Name SOLUTIONS Date

109 Review Up to Energy

1) How much work is done in lifting a 10 kg object 7 m?

$m = 10\,kg$

$F = \text{weight} = mg$

$F = (10)(9.8) = 98\,N$

$d = 7\,m$

$W = Fd$

$W = (98)(7)$

$W = \boxed{686\,J}$

2) A 300 g mass is hung from a spring. The spring constant is 40 N/m. How far will the spring stretch? Give your answer in cm.

$m = 300\,g = .300\,kg$

$F = \text{weight} = (.3)(9.8) = 2.94\,N$

$K = 40\,N/m$

$F = Kx$

$2.94 = 40x$

$\frac{2.94}{40} = x = .0735\,m$

$.0735\,m \times \frac{100\,cm}{m} = \boxed{7.35\,cm}$

3) A person carries a 40 kg air conditioner up a staircase that is 5 m in the horizontal direction and 3 m in the vertical. How much work did the person do on the air conditioner?

$m = 40\,kg$

$F = \text{weight} = mg$

$F = (40)(9.8) = 392\,N$

$d = 3\,m$

$W = Fd$

$W = (392)(3)$

$W = \boxed{1176\,J}$

If it took 45 s for the person to walk up the stairs with the air conditioner, how much power did they generate in this effort?

$t = 45\,s$

$W = 1176\,J$

$P = \frac{W}{t}$

$P = \frac{1176}{45} = \boxed{26.1\,W}$

What was their power in horsepower? (1 hP = 746 Watts)

$26.1\,W \times \frac{1\,hp}{746\,W} = \boxed{.035\,hP}$

Answers: 1) 686 J 2) 7.35 cm 3) 1176 J 26.1 W .035hP

4) A projectile is fired from the ground at an angle. The projectile reaches a maximum height of 70 m. The horizontal component of the projectile was 200 m/s. What was the range of the projectile?

X

$V = 200\ m/s$

$t = 7.6\ s$

$d = vt$

$d = (200)(7.6)$

$d = \boxed{1520\ m}$

Y ON THE WAY DOWN

$V_i = 0\ m/s$

$a = 9.8\ m/s^2$

$d = 70\ m$

$d = v_i t + \frac{1}{2} a t^2$

$70 = 0 + 4.9 t^2$

$\sqrt{\frac{70}{4.9}} = t = 3.8\ s$

5) A 30 kg box is being slid across a floor where the coefficient of friction (u) is 0.4. What is the force of friction?

$m = 30\ kg$

$u = .4$

NORMAL = weight = mg

$NORMAL = (30)(9.8) = 294\ N$

$F_{FRICTION} = (NORMAL)(u)$

$F_{FRICTION} = (294)(.4)$

$F_{FRICTION} = \boxed{117.6\ N}$

6) A 60 N force acted on a 12 kg object. The object started at rest and the force was applied for 3 s. What was the final speed of the object?

$F = 60\ N$

$m = 12\ kg$

$v_i = 0\ m/s$

$t = 3\ s$

$v_f = ?$

$Ft = mv_f - mv_i$

$(60)(3) = (12)(v_f) - (12)(0)$

$180 = 12v_f - 0$

$\frac{180}{12} = v_f = \boxed{15\ m/s}$

7) A car was moving at 25 m/s for I hour and 27 minutes. How far did the car go?

$v = 25\ m/s$

$t = 1\ hour\ 27\ min$

$t = 87\ min \times \frac{60\ s}{min}$

$t = 5220\ s$

$d = vt$

$d = (25)(5220)$

$d = \boxed{130{,}500\ m}$

Answers: 4) 1520 m 5) 117.6 N 6) 15 m/s 7) 130,500 m

8) A young child was fooling around at the grocery store. They let go of their shopping cart. The shopping cart and contents had a mass of 15 kg. Their cart was moving at 4 m/s when it struck a cart with a mass of 35 kg that was at rest. A dozen eggs were broken. The child's cart slowed down to 1 m/s. What was the speed of the 35 kg cart?

momentum before = momentum after

$m_1 = 15\,kg$
$v_{1i} = 4\,m/s \quad v_{1f} = 1\,m/s$
$m_2 = 35\,kg$
$v_{2i} = 0\,m/s$
$v_{2f} = ?$

$m_1v_{1i} + m_2v_{2i} = m_1v_{1f} + m_2v_{2f}$
$(15)(4) + (35)(0) = (15)(1) + 35v_{2f}$
$60 + 0 = 15 + 35v_{2f}$
$60 - 15 = 35v_{2f}$
$45 = 35v_{2f}$
$\frac{45}{35} = v_{2f} = \boxed{1.3\,m/s}$

9) A projectile is fired horizontally from a platform. The range of the projectile was 400 m and the initial velocity was 80 m/s. What was the height of the platform?

