جامعة الملك سعود
King Saud University

College of Sciences
Department of Physics & Astronomy

40

كلية العلوم
قسم الفيزياء والفلك

Final Exam - Academic Year 1444 H – 1st Semester			
Exam Information معلومات الامتحان			
Course name:	General Physics (PHYS 103)*	فيزياء عامة (١٠٣فيز)*	اسم المقرر:
Exam date:	Monday 14/11/2022G	٢٠/٠٤/١٤٤٤هـ الأثنين	تاريخ الامتحان:
Exam time:	08:00 AM	٠٨:٠٠ صباحاً	وقت الامتحان:

Student Information معلومات الطالب		
Student's name:		اسم الطالب:
Student ID no.:		الرقم الجامعي:
Teacher's name:		اسم أستاذ المقرر:

تعليمات الاختبار:

- يجب إتباع تعليمات الجامعة بخصوص الإجراءات الاحترازية والتدابير الوقائية حول عدوى كورونا (COVID-19).
- إظهار بطاقة الطالب الجامعية.
- الجوالات والساعات الذكية يجب أن تكون خارج قاعة الاختبار.
- كتابة الإجابة لكل سؤال بالأحرف الكبيرة (CAPITAL LETTERS) في الجدول أدناه باستخدام قلم الحبر.
- تسلم جميع صفحات الاختبار لأستاذ المادة / المراقب.

Write you final answer for each question (in CAPITAL LETTERS) in the following table:

Q. 1	Q. 2	Q. 3	Q. 4	Q. 5
A	D	C	B	C
Q. 6	**Q. 7**	**Q. 8**	**Q. 9**	**Q. 10**
A	A	A	B	D
Q. 11	**Q. 12**	**Q. 13**	**Q. 14**	**Q. 15**
C	B	A	B	A
Q. 16	**Q. 17**	**Q. 18**	**Q. 19**	**Q. 20**
B	B	D	C	B
Q. 21	**Q. 22**	**Q. 23**	**Q. 24**	**Q. 25**
C	D	B	B	B
Q. 26	**Q. 27**			
A	D			

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Take g = 9.8 ms^{-2} wherever needed

Q	Multiple choice questions
1	A laser light travels from the earth to the moon. How much time does the light take to reach the moon [the distance between the earth and the moon is **3.844 x 10^5 (km)** and the speed of light is **2.99 x 10^8 (m/s)**] A) 1.29 s B) 0.78 s C) 1.29 x 10^{-3} s D) 0.78 x 10^3 s
2	A railroad train travels forward along a straight track at 80 m/s for 1000 m and then travels at 50 m/s for the next 1000 m. The average velocity is: A) 31.2 m/s B) 44.7 m/s C) 56.3 m/s D) 61.5 m/s
3	A worker ascending at **7 m/s** in an open elevator **20 m** above the ground accidentlly drops a stone. The velocity of the stone just before touching the ground is : A) 14 m/s B) 18 m/s C) 21 m/s D) 58 m/s
4	The magnitude, r, and diraction, θ, for the vector $\vec{A} = -3.5\hat{\imath} - 2.5\hat{\jmath}$ are receptively: A) 6.2 & 120° B) 4.3 & 216° C) 6.2 & 160° D) 4.3 & 48°
5	For the two vectors $\vec{A} = \hat{\imath} - 3\hat{\jmath}$ & $\vec{B} = -5\hat{\imath} + 10\hat{\jmath}$. The direction of the resultant vector, **R = A + B** with + x-axis is: A) 45° B) 60° C) 120° D) 280°
6	A rescue plane travelling horizontally at **40 m/s** dropped a package which landed on the ground **200 m** in front of the point of release. What is the height of the plane from the point of release to the ground? A) 122.5 m B) 200.6 m C) 50.5 m D) 12.6 m
7	A satellite moving in a circular orbit **2000 km** above earth. The earth radius is **6.4x10^6 m** and the orbital speed of the satellite is **611 m/s**. The centripetal acceleration of the satellite is: A) 0.044 m/s^2 B) 0.2 m/s^2 C) 0.06 m/s^2 D) 7.3x10^{-5} m/s^2
8	The magnitude of the velocity of a projectile at its maximum height is equal to: A) The x component of its initial velocity B) The y component of its initial velocity C) Its initial velocity D) Zero

