حل اختبار الدوري الثاني

لمادة الفيزياء

مع تحيات فريق ٢٠٢٠

A

1. An object has a position vector $(9\text{ m})\hat{i} + (16\text{ m})\hat{j}$, after time t = 3 s its position vector changed to $(6\text{ m})\hat{i} - (12\text{ m})\hat{j}$. What is its average velocity?
   A) $(5.4\text{ m/s})\hat{i} - (4.8\text{ m/s})\hat{j}$
   B) $(-1\text{ m/s})\hat{i} - (9.3\text{ m/s})\hat{j}$
   C) $(3\text{ m/s})\hat{i} + (1.3\text{ m/s})\hat{j}$
   D) $(3\text{ m/s})\hat{i} - (1.3\text{ m/s})\hat{j}$

   $\frac{\Delta r}{\Delta t}$ $\frac{r_2 - r_1}{t_2 - t_1}$ $6i - 12j$ $9i + 16j$ $-3i - 28j$ $\frac{-3i - 28j}{3}$ $-1i - 9.3j$

2. Two objects are traveling around different circular orbits with constant speed. They both have the same acceleration but object A is traveling one-half as fast as object B. The orbital radius for object A is _____ the orbit radius for object B.
   A) One-fourth
   B) Four times
   C) One-half
   D) twice

   4 16 $a = 4$ A $v = 4$ $\frac{4^2}{4} = 4\text{ m}$ $a = 4$ B $v = 8$ $\frac{8^2}{4} = 16$ $a = \frac{v^2}{R}$ $R = \frac{v^2}{a}$

3. An object moving in circular orbit with constant linear velocity of 4 m/s and orbital radius of 2 m, what is the centripetal acceleration?
   A) 1 m/s^2
   B) 4 m/s^2
   C) 2 m/s^2
   D) 8 m/s^2

   $a = \frac{v^2}{R} = \frac{4^2}{2} = 8$

4. An object completes one full revolution of circular orbit in π seconds, given that the orbital radius is 5 m, what is the objects linear velocity?
   A) 5 m/s
   B) 31.83 m/s
   C) 1.59 m/s
   D) 10 m/s

   $v = \frac{2\pi r}{T} = \frac{2\pi r}{\pi}$ $\frac{2\pi 5}{\pi}$ $2 \times 5 = 10$. $2\pi r$ / T | v

5. An object is at rest at the point of origin (0,0), it accelerates at a rate of $(-3.2\text{ m/s}^2)\hat{i} + (8.6\text{ m/s}^2)\hat{j}$ for 4.7 seconds. Its final coordinates are:
   A) $(-15.04\text{ m})\hat{i} + (40.42\text{ m})\hat{j}$
   B) $(-0.68\text{ m})\hat{i} + (1.83\text{ m})\hat{j}$
   C) $(-35.34\text{ m})\hat{i} + (94.99\text{ m})\hat{j}$
   D) $(-8.26\text{ m})\hat{i} + (45.44\text{ m})\hat{j}$

   $\frac{-3.2t^2}{2} + \frac{8.6t^2}{2}$ $\frac{-3.2(4.7)^2}{2} + \frac{8.6(4.7)^2}{2}$

6. An object changes its velocity from $v_x = 6$ m/s, $v_y = -8$ m/s to $v_x = 2$ m/s, $v_y = -3$ m/s in 2 seconds, what is the magnitude and direction of the average acceleration?
   A) 3.2 m/s^2, 128.66°
   B) 1.8 m/s^2, -33.69°
   C) 5 m/s^2, -36.87°
   D) 2.4 m/s^2, 112.21°

   $\frac{\Delta v}{\Delta t}$ $v_2 = 2i - 3j$ $v_1 = 6i - 8j$ $\Delta v = -4i + 5j$ $\frac{\Delta v}{2} = a = -2i + 2.5j$ $\sqrt{2^2 + 2.5^2} = 3.2$