X
$d = 400m$
$v = 80\,m/s$
$d = vt$
$400 = 80t$
$\frac{400}{80} = t = 5s$

Y ON THE WAY DOWN
$v_i = 0\,m/s$
$a = 9.8\,m/s^2$
$t = 5s$
$d = v_it + \frac{1}{2}at^2$
$d = (0)(5) + \frac{1}{2}(9.8)(5)^2$
$d = 0 + 4.9(25) = \boxed{122.5m}$

10) A 25 kg child was going down a large slide at the fair. The height of the slide was 30 m. What is the child's potential energy at the top of the ride?

$m = 25\,kg$
$h = 30m$
$PE = mgh$
$PE = (25)(9.8)(30) = \boxed{7350\,J}$

What was the child's total energy at the top of the slide?

$\boxed{7350\,J}$ $\quad TE = KE + PE \quad TE = 0 + 7350$

What was the child' total energy at the bottom of the slide?

$\boxed{7350\,J}$

What was the child's speed at the bottom of the slide?

$KE = 7350\,J$
$m = 25\,kg$
$KE = \frac{1}{2}mv^2$
$7350 = \frac{1}{2}(25)v^2$
$7350 = 12.5v^2$
$\frac{7350}{12.5} = v = \boxed{24.2\,m/s}$

Answers: 8) 1.3 m/s 9) 122.5 m 10) 24.2 m/s

11) A 70 kg astronaut is on a planet that has a mass of 7×10^{25} kg. The planet has a radius of 5×10^{7} m. What is the weight (also known as force of attraction) of the astronaut?

$M_1 = 70\text{kg}$

$M_2 = 7\times10^{25}\text{ kg}$

$r = 5\times10^{7}\text{m}$

$$F = \frac{Gm_1m_2}{r^2}$$

$$F = \frac{(6.67\times10^{-11})(70)(7\times10^{25})}{(5\times10^{7})^2} = \boxed{131\text{ N}}$$

What is the acceleration due to gravity on this planet?

$F = w$

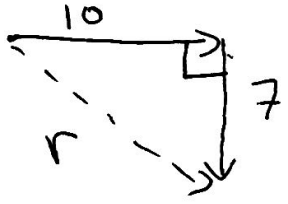
$m = 70\text{kg}$

$F = w = mg$

$131 = 70g$

$131/70 = g = \boxed{1.9\text{ m/s}^2}$

12) A boat on a river, heads east at 10 m/s. The current pushes the boat south at 7 m/s. Draw a head to tail diagram representing this scenario. Calculate the resultant velocity of the boat.



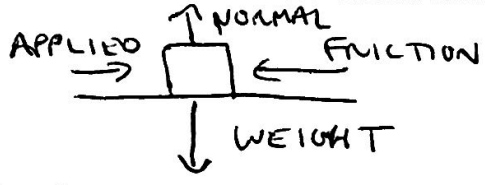
$r^2 = 10^2 + 7^2$

$r^2 = 100 + 49$

$r = \sqrt{149}$

$r = \boxed{12.2\text{ m/s}}$

13) A person applies a 70 N force to a 40 kg box on a warehouse floor. Draw a free body diagram of this. The box accelerates at 1 m/s^2. What is the coefficient of friction between the box and the floor?



APPLIED = 70N

m = 40kg

$a = 1\text{ m/s}^2$

NORMAL = WEIGHT = mg

NORMAL = (40)(9.8)

NORMAL = 392N

F = NET = ma

F = (40)(1)

F = 40N

NET = APPLIED − FRICTION

$40 = 70 - (\text{NORMAL})(u)$

$40 - 70 = -392u$

$-30 = -392u$

$-30/-392 = u = \boxed{.0765}$

Answers: 11) 1.9 m/s^2 12) 12.2 m/s 13) 0.0765