التاريخ	التوقيع	الاسم

رُوجِع على النص العربي ومطابق للأصل ويطبع على مسئولية اللجنة الفنية ،

ARAB REPUBLIC OF EGYPT
Ministry of Education
General Secondary Education Certificate Examination, 2015
[New System – First Session]
Applied Mathematics [Dynamics] **Time: 2 hours**

الرياضيات التطبيقية [الديناميكا] باللغة الإنجليزية

[الأسئلة في صفحتين]

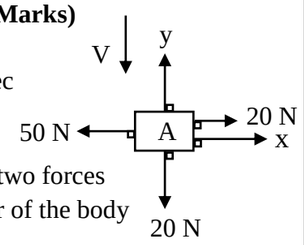
تنبيه مهم : يسلم الطالب ورقة امتحانية باللغة العربية مع الورقة المترجمة .

Remark: 1. Calculators are allowed **2.** The acceleration of gravity g = 9.8 m/sec^2

First: Answer the following Question:

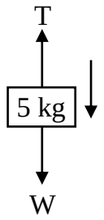
First Question: Complete the following statements: (6 Marks)

a) **In the opposite figure:**
If the body A is moving with uniform velocity V m/sec in the shown direction under the effect of the indicated forces, then x = ……N, y = ……N .



b) If a body of mass 500 gm is moving under the act of two forces $(4\hat{i}+2\hat{j})$ N , $(-\hat{i}+\hat{j})$ N, then the acceleration vector of the body is $\vec{a}$ = ……

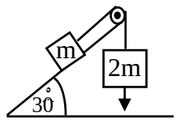
c) **In the opposite figure:**
If the body is moving vertically downwards with a uniform acceleration a = 4 m/sec^2 , then the magnitude of the tension in the string T = …… N



d) If a body of mass 200 gm is lifted vertically upwards with uniform velocity 2 m/sec, then the work done against the gravity every second = …… Joule.

e) If a lift of mass 400 kg descends vertically downwards a distance of 10 m, then the magnitude of the lost potential energy = …… kg.wt.m

f) **In the opposite figure:**
(The plane is smooth and inclines at 30° to the horizontal)
If the motion of the system started from rest, then the magnitude of acceleration of the system equals …… g m/sec^2.
(where g is the acceleration of gravity).



Second: Answer three Questions only of the following:

Second Question: (8 Marks)

a) A train of mass 70 tons moves on a rough horizontal road with a uniform acceleration of magnitude 14 cm/sec^2. If the force of its engine is 2000 kg.wt, determine the coefficient of friction between the road and the train and find the magnitude of the resistance per each ton of the mass of the train.

[بقية الأسئلة فى الصفحة الثانية]

b) A body of mass 2 kg is projected with velocity 1.4 m/sec upwards along the line of greatest slope of a smooth inclined plane which inclines to the horizontal at an angle of measure θ, where $\sin\theta = \frac{1}{98}$. Find the work done by the weight of the body until it comes to rest instantaneously.

Third Question: (8 Marks)

a) A body of mass 2 kg moves under the act of the constant force $\vec{F} = (4\hat{i}+8\hat{j})$ N. If it begins its motion from rest at a point whose position vector is $(2\hat{i}+5\hat{j})$, find the position vector of the body after 3 seconds, and find also the work done by this force in this time interval.

b) Two cars of masses 2 tons, 3 tons move in a straight line on a horizontal road and in two opposite directions with velocities of magnitudes 90 km/h, 60 km/h respectively. If the two cars collided and formed one body after collision, calculate the velocity of this body and the lost kinetic energy by collision, then find the magnitude of the impulse of any of the two cars on the other.

Fourth Question: (8 Marks)

a) A rocket is launched vertically upwards from a rocket launcher on the earth's surface with velocity 1200 m/sec. It hit a plane flying at a height of 1500 m from the earth's surface. Find the velocity of the rocket when it hits the plane.

b) A cyclist started motion from rest with his bike on a rough horizontal ground. His velocity reached its maximum value whose magnitude is 7.5 m/sec after one minute. When he stopped moving the bike pedals, the bike came to rest after covering a distance of 15 m. If the total mass of the cyclist and his bike is 98 kg, calculate his maximum horsepower.