$v = v_o + a\,t$ $\Delta x = v_o\,t + \frac{1}{2}a\,t^2$ $v^2 = v_o^2 + 2\,\Delta x\,a$

A

7.	A friction force is A) A contact force that acts parallel to the contact surface B) A contact force that acts perpendicular to the contact surface C) A scalar quantity since it can act in any direction D) Always equal to the normal force between the objects
8.	When the net force on an object is zero, which of the following statements is *not* true? A) The vector sum of the forces acting on the object is zero B) The object has a constant acceleration C) The object has a constant velocity D) The speed of the object is constant
9.	A 2 kg particle moves with velocity $2\hat{\imath} + 2\hat{\jmath}$ m/s, the net force on the particle is: A) In the direction of the velocity B) Opposite of the velocity C) Zero D) $4\hat{\imath} + 4\hat{\jmath}$ N
10.	A 2 kg box is under a 6 N force east and another 8 N force west, what is the acceleration of the box? (neglecting friction) A) 1 m/s², west B) 1 m/s², east C) 7 m/s², west D) 7 m/s², east
11.	A man of mass 70 kg is in an elevator accelerating downward at 1.2 m/s², the magnitude of the normal force on the man from the elevator floor is: A) 770 N B) 602 N C) 755.2 D) 555.2
12.	A 20 N box is being held at rest on a frictionless incline plane by a force that is parallel to the incline. If the incline is 30° above the horizontal, what is the magnitude of the normal force on the box? A) 14.82 N B) 12.56 N C) 17.32 N D) 10 N

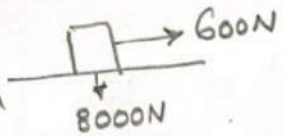
$v = v_o + a\,t$ $\quad \Delta x = v_o\,t + \frac{1}{2}a\,t^2$ $\quad v^2 = v_o^2 + 2\,\Delta x\,a$

A

13. A car is being pulled by a tractor applying a total force of 600 N, if the car weighs 8000 N, what is the magnitude of acceleration of the car?

A) 0.735 m/s²
B) 130.6 m/s²
C) 0.075 m/s²
D) 13.3 m/s²

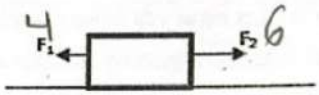
$600 = ma$
$600 = 816.32 \times a$



14. In the following figure, given $F_1 = 4$ N and $F_2 = 6$ N, what is the acceleration of the block if it weighs 20 N?

A) 0.1 m/s²
B) 1.2 m/s²
C) 0.98 m/s²
D) 0.85 m/s²

$6 - 4 = ma$
$2 = 2.04 \times a$



15. Two forces applied on a particle moving with constant velocity, if $\mathbf{F_1} = 46\hat{i} - 12\hat{j}$, then $\mathbf{F_2}$ equals:

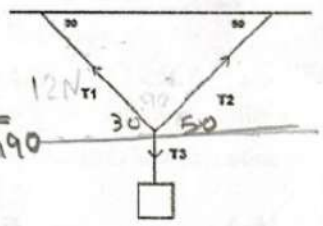
A) Zero
B) $\mathbf{F_2} = -45\hat{i} - 12\hat{j}$
C) $\mathbf{F_2} = 46\hat{i} + 12\hat{j}$
D) $\mathbf{F_2} = -46\hat{i} + 12\hat{j}$

$F_1 + F_2 = 0$
$46i - 12j + F_2 = 0$
$F_2 = -46i + 12j$

16. A crate is hung by two ropes as shown in the following figure, given that $T_1 = 12$ N at angle 30°, find the value of T_2 given that the angle of T_2 with the ceiling is 50°.

A) T_2 = Zero
B) $T_2 = 16.17$ N
C) $T_2 = 54.75$ N
D) $T_2 = 35.5$ N

$\frac{12}{\sin 140} = \frac{T_2}{\sin 120} = \frac{T_3}{\sin 90}$



17. A cannonball is fired with initial velocity $\mathbf{v_o} = 3\hat{i} + 4\hat{j}$ m/s. What is the horizontal range the cannonball will travel before it hits the ground?

