**AP Physics 1 – FR Review Package KEY**

1982B1

a. For the first 2 seconds, while acceleration is constant, d = ½ at2

 Substituting the given values d = 10 meters, t = 2 seconds gives a = 5 m/s2

b. The velocity after accelerating from rest for 2 seconds is given by v = at, so v = 10 m/s

c. The displacement, time, and constant velocity for the last 90 meters are related by d = vt.
To cover this distance takes t = d/v = 9 s. The total time is therefore 9 + 2 = 11 seconds

d.

1993B1

a. i. Use the kinematic equation applicable for constant acceleration: v = v0 + at.For each time interval, substitute the initial velocity for that interval, the appropriate acceleration from the graph and a time of 5 seconds.

 5 seconds: *v* = 0 + (0)(5 s) = 0

 10 seconds: *v* = 0 + (4 *m/s2)(5* s) = 20 *mls*

 15 seconds: v = 20 *mls* + (0)(5 s) = 20 *mls*

 20 seconds: v = 20 *mls* + (-4 *m/s2)(5* s) = 0

 ii. 

b. i. Use the kinematic equation applicable for constant acceleration, x = x0 + v0t + ½ at2. For each time interval, substitute the initial position for that interval, the initial velocity for that interval from part (a), the appropriate acceleration, and a time of 5 seconds.

 5 seconds: x = 0 + (0)(5 s) + ½ (0)(5 s)2 = 0

 10 seconds: x = 0 + (0)(5 s) + ½ (4 m/s2)(5 s)2 = 50 m

 15 seconds: x = 50 m + (20 m/s)(5 s) + ½ (0)(5 s)2 = 150 m

 20 seconds: x = 150 m + (20 m/s)(5 s) + ½ (–4 m/s2)(5 s)2 = 200 m

 ii. 

1985B2

a. Note that the system is at rest. The only forces on the hanging block are gravity and the tension in the rope, which means the tension must equal the weight of the hanging block, or 100 N. You cannot use the block on the incline because friction is acting on that block and the amount of friction is unknown.

b.

 

c. ΣF = 0; *f*s + mg sinθ – T = 0 gives *f*s = 13 N

2005B2.

(a) (b) Apply Fnet(X) = 0 Fnet(Y) = 0

 TP cos 30 = mg TP sin 30 = TH

 TP = 20.37 N TH = 10.18 N

1992M3

a. E = PE + KE = $-\frac{GMm}{R}+\frac{1}{2}mv^{2}$ = –8.1 × 109 J

b. L = mvr = 8.5 × 1013 kg-m2/s

c. Angular momentum is conserved so mvara = mvbrb giving vb = 2.4 × 103 m/s

d. Fg = Fc gives $\frac{GMm}{R^{2}}=\frac{mv^{2}}{R} and v=\sqrt{^{GM}/\_{R}}$ = 5.8 × 103 m/s

e. Escape occurs when E = PE + KE = 0 giving $-\frac{GMm}{R}+\frac{1}{2}mv^{2}=0 and v\_{esc}=\sqrt{^{2GM}/\_{R}}$ = 8.2 × 103 m/s

2001M2

a. i. Fg = Fc gives $\frac{GMm}{R^{2}}=\frac{mv^{2}}{R} and v=\sqrt{^{GM\_{J}}/\_{R}}$

 ii. v = d/T = 2πR/T giving $T=\frac{2πR}{v}=\frac{2πR}{\sqrt{^{GM\_{J}}/\_{R}}}=\sqrt{\frac{4π^{2}R^{3}}{GM\_{J}}}$

b. Plugging numerical values into a.ii. above gives R = 1.59 × 108 m

c. i.

 

 ii.

 

1974B7.

6 riders per minute is equivalent to 6x(70kg)\*9.8 = 4116 N of lifting force in 60 seconds

Work to lift riders = work to overcome gravity over the vertical displacement (600 sin 30)

Work lift = Fd = 4116N (300m) = 1.23x106 J

P lift = W / t = 1.23x106 J / 60 sec = 20580 W

But this is only 40% of the necessary power. 🡺 0.40 (total power) = 20580 W

 Total power needed = 51450 W

1985B2.

(a) The tension in the string can be found easily by isolating the 10 kg mass. Only two forces act on this mass, the Tension upwards and the weight down (mg) …. Since the systems is at rest, T = mg = 100 N

(b) FBD



(c) Apply Fnet = 0 along the plane. T – fs – mg sin θ = 0 (100 N) – fs – (10)(10)(sin60)

 fs = 13 N

(d) Loss of mechanical energy = Work done by friction while sliding

 First find kinetic friction force Perpendicular to plane Fnet = 0 Fn = mg cos θ

 Fk = µk Fn = µk mg cos θ

 Wfk = fkd = µk mg cos θ (d) = (0.15)(10)(10)(cos(60)) = 15J converted to thermal energy

(e) Using work-energy theorem … The U at the start – loss of energy from friction = K left over

 U – Wfk = K

 mgh – Wfk = K
mg(d sin 60) – 15 = K
(10)(10)(2) sin 60 – 15 = K K = 158 J

**1985B1.**

a) Apply momentum conservation perfect inelastic. pbefore = pafter m1v1i = (m+M)vf vf = 1.5 m/s

b) KEi / KEf ½ m v1i2 / ½ (m+M)vf2 = 667

c) Apply conservation of energy of combined masses K = U ½ (m+M)v2 = (m+M)gh h = 0.11 m

**1990B1.**

a) Apply momentum conservation perfect inelastic. pbefore = pafter m1vo = (101m)vf vf = vo / 101

b) ∆K = Kf – Ki = ½ (101m)vf2 – ½ mvo2 = ½ (101m)(vo/101)2 – ½ mvo2 = – (50/101) mvo2

c) Using projectile methods. Find t in y direction. dy = viyt + ½ a t2 t = 
D is found with vx = dx / t D = vxt 

d) The velocity of the block would be different but the change in the x velocity has no impact on the time in the y direction due to independence of motion. viy is still zero so t is unchanged.

e) In the initial problem, all of the bullets momentum was transferred to the block. In the new scenario, there is less momentum transferred to the block so the block will be going slower. Based on D = vxt with the same time as before but smaller velocity the distance x will be smaller.