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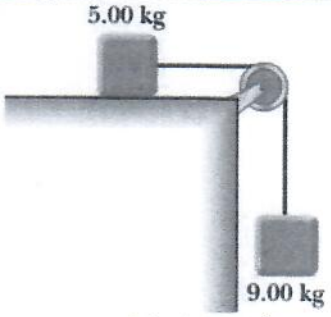
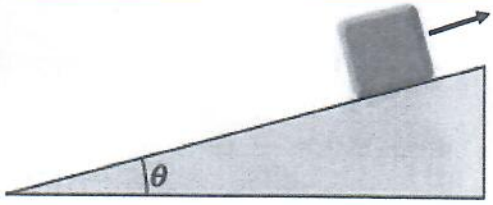
9	If an object moves with a varying velocity, this phenomenon is correlated to Newton's: A) 1st law B) 2nd law C) 3rd law D) None
10	A **3 kg** object undergoes an acceleration given by $\vec{a} = 1.86\hat{\imath} + 5\hat{\jmath}$ m/s^2. Find the resultant magnitude of the force: A) Zero B) 7.5 N C) 22 N D) 16 N
11	A **3 kg** object is moving in a plane, with its x and y coordinates given by $x = 5t^2 - 1$ and $y = 3t^3 + 2$, where x and y are in meters and t is in seconds. The magnitude of the net force acting on this object at $t = 3$ s is: A) 211 N B) 45 N C) 165 N D) 85 N
12	A **5 kg** object placed on a frictionless, horizontal table is connected to a string that passes over a pulley and then is fastened to a hanging **9 kg** object, as in the Figure. The acceleration of the two objects is:  A) 1.3 m/s^2 B) 6.3 m/s^2 C) 5.4 m/s^2 D) 3.6 m/s^2
13	A box is pushed up an inclined plane at ($\theta = 30^o$) with an initial speed of (**4.9 m/s**) then it was released to move freely. If the kinetic friction coefficient is (**0.13**). The distance it will covere before it stops is:  A) 2 m B) 3.9 m C) 5 m D) 4.5 m
14	A car goes around horizontal curve road with constant speed **14 m/s**, the total force on the driver has magnitude **100 N**. If the speed of the car is **28 m/s,** then the total force on the driver will be: A) 200 N B) 400 N C) 40 N D) 10 N

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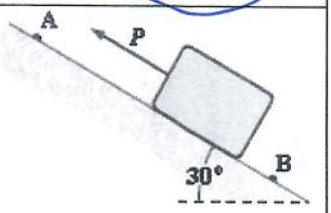
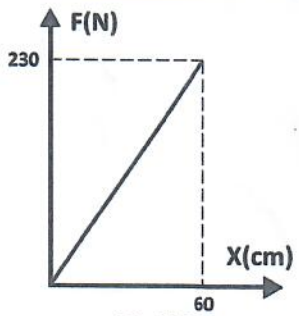
15	An object of mass ***m*** is swing in a vertical loop on a string with a speed ***v***. At the top of the loop, The tension **T** in the string is:  A) $T = \frac{mv^2}{r} - mg$ B) $T = \frac{mv^2}{r} + mg$ C) $T = \frac{mv^2}{r}$ D) zero
16	On a rainy day (يوم ممطر), the car begins to skid on the curve when its speed reaches **20 m/s**. What is the coefficient of static friction if the radius of the curve is **45 m**? A) 0.05 B) 0.91 C) 0.18 D) 0.29
17	A container with a mass of ***m*** is lifted above the ground level to a height ***h*** and then returned back to the ground level. The work done by the gravitational force is: A) *-mgh* B) *zero* C) *mgh* D) *–mgh/2*
18	A person of mass **90 kg** starts from rest to slide down a rough hill of **50 m** high. The person's speed at the bottom of the hill is **20 m/s**. The work done by the frictional force is : A) 17640 J B) -14400 J C) 13.2×10^5 J D) -26.1 kJ
19	A **2 kg** block slides down a frictionless incline from point **A** to point **B**. A force (magnitude $P = 3$ **N**) acts on the block between **A** and **B**, as shown. Points **A** and **B** are **2 m** apart. If the kinetic energy of the block at **A** is **10 J**, what is the kinetic energy of the block at **B**?  A) 34.6 J B) 26.4 J C) 23.6 J D) 19.2 J
20	An archer pulls his bowstring (وتر القوس) back **0.6 m** by exerting a force that increases uniformly from **zero** to **230 N**. The work done by the archer to pull the bow is:  A) 46 J B) 69 J C) 23 J D) 92 J