A) 2.45 m
B) 0.82 m
C) 1.02 m
D) 2.35 m

$\frac{2 \times 3 \times 4}{9.8}$
$\frac{2 \times V_{ox} \times V_{oy}}{g}$

18. A cannonball is fired with initial velocity $\mathbf{v_o} = 3\hat{i} + 4\hat{j}$ m/s. What is the maximum height the cannon ball reaches?

A) 2.45 m
B) 0.82 m
C) 1.02 m
D) 2.35 m

$\frac{V_{oy}^2 \sin\theta^2}{2g}$
$\frac{V_{oy}^2}{2g}$
$\frac{4^2}{2 \times 9.8}$

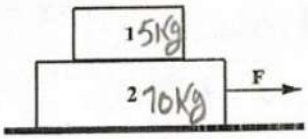
$v = v_o + a\,t$ $\quad$ $\Delta x = v_o\,t + \frac{1}{2}a\,t^2$ $\quad$ $v^2 = v_o^2 + 2\,\Delta x\,a$

A

19. Given the masses of the two blocks shown in the following figure as $M_1 = 5$ kg and $M_2 = 10$ kg, what is the acceleration of the system when the blocks are being pulled by a force of 65 N?

A) 6.5 m/s²
B) 4.3 m/s²
C) 1.3 m/s²
D) 13 m/s²

$F = (m_1 + m_2)a$
$65 = (5+10)a$
$65 = 15a$



20. A string that can withstand tension of 35.0 N but breaks under any larger tension is attached to the ceiling of an elevator. How large a mass can be hung from the string without breaking it if the elevator is accelerating upward with acceleration 3.2 m/s²?

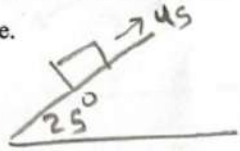
A) 3.57 kg 46.4 T
B) 2.69 kg 34.97
C) 4.26 kg 55.38
D) 5.30 kg 68.9

$T - mg = ma$ $T = 35.0$
$T - = 4.26 \times 3.2$
$mg = 35$

21. A 6 kg block is at rest on an incline plane at angle 25°, calculate the coefficient of static friction between the block and the surface of the plane.

A) 0.466
B) 0.225
C) 0.846
D) 0.75

F_s
F

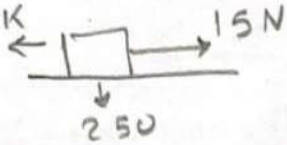


$mg\sin\theta = \mu_K \cdot N\cos\theta$
$6 \times 9.8 \sin 25 = \mu_K \cdot 58.8 \cos 25$

22. A man pulls a crate on a horizontal surface at constant velocity, if the man applies a force of 15 N and the crate weighs 250 N, what is the coefficient of kinetic friction between the crate and the ground?

A) 0.61
B) 0.12
C) 0.06
D) 0.478

μK
FK



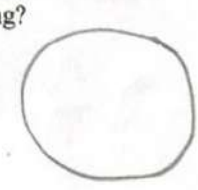
$15 = \mu K \cdot N =$
$\mu K \cdot 250$

23. A 0.4 kg stone attached to a string is swung in a circle of radius 0.8 m, if the stone makes 120 revolutions per minute, what is the tension of the string?

A) 1.82×10^5 N
B) 50.53 N
C) 8.78×10^{-4} N
D) 3.16 N

$T_{inc} = \frac{60}{120} = 0.55$

$T = \frac{mv^2}{R}$



$\frac{0.4 \times 10.05^2}{0.8} = 50.53\text{N}$

$v = v_o + at$

$V = \frac{2\pi 0.8}{0.5} = 10.05$

$\Delta x = v_o t + \frac{1}{2} a t^2$

$v^2 = v_o^2 + 2\Delta x\, a$

A

$F\cos\theta = F_K \quad N$
$\mu K \cdot mg + F\sin\theta$
ميزان

24. A 70 kg man stands on a bathroom scale on a descending elevator. What is the weight reading on the scale if the elevator is slowing down at a rate of 3 m/s² while descending?

