i) Calculate the time taken for the ball to reach the highest point of its path.

time taken = ……………………………….. s [1]

(ii) Calculate the time taken for the ball to hit the wall.

time taken = ……………………………….. s [1]

(iii) Calculate the height of the ball above the ground when it hits the wall.

height of the ball = ……………………………… m [2]

(iv) Calculate the vertical component of the velocity when the ball hits the wall.

magnitude of the vertical velocity = ……………………… m s^{-1} [1]

(v) On Fig. 2.3, sketch the variation with time of the vertical component of the velocity, v_y, taking upwards as positive. Indicate the critical values on the graph, where applicable. [2]

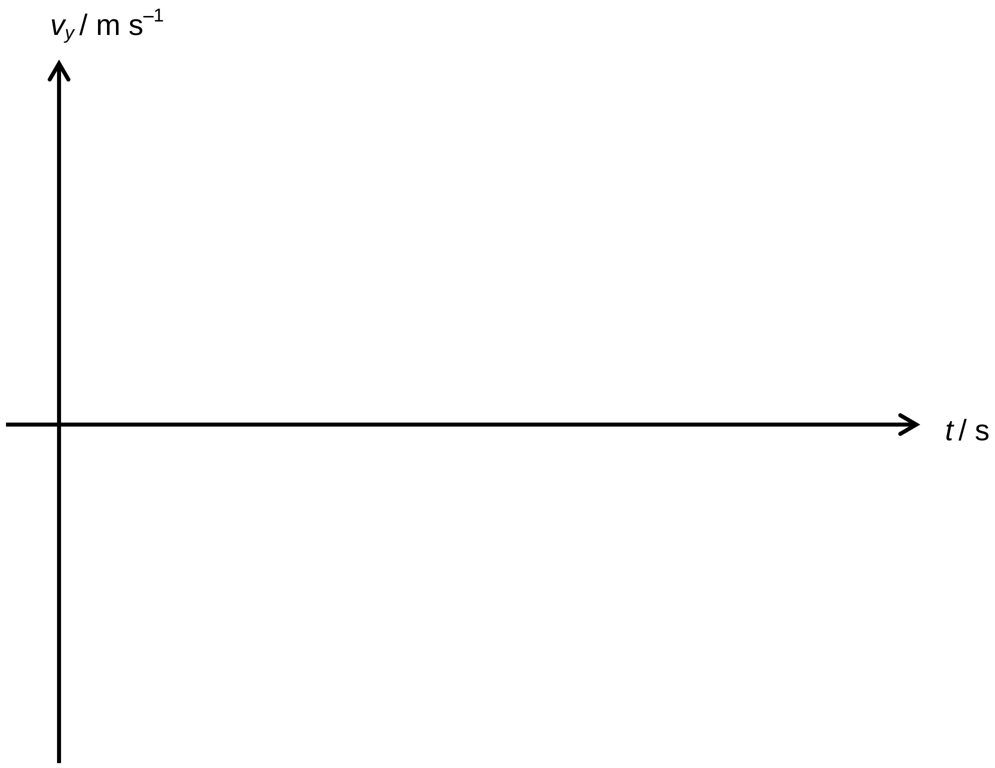

Fig. 2.3

(vi) Assuming that the effect of air resistance is not negligible, draw the projectile path of the ball in Fig. 2.4. The projectile path of the ball with no air resistance is shown in Fig. 2.4.

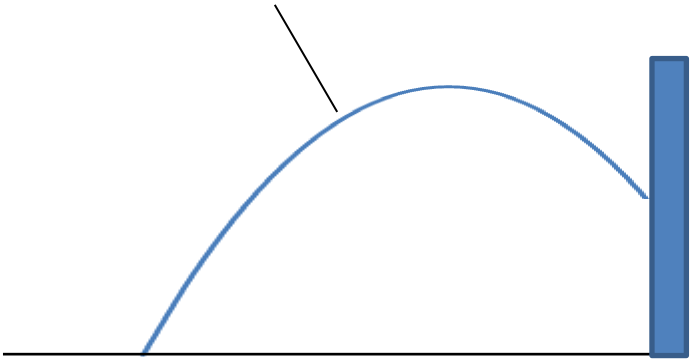

Fig. 2.4

[2]

3 (a) Define linear momentum of a body.