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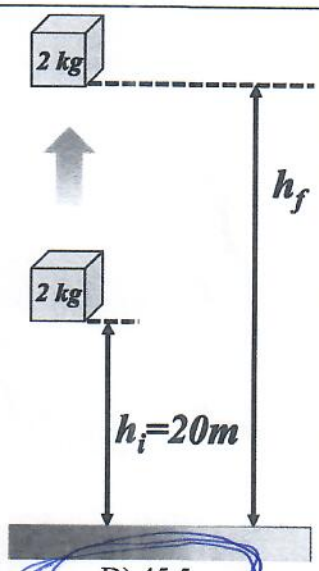
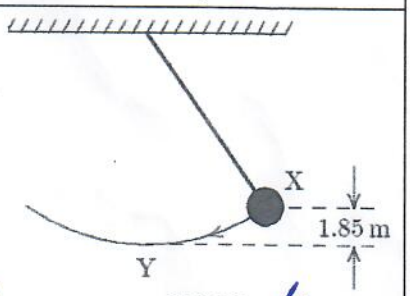
21	A **650 kg** elevator starts from **rest**. It moves upward for **3 s** with constant acceleration until it reaches its cruising speed of **1.75 m/s**. The average power of the elevator motor during this period is: A) 6489 W B) 2023 W C) 5894 W D) 3745W
22	A **2 kg** block is thrown upward from a point **20 m** above Earth's surface. At what height above Earth's surface will the gravitational potential energy of the Earth-block system have increased by **500 J**? (Neglecting air resistance)  A) 5.8 m B) 25.3 m C) 35.1 D) 45.5 m
23	A single conservative force $\mathbf{F} = (3\hat{i} + 5\hat{j})$ **N** acts on a **4 kg** particle. If the particle moves from the origin to the point having the vector position $\mathbf{r} = (2\hat{i} - 3\hat{j})$ **m**. what is the change in the potential energy? A) 19 J B) 9 J C) -9 J D) -19 J
24	A simple pendulum consists of a **2 kg** mass attached to a string. It is released from rest at "X" as shown. Neglecting all resistances, the speed at the lowest point "Y" is about:  A) 0.9 m/s B) 6 m/s C) 18 m/s D) 29 m/s
25	A spring (**k = 600 N/m**) is placed in a vertical position with its lower end supported by a horizontal surface. The upper end is compressed **20 cm**, and a **4 kg** block is placed on top of the compressed spring. The system is then released from **rest**. How far above the point of release will the block rise? A) 46 cm B) 31 cm C) 41 cm D) 20 cm

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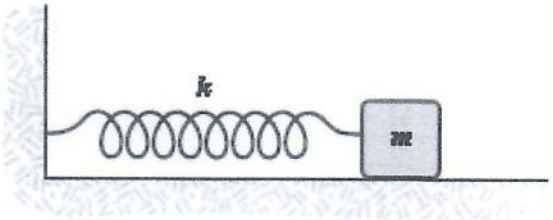
26	The block shown is released from **rest** when the spring is stretched a distance ***d***. If **k = 50 N/m**, ***m* = 0.50 kg**, ***d* = 10 cm**, and the coefficient of kinetic friction between the block and the horizontal surface is equal to **0.25**. Determining the speed of the block when it first passes through the position for which the spring is unstretched.  A) 71 cm/s B) 92 cm/s C) 61 cm/s D) 82 cm/s
27	A block slides across a **rough** horizontal table top. The work done by friction changes: A) only the kinetic energy B) only the potential energy C) only the kinetic and potential energies D) only the kinetic and internal energies