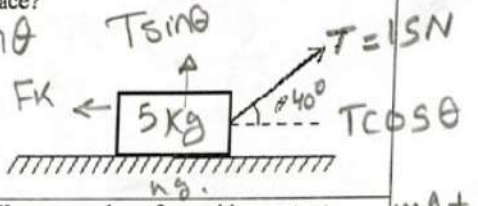
A) 700 N
B) 210 N
C) 896 N
D) 686 N

$mg - T = ma$
$70 \times 9.8 - T = 70 \times 3$

25. A block of mass $m = 5$ kg is pulled at constant velocity along a rough horizontal floor by an applied force $\vec{T} = 15$ N with angle 40° as shown. What is the coefficient of kinetic friction between the block and the surface?

A) 0.29
B) 0.197
C) 0.839
D) 0.42

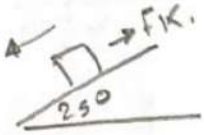
$F\cos\theta = \mu K \cdot 49 + F\sin\theta$
15
$19.49 =$



26. A block of mass m = 8 kg is sliding down at 25° on a rough surface with constant velocity, what is the magnitude of the frictional force?

A) 78.4 N
B) 71.05 N
C) 33.13 N
D) 3.38 N

$mg\sin\theta$

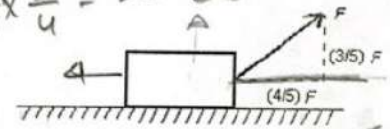


$mg +$

27. A 400 N block is dragged along a horizontal surface by an applied force $\vec{F}$ as shown. The coefficient of kinetic friction is 0.4 and the block moves at constant velocity, what is the magnitude of $\vec{F}$?

A) 153.85 N
B) 200 N
C) 128.46 N
D) 111.3 N

$\tan^{-1}\left(\frac{3}{5} \times \frac{5}{4}\right) = 36.86°$



$F\cos 36.86 = \mu K \times 400 + F\sin 36.86$
0.4

28. An object of mass $m_1 = m$ and another object of mass $m_2 = 2m$ move in a circle of radius 1 m and at a constant linear velocity of 1.0 m/s, what is the ratio of their centripetal acceleration a_{2c}/a_{1c}?

A) 2
B) 1
C) 1/2
D) $\sqrt{2}$

$a = \frac{v^2}{r}$ $\quad$ $a = \frac{v^2}{r}$
$\frac{1}{1}$ $\quad$ $\frac{1}{1}$

$\mu K \cdot N$
mg

$F\cos 36.86 = 0.4 \times 400$

$v = v_o + a\,t$ $\qquad$ $\Delta x = v_o\,t + \frac{1}{2}a\,t^2$ $\qquad$ $v^2 = v_o^2 + 2\,\Delta x\,a$

29.	Why do raindrops fall with constant speed during the later stages of their descent? A) Gravity cannot increase the speed of a falling object more than 9.8 m/s B) The gravitational force is the same for all drops C) The force of gravity is negligible for objects as small as raindrops D) Air resistance balances the force of gravity
30.	A cube has a drag coefficient of 0.8. What would be the terminal velocity of a sugar cube 1 cm on a side in air (ρ = 1.2 kg/m^3)? Take the density of sugar to be 1.6 x 10^3 kg/m^3. A) 18.07 m/s B) 24.5 m/s C) 180.74 m/s D) 244.78 m/s

C

$A = (1 \times 10^{-2})^2 = 10^{-4}$

$V_X = 10^{-12}$

1.2×10^{-12}

$V_t = \sqrt{\frac{2mg}{CpA}}$

(1)