……………………………………………………………………………………………

…………………………………………………………………………………………… [1]

(b) Two frictionless trolleys A and B are moving horizontally towards each other on a frictionless surface, as shown in Fig. 3.1.

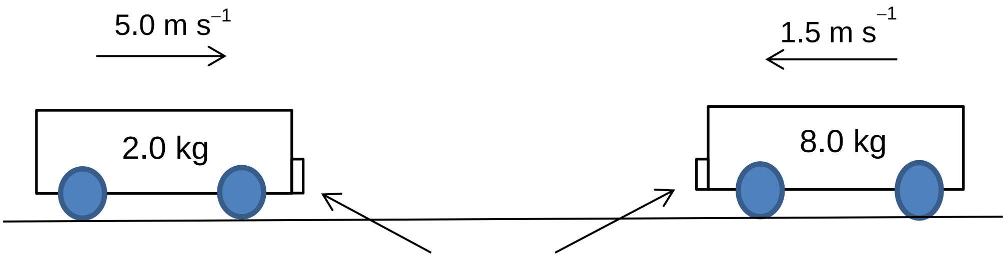

Fig. 3.1

Trolley A of mass 2.0 kg has a speed of 5.0 m s^{-1} and trolley B of mass 8.0 kg has a speed of 1.5 m s^{-1}. The trolleys collide elastically.

(i) Calculate the momentum of the 2.0 kg trolley before the collision.

momentum = ………………….. kg m s^{-1} [1]

(ii) Determine the velocity of the 2.0 kg trolley after collision.

speed = ………………….. m s^{-1} [3]

direction = ……………………….. [1]

(iii) Explain whether, during the collision, it is possible for both trolleys to be at rest simultaneously.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

……………………………………………………………………………………………….. [2]

(c) A wooden block P, placed on a horizontal surface, is connected to block Q with an inelastic string over a frictionless pulley as shown in Fig. 3.2.

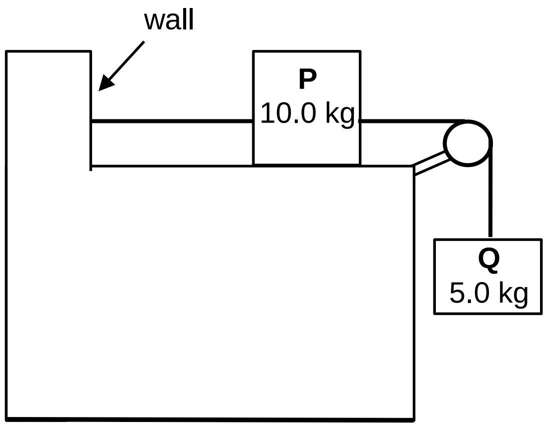

Fig. 3.2

(i) The system is held in equilibrium by another inelastic string attached to a wall. There is a static frictional force of 8.0 N present between block P and the horizontal surface.

1. State and explain the value of the tension in the string between P and Q.

....

....

.... [2]

2. Determine the tension in the string connecting block P to the wall.

tension = ... N [2]

(ii) The string connecting block P to the wall is now cut and the system accelerates. The frictional force between block P and the surface is reduced to a constant value of 5.0 N. Determine

1. the acceleration of the system

acceleration = ……………………….. m s^{-2} [3]

2. the tension in the string between P and Q.

tension = ………………………….. N [1]

4 **(a)** Define the *moment of a force*.

……………………………………………………………………………………………………...................

………..

……….. [2]

(b) A force F of 160 N is applied horizontally at the axle so that the metal wheel is <u>just lifted off the ground</u> as shown in Fig. 4.1. The radius of the wheel is 0.500 m.