The End

Final exam
Phys 103
1st semmester 1444H

Q(1) $\text{time} = \frac{\text{Distance}}{\text{speed}} = \frac{3.844 \times 10^{5} \times 10^{3}\ (m)}{2.99 \times 10^{8}\ m/sec}$

$\Rightarrow$ time $= 1.29$ sec

Q(2) $\vec{v}_{avg} = \frac{\Delta \vec{x}}{\Delta t} = \frac{1000 + 1000}{\left(\frac{1000}{80}\right) + \left(\frac{1000}{50}\right)}$

$= \frac{2000}{12.5 + 20} = \frac{2000}{32.5} = 61.5\ m/s$

Q(3) $\vec{v}_i = 7\ m/s \quad \vec{v}_f = ?? \quad \vec{g} = -9.8\ m/s^2$

$v_f^2 = v_i^2 + 2g\Delta y$

$= (7)^2 + (2 \times 9.8) \times (20)$

$v_f^2 = 49 + 392 = 441$

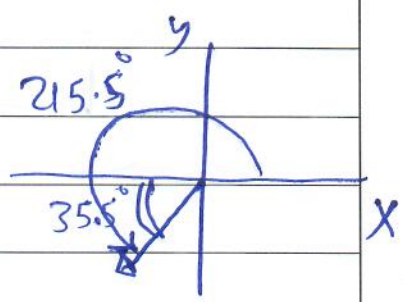
$\Rightarrow v_f = \sqrt{441} = 21\ m/s$