(1) $V_{avg} = \frac{\Delta r}{\Delta t} = \frac{r_2 - r_1}{t_2 - t_1}$ $\quad t=3$

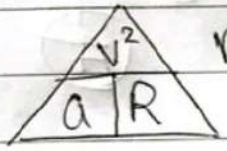
$r_2 \quad 6i - 12j$

$-r_1 \quad 9i + 16j$

$\Delta r = -3i - 28j$

$V_{avg} = \frac{-3i - 28j}{3} = -1j - 9.3j$ (B)

(2) object A: $a=4$, $V=4$ — object B: $a=4$, $V=8$ — نقوض بالقانون



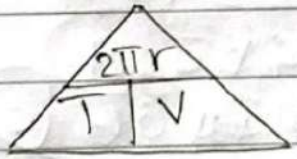
$r = \frac{4^2}{4} = 4m$ $\quad \frac{8^2}{4} = 16m.$

$r_A = 4$ $\quad r_B = 16$

$A = \frac{1}{4}B$ (A)

(3) $a_1 = \frac{V^2}{R} = \frac{4^2}{2} = 8 m/s^2$ (D)

(4) $t = \pi$ seconds $\quad r = 5m \quad V = ??$



$V = \frac{2\pi r}{T}$ $\quad \frac{2\pi 5}{\pi} = 2 \times 5 = 10 m/s$ (D)

(5) $\frac{-3.2t^2}{2} + \frac{8.6t^2}{2}$ $\quad t = 4.7$

$\frac{-3.2(4.7)^2}{2} i + \frac{8.6(4.7)^2}{2} j$ (C)

$-35.34i + 94.99j$

(6) $V_2 = 2i - 3j$

$-V_1 = 6i - 8j$

$\Delta V = -4i + 5j$

$a_{avg} = \frac{\Delta V}{\Delta t}$

$\frac{-4i+5j}{2} = -2i + 2.5j$

$|a| = \sqrt{(-2)^2 + (2.5)^2} = 3.2 m/s^2$

$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{2.5}{2}\right) = 51.34$

$180 - \theta$ في الربع الثاني

$180 - 51.34 = 128.65°$ (A)

(7) A friction force is:
a contact force that acts parallel to the contact surface

(8) when the net force on an object is Zero
which of the following is not true?
The object has a constant acceleration. (B)

(9) Velocity $2i + 2j$ السرعة ثابتة لأنه لا يوجد متغير
إذاً التسارع يصفر
the net force on the particle is أو $v \xrightarrow{\text{تشتق}} a$

$F = m \times a$ اشتقاق أي عدد يصفر

$2 \times 0 = 0$ Zero. (C)

(3)

(10) west. east

8N ← □ → 6N

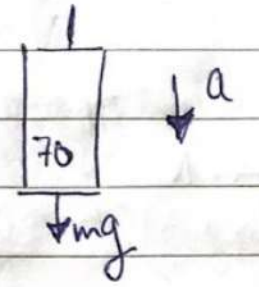
$8-6 = ma$

$2 = 2kg \times a$

$a = 1\ m/s^2$ west (A)

التسارع دائماً في اتجاه محصلة القوى

(11)

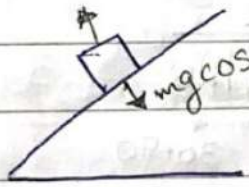


$mg - T = ma$

$70 \times 9.8 - T = 70 \times 1.2 = 602N$ (B)

ma = عكس التسارع – اللي مع التسارع

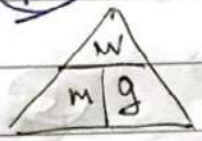
(12)

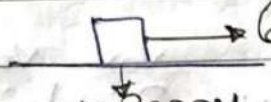


$N = mg\cos\theta$

$20N \cos 30 = 17.32N$ (C)

(13)