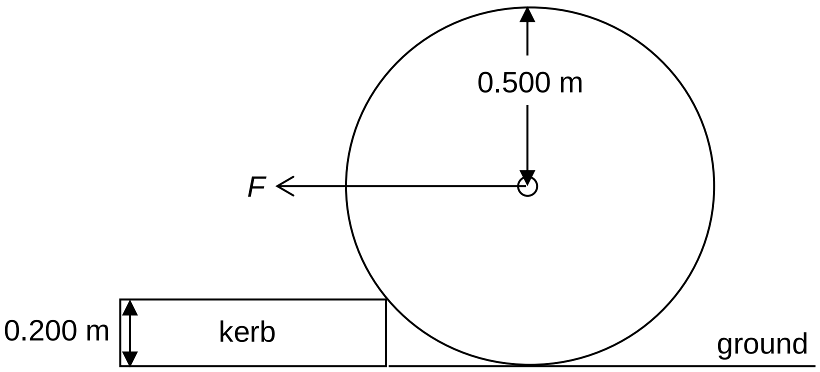

Fig. 4.1

(i) On Fig. 4.1, draw and name the two other forces acting on the wheel. [2]

(ii) Calculate the weight of the wheel.

weight of the wheel = ………………….. N [3]

(iii) Let F_{min} be the minimum force applied <u>at the axle</u> that could lift the wheel.

1. On Fig. 4.1, draw F_{min}. [1]

2. Explain why F_{min} needs to be applied in the direction as stated by your answer.

....

....

.... [2]

(c) (i) State Hooke's law.

....

....

.... [1]

(ii) Fig. 4.2 shows the force-extension graph of a helical spring.

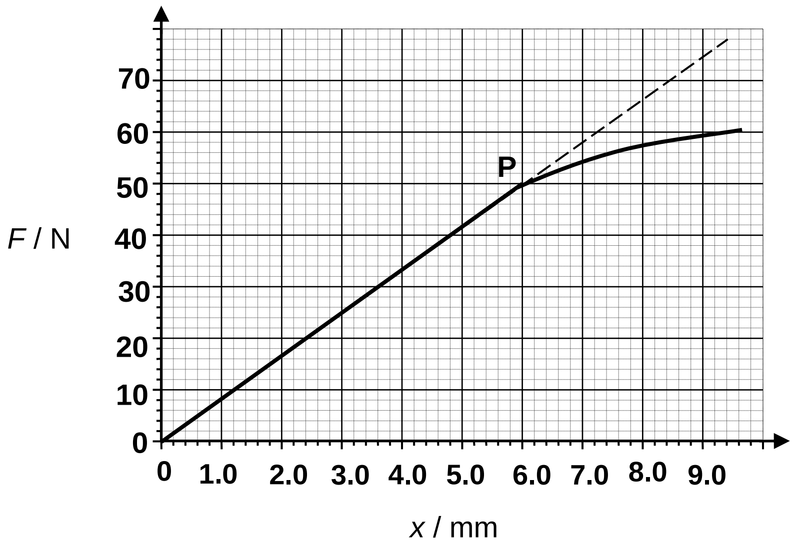

Fig. 4.2

1. Identify point P.

.... [1]

2. Two identical springs, each with a force-extension graph as shown in Fig. 4.2, were connected end to end with a load of 50 N applied to one end as shown in Fig. 4.3.