Q(4) $\vec{A} = -3.5\hat{i} - 2.5\hat{j}$

$A = \sqrt{(3.5)^2 + (2.5)^2} = 4.3$

$\theta = \tan^{-1}\left(\frac{2.5}{3.5}\right) = 35.5^\circ$

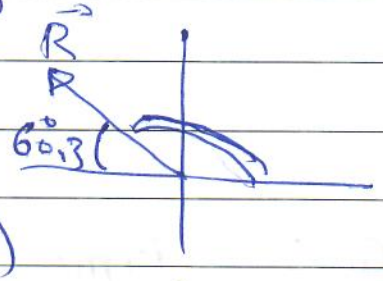
$\theta_{(+x)} = 216^\circ$



Q(5): $\vec{A} = \hat{i} - 3\hat{j}$ $\quad \vec{B} = -5\hat{i} + 10\hat{j}$

$\vec{R} = \vec{A} + \vec{B} = (1-5)\hat{i} + (-3+10)\hat{j}$

$\vec{R} = -4\hat{i} + 7\hat{j}$

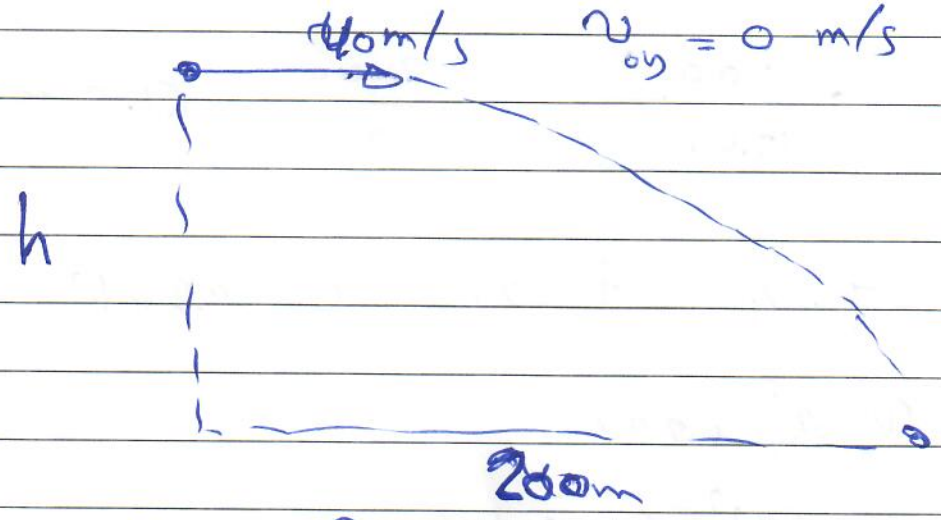


$\theta_R = \tan^{-1}\left(\frac{7}{-4}\right) = 60.3^\circ$ w with (-X)

with (+X) $= 180 - 60.3 = 119.7^\circ$

$\Rightarrow \theta_R \simeq 120^\circ$ w.r.t +X-axis

Q(6): $v_0 = 40\ m/s$ $\quad v_{0x} = +40\ m/s$ $\quad v_{oy} = 0\ m/s$



$\Delta t = \frac{\Delta x}{v_{0x}} = \frac{200}{40} = 5\ sec$

$\Rightarrow \Delta\vec{y} = \vec{v}_{oy}\Delta t + \frac{1}{2}\vec{g}\Delta t^2$

$= 0 - \frac{1}{2} \times 9.8 \times (5)^2$

$\Delta y = -122.5\ m$

$\boxed{h = +122.5\ m}$

Q(7): $a_c = v^2/r$ $\quad v = 611$ m/s

$R = 6.4 \times 10^6$ m $\quad h = 2000$ km $= 2 \times 10^6$ m

$r = R + h = 6.4 \times 10^6 + 2 \times 10^6 = 8.4 \times 10^6$ m

$\Rightarrow a_c = \dfrac{(611)^2}{8.4 \times 10^6} = 0.044$ m/s^2

Q(8) (A) the x-component of its initial velocity.

Q(9): (B) 2nd law

Q(10): $\vec{F} = m\vec{a} = 3 \times (1.86\hat{i} + 5\hat{j})$

$\vec{F} = 5.58\hat{i} + 15\hat{j}$

$F = \sqrt{(5.58)^2 + (15)^2} = 16$ N.

Q(11): $v_x = \dfrac{d\vec{x}}{dt} = 10t$ $\quad v_y = \dfrac{d\vec{y}}{dt} = 9t^2$

$a_x = \dfrac{dv_x}{dt} = 10$ m/s^2 $\quad a_y = \dfrac{dv_y}{dt} = 18t$ m/s^2

at $t = 3$ sec

$\vec{a} = 10\hat{i} + 18 \times 3\hat{j}$

$10\hat{i} + 54\hat{j}$

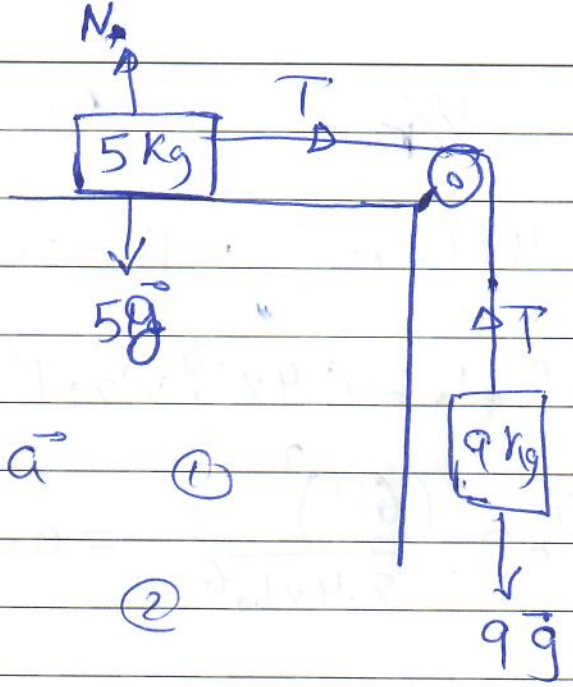
$\Rightarrow a = \sqrt{10^2 + 54^2}$

$a = 54.9$ m/s^2

$F = ma = 3 \times 54.9$

$F = 165$ N

Q(12):