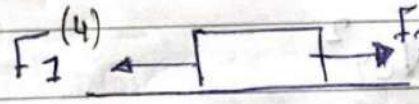
$m = \frac{8000}{9.8} = 816.32$

$600 = ma$

$600 = 816.32 \times a$

$a = 0.735\ m/s^2$

(14)



$m = \frac{20}{9.8} = 2.04$

$6 - 4 = ma$

$2 = 2.04 \times a$

$a = 0.98\ m/s^2$ (C)

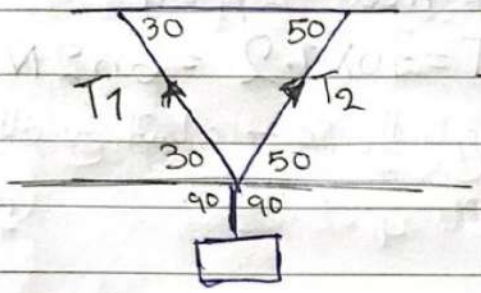
(15) Constant velocity → net force = Zero
$F_1 + F_2 = 0$

$\vec{F}_1 + \vec{F}_2 = 0$

$46i - 12j + \vec{F}_2 = 0$

$\vec{F}_2 = -46i + 12j$ (D)

(16)



$$\frac{T_1}{\sin\theta} = \frac{T_2}{\sin\theta}$$

$$\frac{12N}{\sin 140} = \frac{T_2}{\sin 120}$$

50+90 T_1 ... 30+90

$$T_2 = \frac{12 \times \sin 120}{\sin 140} = 16.17\ N$$ (B)

(17) Range $= \frac{2 V_{ox} \cdot V_{oy}}{g}$

$V_o = 3i + 4j$ (V_{ox}, V_{oy})

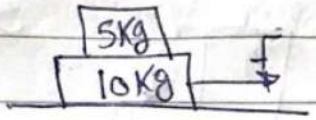
$$= \frac{2 \times 3 \times 4}{9.8} = 2.45m$$ (A)

(18) Maximum height $= \frac{V_{oy}^2}{2g}$

$V_o = 3i + 4j$ (V_{oy})

$$\frac{4^2}{2 \times 9.8} = 0.82m$$ (B)

(5)



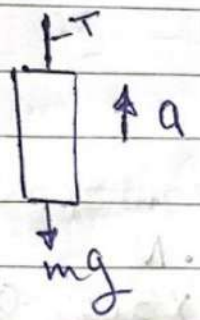
(19)

$F = (m_1 + m_2)a$

$65 = (5+10)a$

$a = 4.3 m/s^2$ (B)

(20)



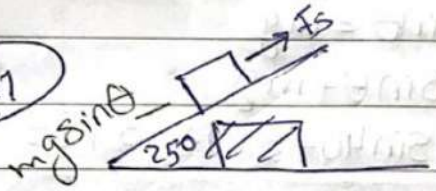
اللي مع التسارع - عكس التسارع = ma

$T - mg = ma$

$35 - (m)(9.8) = (m)(3.2)$

$m = 2.69 Kg$ (B)

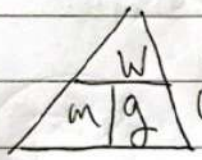
(21)



$mg\sin\theta = \mu K . N\cos\theta$

$6 \times 9.8 \sin 25 = \mu K \cdot 58.8 \cos 25$

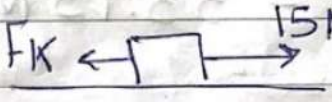
$\mu K = 0.466$ (A)



$W = m \times g$

(N) $6 \times 9.8 = 58.8$

(22)

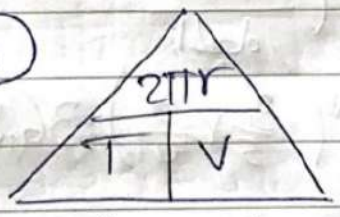


$F = FK$

$F = \mu K \cdot N$

$15 = \mu K \times 250 = 0.06$ (C)

