EUNOIA JUNIOR COLLEGE
JC1 Promotional Examination 2017
General Certificate of Education Advanced Level
Higher 2

PHYSICS 9749

MARK SCHEME

Sep/Oct 2017

Paper 1
Multiple Choice

Q	*Key*	*Q*	*Key*	*Q*	*Key*	*Q*	*Key*
1	**A**	6	**D**	11	**B**	16	**C**
2	**A**	7	**B**	12	**B**	17	**A**
3	**C**	8	**A**	13	**C**	18	**C**
4	**D**	9	**D**	14	**A**	19	**C**
5	**void**	10	**C**	15	**B**	20	**D**

1 Singapore population ~ 5 million
Take average mass per pax ~ 60 kg

$$m_{\text{total}} \approx (5\times10^{6})(60)$$
$$= 3\times10^{8} \text{ kg}$$

2 Set 1 and 2 has the same accuracy but Set 1 is less precise.

Set 3 is precise but inaccurate.

3 Consider error propagation

$$\frac{\Delta P}{P} = \frac{\Delta m}{m} + 2\frac{\Delta v}{v} + \frac{\Delta t}{t}$$
$$= \frac{0.5}{100} + 2\frac{3}{100} + \frac{2}{100}$$
$$= 8.5\%$$

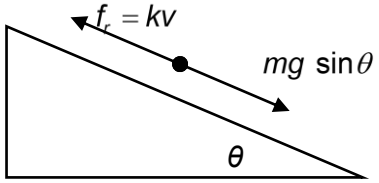
4 gradient of *s*-*t* graph must tend to zero at time t_2

6 Consider horizontal force needed to move sand from no horizontal speed to constant speed.

$$F = \left(\frac{m}{\Delta t}\right)\Delta v = \left(\frac{m}{\Delta t}\right)(v_{\text{final}} - v_{\text{initial}})$$
$$= (4)(1.5-0) = 6 \text{ N}$$

$$F_{\text{total}} = 17 + 6 = 23 \text{ N}$$

7 constant speed so no net force



$$mg\ \sin\theta = f_r = k(1.38)$$

at faster speed:

$$mg\ \sin\theta + F = k(5.55)$$
$$f = k(5.55) - mg\ \sin\theta$$
$$= \frac{mg\ \sin\theta}{1.38}(5.55) - mg\ \sin\theta$$
$$= 80(9.81)\ \sin(5°)\left[\frac{5.55}{138} - 1\right]$$
$$= 207 \text{ N}$$

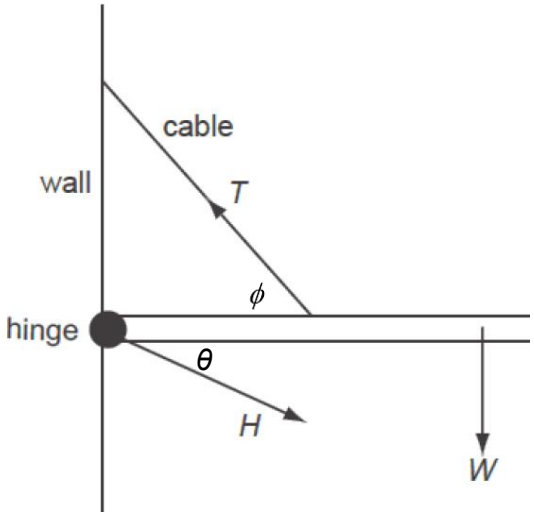
8 By PCE,
loss in GPE_{barrel} =
gain in GPE_{man} + gain in KE_{all}

$$m_{barrel} g \Delta h$$
$$= m_{man} g \Delta h + \frac{1}{2}(m_{man} + m_{barrel}) v^2$$

$$v = \sqrt{\frac{2(m_{barrel} - m_{man}) g \Delta h}{(m_{man} + m_{barrel})}}$$
$$= \sqrt{\frac{2(120-80)(9.81)(9)}{(80+120)}}$$
$$= 5.94 \text{ m s}^{-1}$$

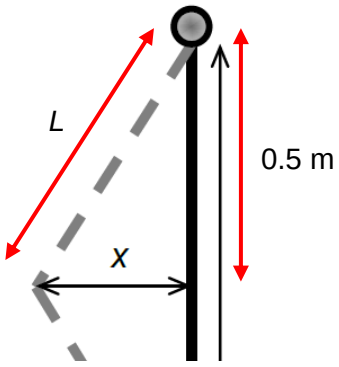
9 recall "origin of upthrust"