$9\vec{g} - T = 9\vec{a}$ ①

$T = 5\vec{a}$ ②

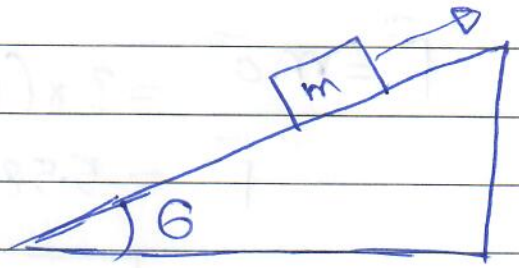
$\Rightarrow 9\vec{g} = (9+5)\vec{a}$

$\vec{a} = \frac{9 \times 9.8}{14} = 6.3 \text{ m/s}^2$

Q(13) $\theta = 30^\circ$

$v_i = 4.9 \text{ m/s}$

$\mu_k = 0.13$



$mg\sin\theta + f = ma$

$\Rightarrow -mg\sin\theta + \mu_k mg\cos\theta = ma$

$-9.8 \times \sin 30 + 0.13 \times 9.8 \times \cos(30) = a$

$\vec{a} = -4.9 - 1.1$

$= -6 \text{ m/s}^2$

$\Rightarrow v_f^2 = v_i^2 - 2a\Delta x$

$0 = (4.9)^2 - 2 * 6 * \Delta x$

$$\Rightarrow d = \frac{(4.9)^2}{2 \times 6} = 2\ m$$

(14) $v_1 = 14\ m/s$

$\vec{F}_{c_1} = 100\ N$

$v_2 = 28\ m/s$

then what $\vec{F}_{c_2}$??

$$F_{c_1} = \frac{m v_1^2}{r} \Rightarrow 100 = \frac{m \times (14)^2}{r}$$

$$\Rightarrow \frac{m}{r} = \frac{100}{(14)^2} = 0.51\ kg/m$$

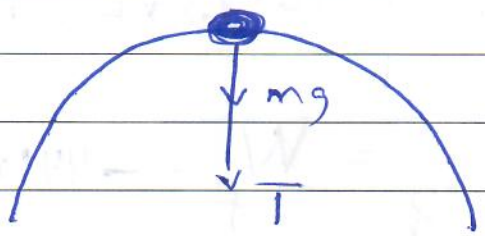
$$F_{c_2} = \frac{m}{r}(v_2)^2 = 0.51 \times (28)^2$$

$$= 399.84 = 400\ N$$

Q(15): $\sum \vec{F} = \frac{mv^2}{r}$

$$T + mg = \frac{mv^2}{r}$$

$$\Rightarrow \boxed{T = \frac{mv^2}{r} - mg}$$



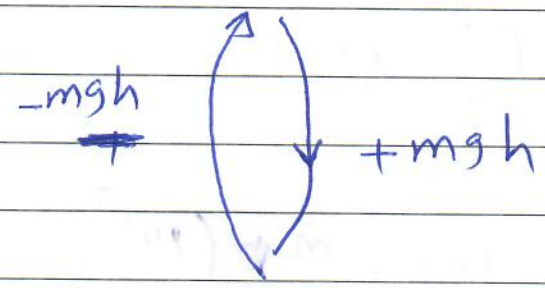
Q(16) $v_i = 20\ m/s$

$$f_s = \frac{mv^2}{r} \Rightarrow \mu_s mg = \frac{mv^2}{r}$$

$$\mu_s = \frac{v^2}{rg} = \frac{(20)^2}{45 \times 9.8}$$

$$\mu_s = \frac{400}{441} = 0.91$$

Q(17)