Fifth Question: (8 Marks)

a) A body of mass 400 gm rests on a smooth horizontal table and is connected by a light string passing over a smooth pulley at the edge of the table to a hanging body of mass m gm. If the magnitude of the tension in the string is 80 gm.wt,
find: i) The pressure on the axis of the pulley.
ii) The acceleration of the system. **iii)** The value of m.

b) A body of mass 60 kg descends from rest along the line of greatest slope of an inclined plane whose length is 20 meters and whose height is 12 meters. If the body started motion from the top of the plane and the coefficient of friction between the body and the plane is $\frac{3}{16}$, find the kinetic energy of the body when it reaches the bottom of the plane.

[انتـهـت الأسـئـلـة]

[٥٧] الدور الأول (نظام حديث)	جمهورية مصر العربية وزارة التربيـة والتعليـم امتحان شهادة إتمام الدراسة الثانوية العامة لعام ٢٠١٥ م نموذج إجابة [الرياضيات التطبيقية " الديناميكا بالإنجليزية "]	الدرجة العظمـى (٣٠) الدرجة الصغرى (ــ) عدد الصفحـات(٥)

First Question: (6 marks) : One mark for each item

a) $x = 30$ **0.5** , $y = 20$ **0.5**

b) $(6\hat{\imath} + 6\hat{\jmath})$ **1**

c) 29 **1**

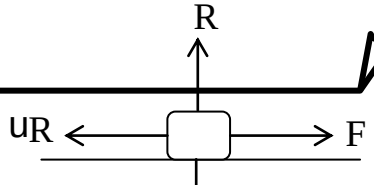
d) 3.92 **1**

e) 4000 **1**

f) $\frac{1}{2}$ **1**

(تراعى الحلول الأخرى)

Second Question: (8 marks) : (a) 4 marks, (b) 4 marks



(a) $\because R = mg$ **0.5**

$\therefore R = 70 \times 1000 \times 9.8\ N$ **0.5**

$, F - \mu R = ma$ **0.5**

$\therefore 2000 \times 9.8 - \mu \times 70 \times 1000 \times 9.8 = 70 \times 1000 \times 0.14$ **0.5**

$\therefore \mu = \frac{2000 \times 9.8 - 70 \times 140}{70 \times 1000 \times 9.8} = \frac{1}{70}$ **1**

,Resístance per ton $= \frac{1000 \times 9.8}{70} = 140\ N$ **1**

(b) $a = -g\ sin\theta$ **0.5**

$= -9.8 \times \frac{1}{98} = -0.1\ m/sec^2$ **0.5**

$, \because v^2 = {v_0}^2 + 2\ a\ S$ **0.5**

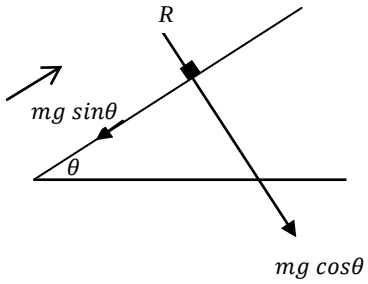
$\therefore\ 0 = (1.4)^2 - 2 \times 0.1\ S$

$\therefore S = 9.8\ m$ **0.5**

$\therefore W = -mg\ sin\theta\ S$ **0.5**

$= -2 \times 9.8 \times \frac{1}{98} \times 9.8$ **0.5**

$= -1.96\ N.m$ **1**



Another Solution:

$\because \tau - \tau_0 = W$ **1**

$\therefore W = 0 - \frac{1}{2} m {v_0}^2$ **1**

$\therefore W = -\frac{1}{2} \times 2 \times (1.4)^2$ **1**

ى$W = -1.96\ N.m$ **1**

(تراعى الحلول الأخرى)