**C2008M2** FT

a) FBD H 

 mrg mg

 V

b) Apply rotational equilibrium using the hinge as the pivot
+(FTsin30)(0.6) – (mg)(0.6) – (mrg)(0.3) = 0
+(FTsin30)(0.6) – (0.5)(9.8)(0.6) – (2)(9.8)(0.3)=0 FT = 29.4 N

c) Apply Fnet(x), Fnet(y) = 0 to find H and V V=9.8N, H=25.46N

 combining H and V Fhinge = 27.28 N

**1982B2**

(a) Simple application of Fnet(y) = 0 N1 + N2 – mbg - mpg = 0
 N1 + N2 = (40)(9.8) + (50)(9.8) = 882 N

 5m r

(b) Apply rotational equilibrium

 (mbg) • r1 = (mpg) • r2

 (40) (5m) = (50) (r) r = 4m from hinge

 mbg mpg 🡺 1 m from point X

**1983B2.**

a) Apply momentum conservation perfect inelastic. pbefore = pafter 2Mvo = (3M)vf vf = 2/3 vo

b) Apply energy conservation. K = Usp½ (3M)(2/3 vo)2 = ½ k ∆x2 

c) Period is given by 

**1998B5.**

a) λ = dist / cycles = 1.2 m / 4 = 0.60 m

b) v = f λ = (120)(0.60) = 72 m/s

c) More ‘loops’ means a smaller wavelength. The frequency of the tuning fork is constant. Based on v = f λ, less speed would be required to make smaller wavelength. Since speed is based on tension, less M, makes less speed.



d) In one full cycle, a point on a wave covers 4 amplitudes … up, down, down, up. …

So the amplitude is 1 cm.

1975B2

a. VC = kQ/a + kQ/a = 2kQ/a; W = –qΔV = – (+q)(V∞ – VC) = –q(0 – 2kQ/a) = 2kQq/a

b. Looking at the diagram below, the fields due to the two point charges cancel their x components and add their y components, each of which has a value (kQ/a2) sin 30º = ½ kQ/a2 making the net E field (shown by the arrow pointing upward) 2 × ½ kQ/a2 = kQ/a2. For this field to be cancelled, we need a field of the same magnitude pointing downward. This means the positive charge +2Q must be placed directly above point C at a distance calculated by k(2Q)/d2 = kQ/a2 giving d = $\sqrt{2}$a

+2Q

E sin 30º

1987B2

a. V = kQ/r = 9 × 104 V

b. W = qΔV (where V at infinity is zero) = 0.09 J

c. F = kqQ/r2 = 0.3 N

d. Between the two charges, the fields from each charge point in opposite directions, making the resultant field the difference between the magnitudes of the individual fields.
E = kQ/r2 gives EI = 1.2 × 106 N/C to the right and EII = 0.4 × 106 N/C to the left
The resultant field is therefore E = E­I – EII = 8 × 105 N/C to the right

e. From conservation of momentum mIvI = mIIvII and since the masses are equal we have vI = vII.
Conservation of energy gives U = K = 2(½ mv2) = 0.09 J giving v = 6 m/s

1988B3

a. On the right we have two resistors in series: 10 Ω + 2 Ω = 12 Ω. This is in parallel with the 4 Ω resistor which is an equivalent resistance of 3 Ω and adding the remaining main branch resistor in series gives a total circuit resistance of 9 Ω. The current is then I = E/RT = 8 A

b. The voltage remaining for the parallel branches on the right is the emf of the battery minus the potential dropped across the 6 Ω resistor which is 72 V – (8 A)(6 Ω) = 24 V. Thus the current in the 10 Ω resistor is the current through the whole 12 Ω branch which is I = V/R = (24 V)/(12 Ω) = 2 A

c. V10 = I10R10 = 20 V

d. When charged, the capacitor is in parallel with the 10 Ω resistor so VC = V10 = 20 V and Q = CV = 60 μC

e. UC = ½ CV2 = 6 × 10–4 J

1976B3

a. VT = E – Ir = 6 V

b. In parallel, each resistor gets 6 V and P = V2/R gives R = 3 Ω

c. For the 3 Ω resistor we have I = V/R = 2 A leaving 1 A for the branch with R1. R = V/I = 6 Ω

1980B2

a. The resistance of the device is found from R = V/I = 6 Ω. With a 24 volt source, to provide a current of 2 A requires a total resistance of 12 Ω. For the additional 6 Ω resistance, place two 3 Ω resistors in series with the device.

 

b. Since the device requires 2 A, a resistor in parallel with the device must carry a current of 6 A – 2 A = 4 A. In parallel with the device, the resistor will have a potential difference of 12 V so must have a resistance of V/I = 3 Ω. Thus, a single 3 Ω resistor in parallel will suffice.

 

c. P = I2R = 48 W