$$total = -mgh + mgh = Zero$$

Q(18) $m = 90\ kg$ $h = 50\ m$ $v_i = 0\ m/s$ $v_f = 20\ m/s$

$$\Rightarrow \Delta U + \Delta K = W_f$$

$$(0 - mgh) + \frac{1}{2}m(v_f^2 - 0) = W_f$$

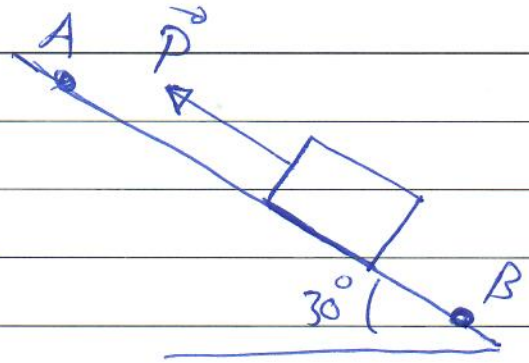
$$-90 \times 9.8 \times 50 + \frac{1}{2} \times 90 \times (20)^2 = W_f$$

$$\Rightarrow W_f = -44100 + 18000$$

$$= -26100\ J$$

$$\boxed{W_f = -26.1\ kJ}$$

Q(19)



$W = \Delta K$

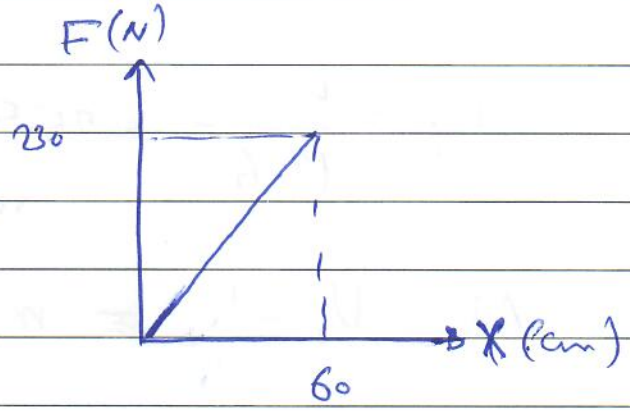
$(mg\sin\theta - \vec{P}) \cdot \Delta\vec{x} = \Delta K$

$(2 \times 9.8 \times 0.5 - 3) \times 2 = K_B - K_A$

$(9.8 - 3) \times 2 = K_B - 10$

$\Rightarrow K_B = 13.6 + 10 = 23.6\ J$

Q(20):



$W = \frac{1}{2} \times 60 \times 230$

$= 30 \times 230$

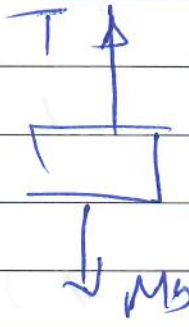
$W = 69\ J$

Q(21) $M = 650\ kg$ $v_i = 0$ $\Delta t = 3\ sec$

$v_f = 1.75\ m/s$

$\vec{a} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t} = \frac{1.75 - 0}{3} = 0.6\ m/s^2$

$\Rightarrow$ ~~$P = F \cdot v = Mg \cdot v$~~



$T - Mg = Ma$

$T = M(a + g)$

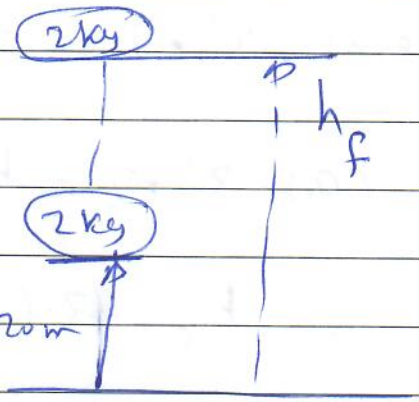
$= 650(0.6 + 9.8)$

$= 6760\ N$

$$P_{avg} = T v_{avg} = 6760 \times \left(\frac{1.75}{2}\right)$$

$$= 5915 \text{ W}$$

(22)