Third Question: (8 marks) : (a) 4 marks, (b) 4 marks

(a) $\because \vec{F} = m\vec{a}$ **0.5**

$\therefore 4\hat{\imath} + 8\hat{\jmath} = 2\vec{a}$

$\therefore \vec{a} = 2\hat{\imath} + 4\hat{\jmath}$ **0.5**

$\because \vec{s} = \overrightarrow{v_0}t + \frac{1}{2}\vec{a}t^2$ **0.5**

$\therefore \vec{s} = \frac{1}{2}(2\hat{\imath} + 4\hat{\jmath}) \times 9$

$\therefore \vec{s} = 9\hat{\imath} + 18\hat{\jmath}$ **0.5**

$,\because \vec{s} = \overrightarrow{OB} - \overrightarrow{OA}$ **0.5**

$\therefore 9\hat{\imath} + 18\hat{\jmath} = \overrightarrow{OB} - (2\hat{\imath} + 5\hat{\jmath})$

$\therefore \overrightarrow{OB} = 11\hat{\imath} + 23\hat{\jmath}$ **0.5**

$,W = \vec{F} \odot \vec{s} = (4,8) \odot (9,18)$ **0.5**

$\therefore W = 180\ Joule$ **0.5**

(b) $\because m_1v_1 + m_2v_2 = (m_1+m_2)v$ **0.5**

$\therefore 3 \times 60 - 2 \times 90 = 5v$ **0.5**

$\therefore v = zero$ **0.5**

i.e. the body came to rest after impact.

Loss in K.E. $= \frac{1}{2}m_1{v_1}^2 + \frac{1}{2}m_2{v_2}^2 - zero$ **0.5**

$= \frac{1}{2} \times 2000 \times (90 \times \frac{5}{18})^2 + \frac{1}{2} \times 3000 \times (60 \times \frac{5}{18})^2$ **0.5**

$= \frac{3125000}{3}\ Joule$ **0.5**

$,I = m(v - v_0)$

$= 2 \times 1000\ \left(0 - 90 \times \frac{5}{18}\right)$ **0.5**

$= -50000$ N.sec **0.5**

(تراعى الحلول الأخرى)

Fourth Question: (8 marks) : (a) 4 marks, (b) 4 marks

(a) $\because -mg = ma$ **1**

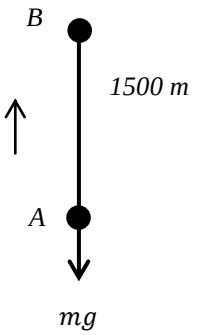
$\therefore a = -g = -9.8\, m/sec^2$ **1**

$\therefore v^2 = {v_0}^2 + 2a\, s$ **0.5**

$\therefore v^2 = (1200)^2 - 2 \times 9.8 \times 1500$ **0.5**

$\therefore v^2 = 1410600$

$\therefore v = \sqrt{1410600}\ m/sec$ **1** ئ 1187.69 m / sec



Another Solution:

$\because P_A + T_A = P_B + T_B$ **1**

$\therefore 0 + \frac{1}{2}\, m\, (1200)^2 = m \times 9.8 \times 1500 + \frac{1}{2}\, m\, v^2$ **1**

Where m is the mass of the rocket

$\therefore (1200)^2 = 2 \times 9.8 \times 1500 + v^2$ **0. 5**

$\therefore v^2 = (1200)^2 - 2 \times 9.8 \times 1500$ **0.5**

$\therefore v^2 = 1410600$ **0.5**

$\therefore v = \sqrt{1410600}\ m/sec$ **0.5** ئ 1187.69 m / sec

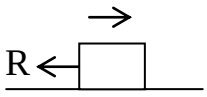
(b) $\because v^2 = {v_0}^2 + 2a\, s$,when he stopped moving the pedals

$\therefore 0 = (750)^2 + 2a \times 1500$

$\therefore a = \frac{-(750)^2}{2 \times 1500} = -\frac{375}{2}\ cm/sec^2$ **0.5**

$,\because -R = ma$ **0.5** $\Longrightarrow -R = 98 \times 1000 \times (\frac{-375}{2})$

$\therefore R = 98 \times 1000 \times \frac{375}{2}\ dyne$ **0.5**



In the first stage:

$\because v = v_0 + at \quad \Longrightarrow \quad 750 = 0 + 60a$

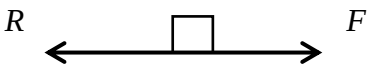
$\therefore a = \frac{750}{60} = \frac{25}{2}\ cm/sec^2$ **0.5**

$,\because F - R = ma$ **0.5**

$\therefore F = R + ma = 98 \times 1000 \times \frac{375}{2} + 98 \times 1000 \times \frac{25}{2}$

$\therefore F = 98 \times 1000 \times 200\ dyne = 20\ kg.wt.$ **0.5**

$\therefore Power = Fv = 20 \times 7.5 \times \frac{1}{75} = 2\ horses$ **1**



(تراعى الحلول الأخرى)

Fifth Question: (8 marks) : (a) 4 marks, (b) 4 marks

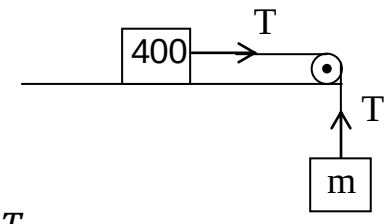
(a) $\because P = 2T\cos 45^\circ$ **0.5**

$\therefore P = 2 \times 80 \times \frac{\sqrt{2}}{2} = 80\sqrt{2}\ gm.wt.$ **0.5**

$\because T = 400\ a$ **0.5**

$\therefore 80 \times 980 = 400\ a$ **0.5**

$\therefore a = 196\ cm/sec^2$ **0.5**



$\because mg - T = ma$ **0.5** $\Rightarrow$ $m(g-a) = T$

$\therefore m = \frac{80\times980}{980-196}$ **0.5** $\Rightarrow$ $m = 100\ gm$ **0.5**

(b) $R = mg\cos\theta$ **0.5**

$= 60 \times 9.8 \times \frac{4}{5}$ **0.5**

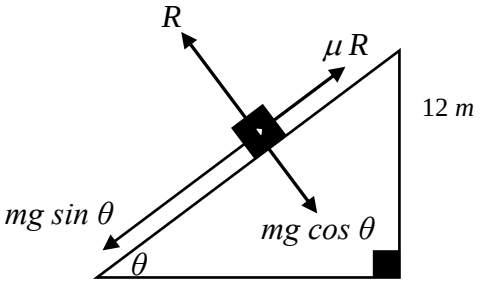
$\therefore R = 48 \times 9.8$ N **0.5**

$\because \mathcal{T} - \mathcal{T}_0 = W$ **0.5**

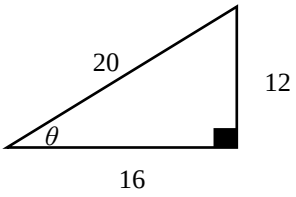
$\therefore \mathcal{T} - 0 = (mg\ sin\theta - \mu R)S$ **0.5**

$\therefore \mathcal{T} = \left(60 \times 9.8 \times \frac{3}{5} - \frac{3}{16} \times 48 \times 9.8\right) \times 20$ **1**

$\therefore \mathcal{T} = 5292\ Joule$ **0.5**



Another Solution:



$R = mg\cos\theta$ **0.5**

$\therefore R = 60 \times 9.8 \times \frac{4}{5} = 48 \times 9.8\ \ N$ **0.5**

$\because mg\ sin\theta - \mu R = ma$ **0.5**

$\therefore 60 \times 9.8 \times \frac{3}{5} - \frac{3}{16} \times 48 \times 9.8 = 60\ a$ **0.5**

$\therefore a = 4.41\ \ m/sec^2$ **0.5**

$\because v^2 = {v_0}^2 + 2as$

$\therefore v^2 = 2 \times 4.41 \times 20 = 176.4$ **0.5**

$\therefore \mathcal{T} = \frac{1}{2}mv^2 = \frac{1}{2} \times 60 \times 176.4$ **0.5**

$\therefore \mathcal{T} = 5292\ Joule$ **0.5**

(تراعى الحلول الأخرى)

(انتهى نموذج الإجابة)