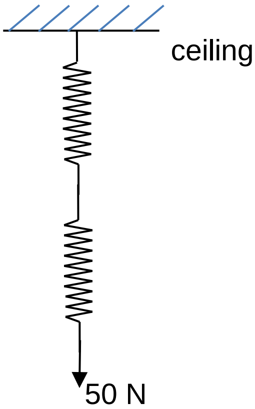

Fig. 4.3

By considering the forces experienced in each spring, calculate the equivalent spring constant of the setup.

spring constant = ………………….. N m^{-1} [2]

3. The two springs are now connected in parallel as shown in Fig. 4.4.

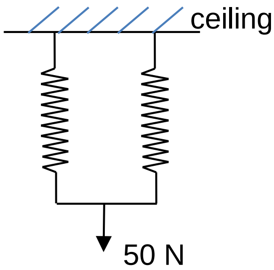

Fig. 4.4

By considering the forces experienced in each spring, calculate the equivalent spring constant of the setup.

spring constant = ………………….. N m^{-1} [2]

5 (a) (i) Define *work*.

…………………………………………………………………………………………………

…………………………………………………………………………………………….. [1]

(ii) A body of mass, m is lifted to a height h above its initial position at a <u>constant velocity</u> by a constant upward force F as shown in Fig. 5.1

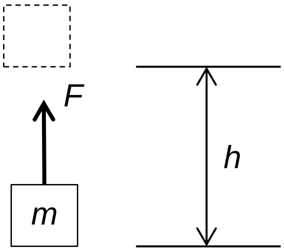

Fig. 5.1

Derive, using the definition of work, the formula $E_p = mgh$ for potential energy changes near the Earth's surface. [Show your explanations clearly. No marks will be awarded for pure derivation without explanations.] [2]

(iii) Determine the power of the applied force when the mass of the body is 5.0 kg and the body is moving with a constant velocity of 3.0 m s^{-1}.

power = ………………….. W [2]

(b) A cyclist, together with his bicycle, has a total mass of 95 kg and is travelling with a constant speed of 20 m s^{-1} on a flat road. He then goes down the long slope, with a constant frictional force of 15 N along the slope, to point B which is 4.0 m vertically below the original height as shown in Fig. 5.2.

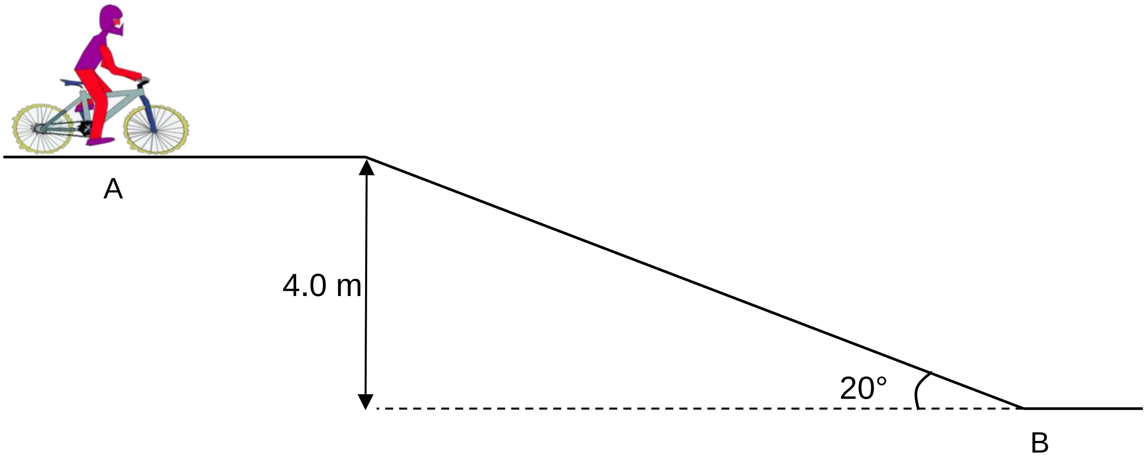

Fig. 5.2

Calculate

(i) the work done against friction along the slope,

work done against friction = ………………….. J [1]

(ii) the speed at point B given that the cyclist stoppd pedalling along the slope,

speed at B = ………………….. m s^{-1} [2]

(iii) Describe and explain the energy transformations taking place when the cyclist is travelling at constant speed on the flat road before reaching the slope.

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………………………… [2]

– End of Paper –