$\Delta U + \cancel{\Delta K} = 0$

$500 - 2 \times 9.8 \times 20 +$

$U_f = mgh_f$

$\cancel{500 = 2 \times 9.8 \times h_f}$

$$h_f = \frac{500}{19.6} = 25.5 \text{ m}$$

$$\Delta U = U_f - U_i \equiv mgh_f - mgh_i$$

$$500 = 2 \times 9.8 (h_f - 20)$$

$$\Rightarrow \frac{500}{19.6} = h_f - 20$$

$$\Rightarrow h_f = 25.5 + 20 = 45.5 \text{ m}$$

(23) $\vec{F} = 3\hat{i} + 5\hat{j}$, $m = 4 \text{ kg}$

$$W = -\Delta U \Rightarrow \vec{F} \cdot \Delta\vec{r} = \Delta U$$

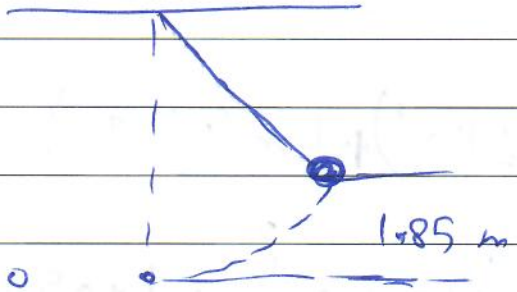
$$3 \times 2 - 5 \times 3 = -\Delta U$$

$$\Rightarrow 6 - 15 = -\Delta U$$

$\Rightarrow -\Delta U = -9$

$\Rightarrow \boxed{\Delta U = +9\ J}$

(24)



$\Delta U + \Delta K = 0$

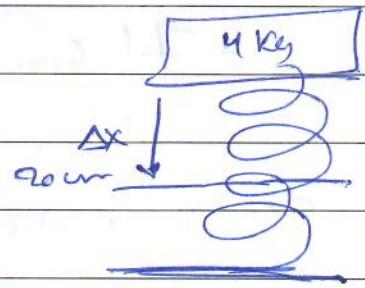
$-mgh + \frac{1}{2}m(v_y^2 - v_x^2) = 0$

$\Rightarrow \cancel{+}\cancel{mgh} = \cancel{+}\frac{1}{2}\cancel{m}v_y^2$

$v_y = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 1.85}$

$\boxed{v_y = 6\ m/s}$

(25)



$\frac{1}{2}kx^2 = mgh$

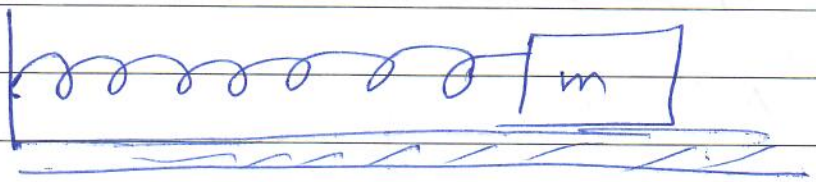
$+\frac{1}{2} \times 600 \times (0.2)^2 = 4 \times 9.8 \times h$

$h = \frac{300 \times 0.04}{4 \times 9.8} = 0.306m$

$\simeq 0.31\ m$

$h \simeq 31$ cm.

Q (26)



$K = 50\ N/m$

$m = 0.5\ kg \quad d = 10\ cm \quad \mu_K = 0.25$

$$(0 - \tfrac{1}{2}Kx^2) + \tfrac{1}{2}m(v_f^2 - v_i^2) = W_f$$

$$-\tfrac{1}{2} \times 50 \times (0.1)^2 + \tfrac{1}{2} \times 0.5 \times v_f^2 = -\mu_K \times mg \times d$$

$$-25 \times 0.01 + 0.25\, v_f^2 = -0.25 \times 0.5 \times 9.8 \times 0.1$$

$$\Rightarrow v_f^2 = \frac{-(-0.1225) + 0.25}{0.25}$$

$$v_f^2 = 0.51$$

$$\Rightarrow v_f = \sqrt{0.51} = 0.71\ m/s$$

$$= 7.1\ cm/sec$$

Q (27) A block slides across a rough horizontal table top, the work done by friction changes:

the Kinetic & Internal Energies