(23)

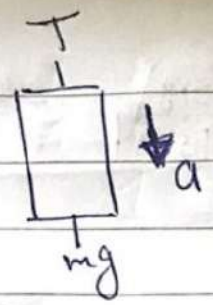


$T = \frac{\text{الزمن}}{\text{عدد اللفات}} = \frac{60}{120} = 0.55$ ①

$V = \frac{2\pi r}{T} = \frac{2\pi(0.8)}{0.5} = 10.05$

② $T = \frac{mV^2}{R} = \frac{0.4 \times (10.05)^2}{0.8} = 50.53N$ (B)

(24) slowdown $a = -3\ m/s^2$ (6)

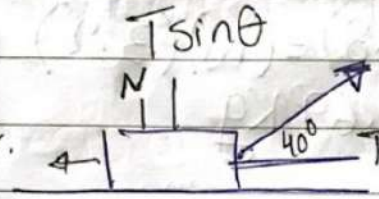


$mg - T = ma$

$70 \times 9.8 - T = 70 \times (-3) = 896\ N$ (C)

reading on scale = T

(25)



$T\cos\theta = FK$

$15\cos 40 = \mu K \cdot N$

$15\cos 40 = \mu K \times 39.35 = 0.29$ (A)

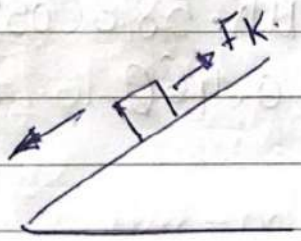
$N + T\sin\theta = mg$

$N = -T\sin\theta + mg$

$-15\sin 40 + 5 \times 9.8 = 39.35$

constant velocity

(26)

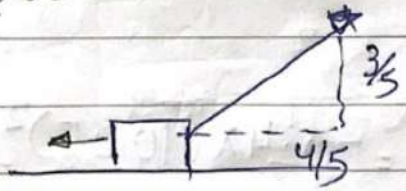


$FK = mg\sin\theta$

$8 \times 9.8 \sin 25$

$= 33.13\ N$ (C)

(27) توجد أكثر من طريقة



$\theta = \tan^{-1}\left(\frac{\text{المقابل}}{\text{المجاور}}\right)$

$\tan^{-1}\left(\frac{3}{5} \times \frac{5}{4}\right) = 36.87$

$F\cos\theta = FK$

$F\cos 36.87 = \underset{0.4}{\mu K}\left(\underset{400}{mg} - F\sin 36.87\right) = 153.8\ N$ (A)

$r = 1 \quad v = 1$

(28) $a_1 = \frac{v^2}{r}$ $\quad a_2 = \frac{v^2}{r}$

$\frac{1}{1} = 1$ $\quad \frac{1}{1} = 1$

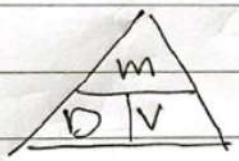
$a_2/a_1 = \frac{1}{1}$ (B)

(29) Why do raindrops fall with constant speed

air resistance balances the force of gravity.. (D)

(30) $C = 0.8$ $\quad L = 0.01\,m = 1 \times 10^{-2}$ $\quad \rho_{air} = 1.2\,kg/m^3$

$\rho_{sugar} = 1.6 \times 10^3\,kg/m^3$



$\frac{\text{mass}}{\text{volume}}$

$M_{sugar} = 1.6 \times 10^3 \times L^3$

$1.6 \times 10^3 \times (0.01)^3 = 1.6 \times 10^{-3}\,kg$

$A = L^2 \quad (0.01)^2 = 1 \times 10^{-4}\,m^2$

الطلوب

$V_t = \sqrt{\frac{2mg}{C\rho A}}$

$= \sqrt{\frac{2 \times 1.6 \times 10^{-3} \times 9.8}{0.8 \times 1.2 \times 10^{-4}}} = 18.\overline{3}\,m/s$ (A)