10 consider vertical equilibrium
$T \sin\phi = H \sin\theta + W$
$T > H$
$T > W$



consider rotation equilibrium
pivot at $L/4$ where cable attaches to door:
sum of ↻ moments = sum of ↺ moments
$\frac{L}{4}(H \sin\theta) = \frac{L}{4} W$
so $H > W$

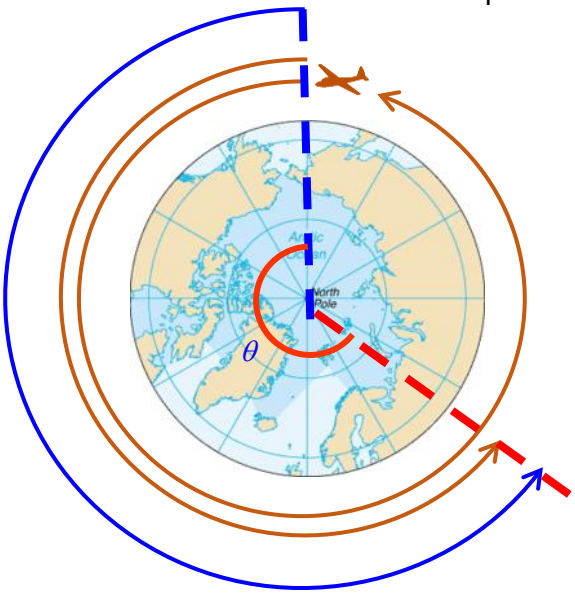
11 consider half the extended cord:



by conserving energy

$$\frac{1}{2} k \left(2[L - 0.5]\right)^2 = \frac{1}{2} m v^2$$
$$(80)\left(2\left[\sqrt{0.5^2 + x^2} - 0.5\right]\right)^2 = 0.2(10)^2$$
$$x = 0.56 \text{ m}$$

12 consider view from Earth's north pole:



(answer is not unique) the first possible answer is plane has flew one extra round to end up at same angular displacement

$$\theta_{Earth} = \omega_{Earth} t$$
$$= \frac{2\pi}{T_{Earth}}(t) = \frac{2\pi}{24}(18)$$
$$= 1.5\pi$$

$$\theta_{plane} = 1.5\pi + 2\pi = 3.5\pi = \frac{2\pi}{T_{plane}}(t)$$

$$3.5\pi = \frac{2\pi}{T_{plane}}(18)$$

$$T_{plane} = 10.3 \text{ h}$$

13 compare ratios:

$$a = r\omega^2$$

$$\omega = \sqrt{\frac{a}{r}} = \sqrt{\frac{120}{0.03}} = \sqrt{4000}$$

$$v = r\omega = (0.05)\sqrt{4000}$$
$$= 3.16 \text{ m s}^{-1}$$

14 the keyword is the "now" in "The spacecraft will *now* move" i.e. the behaviour of the spacecraft at the instant the engine is fired.

Net force zero at that instant so by N1L the spacecraft will continue with its linear velocity tangential to the orbit.

15 gravitational force provides centripetal force

$$\frac{GM_{\text{Earth}}\cancel{m}}{\cancel{r^2}} = \frac{\cancel{m}v^2}{\cancel{r}}$$

$$v = \sqrt{\frac{GM_{\text{Earth}}}{r}}$$
$$\propto \frac{1}{\sqrt{r}}$$

$$\frac{v_{\text{new}}}{v_{\text{old}}} = \sqrt{\frac{r_{\text{old}}}{r_{\text{new}}}} = \sqrt{\frac{6610}{6890}}$$

$$v_{\text{new}} = \sqrt{\frac{6610}{6890}}(7780)$$
$$= 7620 \text{ m s}^{-1}$$

16 displacement is a sine graph so

velocity is cosine graph and

$\frac{1}{2}mv^2$ resembles C

17 resistive force opposes relative motion: A

18 consider phase difference:

$$\lambda = \frac{v}{f} = \frac{340}{1000}$$

$$\frac{\Delta s}{\lambda} = \frac{\Delta\phi}{2\pi}$$

$$\Delta\phi = \frac{\Delta s}{\lambda}(2\pi) = \frac{\Delta s}{\lambda}(2\pi)$$
$$= \frac{0.17}{\frac{340}{1000}}(2\pi)$$
$$= \pi$$

19 consider Rayleigh's criteria:

$$\theta \simeq \frac{\lambda}{b}$$

$$\frac{\theta_{\text{new}}}{\theta_{\text{old}}} = \frac{b_{\text{old}}}{b_{\text{new}}} = 2$$

20

$$d \sin\theta = n\lambda$$

$$\sin\theta_2 = \frac{n\lambda}{d} = \frac{n\lambda}{1/N} = 2N\lambda$$